syngenta®

Vegetable
Catalogue

South Africa

SmartFarm
Inspired

InteliSeed
intelligent crop solutions

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Introduction

Introducing Syngenta seeds

Syngenta offers a range of vegetable seeds that are bred according to latest market needs. We draw on a wealth of expertise and genetic material to develop the right seeds. You can count on us for reliability, disease resistance and high yields. Our varieties are tested in growing conditions right across the region to ensure they meet local needs. And wherever you are, our local specialists are nearby to provide advice and support.

Throughout the value chain, market trends demand varieties that are fresh, attractive, efficient and cost-effective. Syngenta provides them. We work closely with industry partners to develop varieties that are easy to harvest, clean, process and package. Our unique consumer research ensures these varieties also deliver what end-consumers expect. That includes convenience and healthier options, as well as enticing new flavours, shapes and colours.

The seed business of Syngenta has a long history of developing and marketing seeds for farmers and growers around the world.

We've played a pivotal role in developing high-performance crops that are increasingly productive and resilient, as population growth outpaces the availability of new farmland. We've continued to raise the standard, developing varieties that maintain quality during global shipping and handling.

And we're dedicated to improving the quality and availability of food and flowers even further.

Syngenta is committed to sustainable agriculture. If the growing world population is to continue to be fed at current levels, the cultivation of crops will have to become both more efficient and more sustainable. Syngenta is focussed on innovation and research in both our seeds and crop protection businesses, promising continued strides in food productivity and quality.

For over 150 years, Syngenta seed businesses have helped create the food products that end up on your dinner table, and the flowers in your garden. We develop and market seeds for commecial agriculture - seeds that grow to become nutritious fruits and vegetables, high quality feed for meat and dairy production, the quality ingredients in your breakfast cereal or baby formula, or the vibrant flowers at your home. As one of the leading companies devoted solely to agriculture, Syngenta is able to bring a new focus to providing complete crop solutions that improve field production, and help farmers and growers run their businesses more effectively. Our representatives work with growers and farmers to develop integrated programs of seed and crop protection products for their growing conditions.

Syngenta is a world leading agribusiness committed to sustainable agriculture through innovative research and technology. The company is a leader in crop protection, and ranks third in the high-value commercial seeds market.

Syngenta employs some 27,000 people in over 90 countries. Syngenta is listed on the Swiss stock exchange (SYNN) and in New York (SYT). Further information is available at www. syngenta.com

Conditions of sale syngenta South Africa (PTY) limited

1. These terms and conditions apply to all agreements between Syngenta South Africa (Pty) Limited, Seed Division ("the Seller") and the Seller's customers ("the Purchaser"). These conditions will apply to the exclusion of any conditions imposed by the Purchaser.
2. Offers made by the Seller can be withdrawn at any time up to date of acceptance.
3. The Seller's price list will be published annually. However, the Seller reserves the right to adjust its prices periodically in order to provide for unforeseen contingencies. Any adjustments to the Seller's price list will take effect from date of publication. Prices are quoted in Euros. The Purchaser will be invoiced in ZAR at the exchange rate communicated by the Seller to the Purchaser; being the exchange rate quoted by the Seller's bankers in respect of the forward cover facility to the Seller. In the event of any such communication not being received by the Purchaser, the invoiced price will be calculated at the

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exchange rate prevailing on the date of invoice.

4. The Seller warrants that all goods conform to the label description within tolerances established according to the laws of South Africa. All other warranties, whether expressed or implied, are specifically excluded.
5. Any recommendations made by the Seller are given in good faith and are based on the Seller's best judgment but without warranty as to results and without liability of whatsoever nature. Under no circumstances is any warranty offered that the goods are fit for the purpose.
6. Goods are supplied against cash before delivery or on account, if the Purchaser is accredited by the Seller. Payment terms are strictly 30 days from month end. Ownership of the goods will remain vested in the Seller until the purchase price has been paid in full. The Seller reserves the right to recover possession of its goods without notice and without the necessity to cancel any contract of sale in the event of the Purchaser's breach of contract.
7. Interest will be charged on all overdue accounts at 3% above the prime-lending rate of the Standard Bank of South Africa Limited, from time to time. Debt collection charges will be for the Purchasers' account when such action is taken.
8. No goods supplied by the Seller may be used for multiplication, breeding or research or for any use other than cultivation. If goods are resold, they may not be repacked. Under no circumstances will the Seller be liable for inappropriate use of the goods.
9. Orders are accepted in good faith and are based on anticipated stock levels. However, the Seller will not be liable for any loss due to the Seller's failure to deliver timeously, or at all, for any reason whatsoever.
10. The cost of delivery of the goods within a reasonable period of time to a mutually agreed address in RSA will be for the Seller's account, unless the value of the order falls below such amounts as may be specified by the Seller from time to time, or the purchaser requests urgent delivery.
11 The Seller is entitled to effect partial deliveries. In the event of partial deliveries, the Seller is entitled to invoice each delivery separately.
12. The Purchaser must report all deficiencies in the goods and/or short deliveries within 7 days from the date of delivery.
13 The Seller will not be liable for any claim unless notified by the Purchaser in writing within 3 months of the date of invoice. In the event of a justifiable claim, the maximum aggregate liability of the Seller will be equal to the invoiced value of the goods. Under no circumstances will the Seller be liable for any direct and/or consequential loss sustained by the Purchaser.
14. Goods may not be returned in the absence of the Seller's prior written approval and only after a germination test has been conducted by an independent third party (ISTA approved Institution). In such cases, the goods are only accepted when in original, unopened and undamaged packaging. The Seller will not accept returns exceeding 10% of the original invoiced value. A service fee equal to the greater of the cost of the germination test or 10% of the value of the stock returned will be levied.
15. A certificate signed by any director of the Seller, whose authority it shall not be necessary to prove, shall constitute prima facie proof of the amount due by the Purchaser to the Seller and shall be considered as a liquid document for the purposes of entering judgment against the Purchaser or for any other reason whatsoever.

Introduction

Glossary of terms

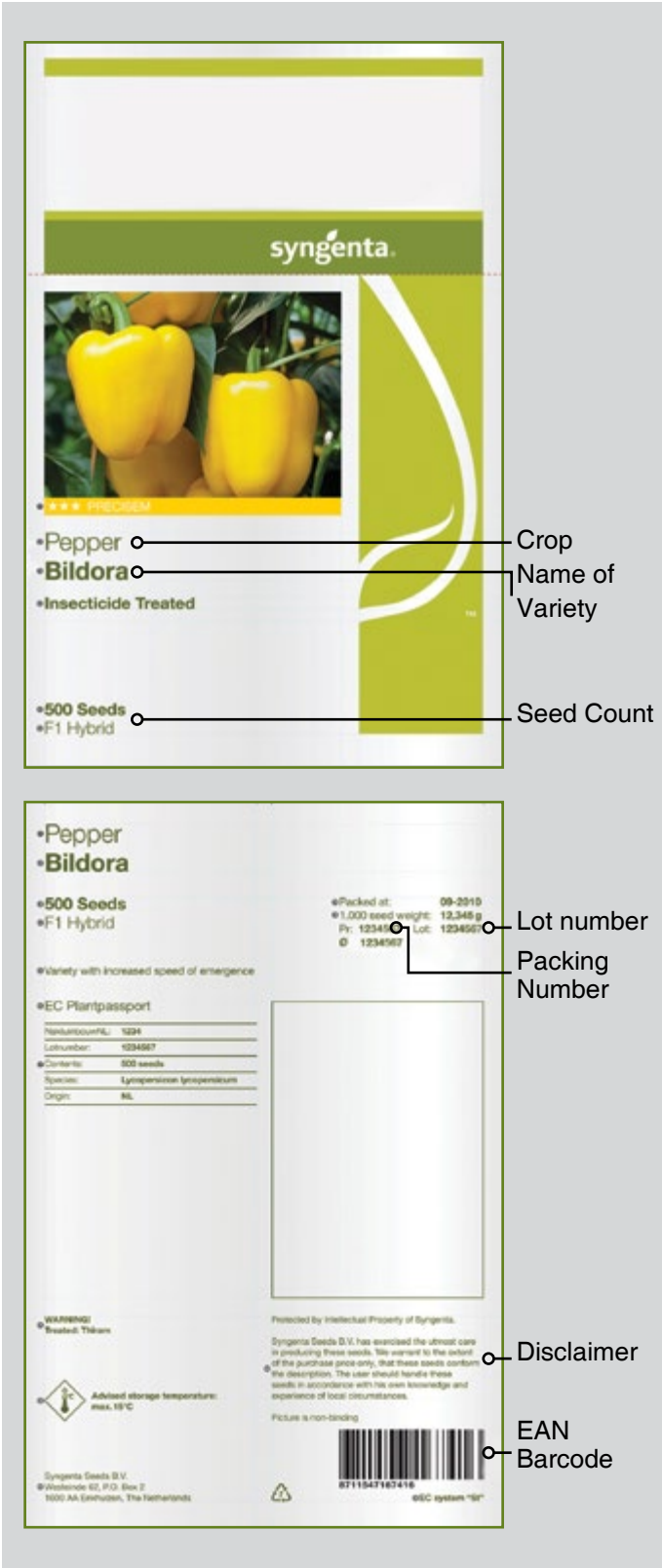
Hybrid
The first generation of a cross; produced by combining two or more inbred parent lines.

Tolerance
Tolerance describes the ability of a plant variety to endure abiotic stress without serious consequences for growth, appearance and yield. Vegetable companies will continue to use tolerance for abiotic stress. Tolerance will be referred to in this catalogue by the abbreviation of the diseases / virus in brackets, e.g. (TSWV) = Tolerance to Tomato Spotted Wilt Virus where applicable.

Resistance
Resistance describes the ability of a plant variety to restrict the growth and development of a specified pest or pathogen and/or damage they cause when compared to susceptible plant varieties under similar environmental conditions and pest or pathogen pressure. Resistant varieties may exhibit some disease symptoms or damage under heavy pest or pathogen pressure.

Parthenocarpic
Refers to the tendency of a plant to set fruit without pollination. Variety Names* Varieties listed in this catalogue are listed on the South African Variety list and adhere to international UPOV standards. Some exceptions may however occur when varieties were included that have already been submitted for registration but the final feedback was still outstanding at the point of going to print. In such instances the variety name will be followed by an astrerix (*) to indicate that it is still pending as it has not been accepted in the South Africa Variety list.

Growing Guidelines
In this catalogue several crops have growing guidelines. These should be seen only as additional information concerning the crop. Reference is made to techniques and or processes that are not necessarily the preferred way in South Africa and should only be seen more as informative. Also, in all cases where recommendations with regard to fertilizer and crop protection chemicals are concerned local law applies and information should be cleared with your AVCASA registered sales person.



Crop Name	Botanical Crop name	Scientific name	Addition	Common Disease name	Type of Organism	Commercial abbreviation	Remark
Bean	Phaseolus vulgaris	Pseudomonas savastanoi pv. phaseolicola	race 1, 2	Halo blight	B	Psp 1, 2	
		Colletotrichum lindemuthianum	race alpha, beta delta gamma, lambda	Anthracnose Rust	F F	Cl 1 (Ua)	
		Uromyces appendiculatus		Bean common mosaic	V	BCMV	
		Bean Common Mosaic Virus					
Brassicas	Brassica spp.	Albugo Candida		White Blister	F	Ac	
		Fusarium oxysporum f.sp. conglutinans	race 1	Yellows Ring	F	Foc 1 (Foc 1)	
		Mycosphaerella brassicicola		spot Downy	F	(Mb)	
		Peronospora parasitica		mildew	F	Pp	
		Plasmodiophora brassicae		Clubroot	F	(Pb)	
		Xanthomonas campestris pv. campestris		Black rot	B	(Xcc)	
Carrot	Daucus carota	Alternaria dauci Cladosporium		Late leaf blight	F	(Ad)	
Cucumber	Cucumis sativus	cucumerinum Corynespora cassiicola Erysiphe cichoracearum Pseudoperonospora cubensis Sphaerotheca fuliginea Cucumber Mosaic Virus Cucumber Vein Yellowing Virus		Scab and gummosis Corynespora blight and target spot	F	Ccu	
				Powdery mildew	F	Cca	
				Downy mildew	F	(Ec)	
				Powdery mildew	F	(Pc)	
				Cucumber mosaic	F	Sf (Sf)	
				Cucumber vein yellowing	V	CMV (CMV)	
					V	(CVYV)	
Lettuce	Lactuca sativa	Bremia lactucae	race 1-24	Downy mildew	F	Bl 1-24	
		Nasonovia ribisnigri		Lettuce leaf aphid	I	Nr	
		Lettuce Mosaic Virus	pathotype 2	Lettuce mosaic	V	(LMV2)	
Melon	Cucumis melo	Erysiphe cichoracearum		Powdery mildew	F	(Ec)	
		Fusarium oxysporum f.sp. melonis	race 0, 1, 2	Fusarium wilt	F	Fom 0-2	
		Fusarium oxysporum f.sp. melonis	race 1-2	Fusarium wilt	F	(Fom 1-2)	Root-stock
		Sphaerotheca fuliginea	race 1,2	Powdery mildew	F	(Sf 1, 2)	
		Aphis gossypii		Cotton aphid	I	Ag	
		Melon Necrotic Spot Virus		Melon necrotic spot	V	MNSV	
Pea	Pisum sativum	Erysiphe pisi		Powdery mildew	F	Ep	
		Fusarium oxysporum f.sp. pisi	race 1	Near wilt	F	(Ep)	
		Peronospora viciae		Downy mildew	F	Fop 1 (Fop 1)	
		Pea Seedborne Mosaic Virus		Pea seedborne mosaic	V	Pv PSbMV	
Pepper	Capsicum annuum	Xanthomonas vesicatoria Leveillula taurica Phytophthora capsici		Bacterial spot	B	(Xv)	
				Powdery mildew	F	(Lt)	
		Pyrenochaeta lycopersici		Buckeye fruit and root rot	F	(Pc) (	
		Meloidogyne arenaria, M.incognita		Corky root	F	Pl)	
				Root-knot	N	(MaMi	

Crop Name	Botanical Crop name	Scientific name	Addition	Common Disease name	Type of Organism	Commercial abbreviation	Remark
Pepper	Capsicum annuum	Cucumber Mosaic Virus		Cucumber	V	(CMV)	
		Potato Virus Y	pathotype 0-2	Mosaic Potato	V	(PVY 0-2) V	
		Tobacco Etch Virus	pathotype P0	Virus Y Tobacco	V	(TEV)	
		Tobamovirus (ToMV, TMV, PMMV)	pathotype	Etch Tomato			
		Tobamovirus (ToMV, TMV, PMMV)	P0, P1, P1-2	mosaic,	V	Tm1	L1 Gene
		Tobamovirus (ToMV, TMV, PMMV)	pathotype P0,	Tobacco mosaic,	V	Tm3	L3 Gene
		Tomato Spotted Wilt Virus	P1, P1-2, P1-2-3	Pepper mild mottle	V	Tm4	
				Tomato spotted wilt	V	(TSWV) A	
				Stip	A	(St)	
Radish	Raphanus sativus	Fusarium oxysporum f.sp. raphani	race 1	Yellows	F	For 1 (For 1)	
Spinach	Spinacea oleracea	Peronospora farinosa f.sp. spinaciae	race 1-7	Downy mildew	F	Pfs 1-7	
Squash	Cucurbita spp.	Erysiphe cichoracearum Sphaerotheca fuliginea		Powdery mildew	F	(Ec)	
				Powdery mildew	F	(Sf)	
		Cucumber Mosaic Virus Watermelon Mosaic Virus Zucchini Yellow Mosaic Virus		Cucumber Mosaic	V	(CMV)	
				Watermelon Mosaic	V	(WMV)	
				Zucchini Yellows	V	(ZYMV)	
Sweetcorn	Zea mays	Pantoea stewartii		Stewart's disease (bacterial wilt)	B	(Pst)	
		Puccinia sorghi		Common rust	F	(Ps)	
		Exserohilum turcicum		Northern leaf blight	F	(Et)	
Tomato	Lycopersicon esculentum	Cladosporium fulvum	Pseudomonas	Bacterial speck	B	Pst	
		Fusarium oxysporum f.sp. lycopersici	syringae pv.	Leaf mold	F	Cf 1-5	
		Fusarium oxysporum f.sp radicis-lycopersici	tomato race 1-5 race 1, 2	Fusarium wilt	F	Fol 1, 2	
		Oidium lycopersicum		Fusarium crown and root rot	F	For	
		Pyrenochaeta lycopersici					
		Stemphylium botryosum f.sp. lycopersici		Powdery mildew	F	(Ol)	
		Verticillium dahliae,		Corky root rot	F	(Pl)	
		V.albo-atrum Meloidogyne arenaria,	strain 0, 1, 1.2, 2	Gray leaf spot	F	Sbl	
		M.incognita, M.javanica		Verticillium wilt	F	VaVd	
		Tomato Mosaic Virus Tomato Spotted Wilt Virus Tomato Yellow Leaf Curl Virus		Root-knot	N	(MaMiMj)	
				Tomato mosaic	V	ToMV 0-2	
				Spotted wilt	V	(TSWV)	
				Tomato yellow leaf curl	V	(TYLCV)	
Watermelon	Citrullus lanatus	Colletotrichum orbiculare	race 1	Anthracnose	F	Co1	
		Fusarium oxysporum f.sp. niveum	race 0, 1	Fusarium wilt	F	Fon 0, 1	
		Phomopsis sclerotioides Meloidogyne incognita		Black root rot	F	Ps	Root-stock
				Root-knot	N	(Mi)	Root-stock

Key to symbols: A = A-biotic, B = Bacterium, F = Fungus, I = Insect, N = Nematode, V = Virus Commercial abbreviation between brackets = Tolerance

Vegetable Sowing Guide									
Vegetable Sowing Guide	Seeds/g	Mass per ha			Sow Depth mm	Dis. in Row cm	Between rows cm	Soil temperature (0C) for Germination	
		Seed tray	Seed bed	Dir. Sow				Minimum	Optimum
Beans - Dwarf	2-5	-	-	50-100 kg	20	7	50	16	16-29
Beet	45-60	-	-	10 kg	10	7	20	4	10-29
Brinjal	215-250	140-200 g	500 g	2 kg		50	75	16	24-32
Broccoli	175-330	150-300 g	500 g	-		45	60	4	7-30
Brussels Sprouts	225-350	70-150 g	500 g	-		50	90	4	7-29
Cabbage	200-350	120-200 g	300 g	0,5-2 kg		35	60	4	18-35
Carrot	700-1250	-	-	3 kg	10	5	15	4	7-29
Cauliflower	200-400	120-200 g	500 g	0,5-1,5 kg		45	70	4	7-29
Cucumber	30-35	1-1,5 kg	-	2 kg		40	130	16	16-35
Leeks	280-400	0,7-1,5 kg	4 kg	8 kg	10	10	30	2	10-32
Lettuce	600-1200	300-500 g	50 g	1,5-3 kg		25	40	2	4-27
Melon	20-40	-	-	3 kg	15	25	150	16	24-35
Onion	225-300	2000-2500 g	3-5 kg	7 kg	10	8	20	2	10-35
Pepper	150-175	150-200 g	250 g	-		50	80	16	18-35
Peas	3-10	-	-	75-150 kg	20	7	60	4	4-24
Radish	75-110	-	-	6 kg	10	5	15	4	7-32
Spinach	100-140	-	-	10 kg	10	7	20	2	7-24
Squash	4-10	1-3 kg	-	2-3 kg	15	50	100	16	21-35
Sweetcorn	3-8	-	-	12-15 kg	20	25	75	5	20-30
Tomato	200-350	100-200 g	250 g	4 kg	8	45	120	10	16-35
Watermelon	12-20			5-4	15	50	175	16	21-35

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Between Rows cm	Number of Thousand plants per hectare at following distances between rows and between Between Plants cm													
	10	15	20	25	30	40	50	60	70	80	90	100	125	150
2	5 000,0	3 333,3	2 500,0	2 000,0	1 666,6	1 250,0	1 000,0	833,3	710,0	625,0	555,0	500,0	400,0	330,0
5	2 000,0	1 333,3	1 000,0	800,0	666,0	500,0	400,0	333,3	284,0	250,0	222,0	200,0	160,0	132,0
10	1 000,0	666,0	500,0	400,0	333,0	250,0	200,0	166,0	142,0	125,0	111,0	100,0	80,0	66,0
15	666,0	443,6	333,0	266,4	221,8	166,5	133,2	110,6	94,6	83,3	73,9	66,6	53,3	43,4
20	500,0	333,0	250,0	200,0	166,5	125,0	100,0	83,0	71,0	62,5	55,5	50,0	40,0	33,0
25	400,0	266,4	200,0	160,0	133,2	100,0	80,0	66,4	56,8	50,0	44,4	40,0	32,0	26,4
30	333,0	221,8	166,5	133,2	110,9	83,3	66,6	55,3	47,3	41,6	37,0	33,3	26,6	22,0
35	285,0	189,8	142,5	114,0	94,9	71,3	57,0	47,3	40,5	35,6	31,6	28.5	22,8	18,8
40	250,0	166,5	125,0	100,0	83,3	62,5	50.0	41,5	35,5	31,3	27,8	25,0	20,0	16,5
45	222,0	147,9	111,0	88,8	73,9	55,5	44,4	36,8	31,5	27,8	24,6	22,2	17,8	14,6
50	200,0	133,2	100,0	80,0	66,6	50.0	40,0	33,2	28,4	25,0	22,2	20,0	16,0	13,2
55	181,0	120,5	90,5	72,4	60,3	45,3	36,2	30,1	25,7	22,6	20,1	18,1	14,5	11,9
60	166,0	110,6	83,0	66,4	55,3	41,5	33,2	27,6	12,6	20,8	18,4	16,6	13,3	11,0
65	153,0	101,9	76,5	61,2	50,9	38,3	30,6	25,4	21,7	19,1	16,9	15,3	12,2	10,1
70	142,0	94,6	71,0	56,8	47,3	35,5	28,4	23,6	20,2	17,8	15,8	14,2	11,4	9,4
75	133,0	88,6	66,5	53,2	44,3	33,3	26,6	22,1	18,9	16,6	14,8	13,3	10,6	8,8
80	125,0	83,3	62,5	50,0	41,6	31.3	25,0	20,8	17,8	15,6	13,8	12,5	10,0	8,2
85	117,0	77,9	58,5	29,3	38,9	29,3	23,4	19,4	16,6	14,6	13,0	11,7	9,4	7,7
90	110,0	73,9	55,5	44,4	37,0	27,8	22,2	18,4	15,8	13,9	12,3	11,1	8,9	7,3
95	105,0	69,9	52,5	42,0	35,0	26,3	21,0	17,4	14,9	13,1	11,6	10,5	8.4	6,9
100	100.0	66,6	50,0	40,0	33,3	25,0	20,0	16,6	14,2	12,5	11,1	10,0	8,0	6,6
120	83,0	55,3	41,5	33,2	27,7	20,8	16,6	13,8	11,8	10,4	9,2	8,3	6,7	5,5
125	80,0	53,3	40,0	32,0	26,6	20,0	16,0	13,3	11,4	10,0	8,9	8.0	6,4	5,3
150	66,0	44,0	33,0	26,4	22,0	16,5	13,2	11,0	9,4	8,3	7,3	6,6	5,3	4,4
175	57,0	37,9	28,5	22,8	19,0	14,3	11,4	9,5	8,1	7,1	6,3	5,7	4,6	3,7
200	50,0	33,3	25,0	20,0	16,7	12,5	10,0	8,3	7,1	6,3	5,6	5,0	4,0	3,3
225	44,0	29,3	22,0	17,6	14,6	11,0	8,8	7,3	6.2	5,5	4,9	4,4	3,5	2.9
250	40,0	26,6	20,0	16,0	13,3	10,0	8,0	6,6	5,7	5,0	4,4	4,0	3,2	2,6
275	36,0	24,0	18,0	14,4	12,0	9,0	7,2	6,0	5,1	4,5	4,0	3,6	2,9	2,4
300	33,0	22,0	16,5	13,2	11,0	8.3	6,6	5,5	4,7	4,1	3,7	3,3	2,6	2,2

Registration summary

		ASPARAGUS	BRASSICA LEAFY VEG						BULB VEG GROUP						CUCURBIT VEG									FRUITING VEG (EX CUCUR)						HERBS & SPICES	LEAFY VEG (EX BRASSI)						LEGUME VEG						SWEETCORN	TUBEROUS ROOT/CORM VEG					ROOT & TUBER VEG GROUP						LEAVES OF ROOT AND TUBER VEGETABLES
			Cabbage	Broccoli	Cauliflower	Brussel sprouts	Kale	Other	Onion	Spring Onion	Leek	Chives	Garlic	Other	Cucumber	Squash	Melon	Pumpkin	Gherkin	Watermelon	Butternut	Hubbard Squash	Other	Tomatoes	Pepper	Eggplant	Hot Pepper	Capsicums/ Pepper group	Other		Lettuce	Spinach	Celery	Swiss Chard	Radicchio	Other	Green Beans	Peas	Mange Tout	Lupins	Dry Beans	Other		Sweet potato	Artichoke	Turmeric	Ginger	Other	Carrots	Beet	Radish	Turnip	Parsnip	Other	
Fungicides																																																					
Amistar®	contains azoxystrobin (CAUTION)	Reg. no. L6230, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X		X	X														X											
Amistar® Top	contains azoxystrobin and difenoconazol (CAUTION)	Reg. no. L7897, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X														X	X	X	X	X	X						
Amistar® Opti	contains azoxystrobin and chlorothalonil (CAUTION)	Reg. no. L8265, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X		X	X					X						X	X	X	X	X	X		X						
Artea®	contains propiconazole and cyproconazole (CAUTION)	Reg. no. L6820, Act/Wet no. 36 of/van 1947																																								X											
Bion®	contains acibenzolar-S-methyl (CAUTION)	Reg. no. L6512, Act/Wet no. 36 of/van 1947																						X																												
Bravo® 720	contains chlorothalonil (CAUTION)	Reg. no. L7005, Act/Wet no. 36 of/van 1947		X	X	X	X	X							X	X	X	X	X	X	X	X	X	X													X	X															
Ridomil Gold® Flo	contains mefenoxam and chlorothalonil (CAUTION)	Reg. no. L6669, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X															X																											
Ridomil Gold® Pepite	contains mefenoxam and mancozeb (CAUTION)	Reg. no. L7191, Act/Wet no. 36 of/van 1947																						X																												
Revus®	contains mandipropamid (CAUTION)	Reg. no. L8617, Act/Wet no. 36 of/van 1947																						X																												
Scolari®	contains Fludioxonil	Reg. no. L8578, Act/Wet no. 36 of/van 1947																																								X	X										
Score®	contains difenoconazole (CAUTION)	Reg. no. L5132, Act/Wet no. 36 of/van 1947																						X													X						X	X	X								
Thiovit Jet®	contains sulphur	Reg. no. L1061, Act/Wet no. 36 of/van 1947													X	X	X	X	X	X	X	X	X	X													X	X															
Topaz® 200 EW	contains penconazole (CAUTION)	Reg. no. L5246, Act/Wet no. 36 of/van 1947					X								X	X	X	X	X	X	X	X	X	X		X	X											X	X	X	X	X	X										
Tecto®	contains thiabendazole	Reg. no. L5950, Act/Wet no. 36 of/van 1947															X																																				
Insecticides																																																				
Actara®	contains thiamethoxam	Reg. no. L7207, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X			X	X																									
Agrimec® 018 EC	contains abamectin (Harmful)	Reg. no. L3209, Act/Wet no. 36 of/van 1947																						X																												
Agrimec® Gold	contains abamectin (HARMFUL)	Reg. no. L9235, Act/Wet no. 36 of/van 1947							X	X					X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X							
Ampligo®	contains Chlorantraniliprole and Lambda-cyhalothrin (HARMFUL)	Reg. no. L8685, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X	X		X	X		X	X	X	X	X	X	X	X			X	X	X	X	X							
Aphox®	contains pirimicarb (HARMFUL)	Reg. no. L3428, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X			X	X		X	X	X	X	X	X	X	X	X		X	X		X	X		X	X	X	X	X	X	X	X			X	X					X	X				
Chess®	contains pymetrozine (CAUTION)	Reg. no. L8104, Act/Wet no. 36 of/van 1947	X	X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X					X	X	X	X	X							
Karate Zeon® 10 CS	contains lambda-cyhalothrin (HARMFUL)	Reg. no. L9023, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X					X							
Patron® 75WP	contains cyromazine	Reg. no. L3035, Act/Wet no. 36 of/van 1947																						X													X															
Pegasus® 500 SC	contains diafenthiuron (CAUTION)	Reg. no. L8668, Act/Wet no. 36 of/van 1947																						X																											
Proclaim®	contains Emamectin benzoate (CAUTION)	Reg. no. L7581, Act/Wet no. 36 of/van 1947		X	X	X	X	X	X															X	X	X	X	X	X		X	X	X	X	X	X					X										
Sorba®	contains lufenuron (CAUTION)	Reg. no. L5343, Act/Wet no. 36 of/van 1947		X																				X	X		X	X																								
Herbicides																																																				
Bateleur® Gold	contains flumetsulam and S-metolachlor (CAUTION)	Reg. no. L6136, Act/Wet no. 36 of/van 1947																																								X											
Dual Gold®	contains S - metolachlor (HARMFUL)	Reg. no. L5749, Act/Wet no. 36 of/van 1947																																								X											
Fusilade Forte®	contains fluazifop-p-butyl (HARMFUL)	Reg. no. L7304, Act/Wet no. 36 of/van 1947					X			X	X																											X	X									X					
Gramoxone®	contains paraquat ion (HARMFUL)	Reg. no. L1174, Act/Wet no. 36 of/van 1947	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Metagan® Gold	contains S - metolachlor (HARMFUL)	Reg. no. L5748, Act/Wet no. 36 of/van 1947																																				X															
Preeglone®	contains paraquat ion and diquation (HARMFUL)	Reg. no. L3304, Act/Wet no. 36 of/van 1947	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Seedlings																																																				
Apron® XL	contains mefenoxam (HARMFUL)	Reg. no. L6837, Act/Wet no. 36 of/van 1947	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Celest®	contains Fludioxonil	Reg. no. L6173, Act/Wet no. 36 of/van 1947	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Celest® XL	contains Fludioxonil and Mefenoxam	Reg. no. L6353, Act/Wet no. 36 of/van 1947																																								X	X	X	X	X	X	X	X	X	X	X	X

BRASSICA (COLE) LEAFY VEGETABLES	Broccoli; cauliflower; cabbage; mustard greens, Chinese broccoli (gai lon); raab broccoli (rapini); Brussels sprouts; Chinese cabbage (bok choy); Chinese cabbage (napa); Chinese mustard cabbage (gai choy); cavalo broccolo; collards; kale; kohlrabi; mizuna; mustard spinach; rape greens
BULB VEGETABLE GROUP	bulb onion, green Chive, fresh leaves; chive, Chinese, fresh leaves; daylily, bulb; elegans hosta; fritillaria, bulb; fritillaria, leaves; garlic, bulb; garlic, great-headed, bulb; garlic, serpent, bulb; kurrat; lady's leek; leek; leek, wild; lily, bulb; onion, Beltsville bunching; onion, bulb; onion, Chinese, bulb; onion, fresh; onion, green; onion, macrostem; onion, pearl; onion, potato, bulb; onion, tree, tops; onion, Welsh, tops; shallot, bulb; shallot, fresh leaves; cultivars, varieties, and/or hybrids of these
CUCURBIT VEGETABLES	Cucumber, muskmelon, summer squash Chayote (fruit); Chinese waxgourd (Chinese preserving melon); citron melon; cucumber; gherkin; edible gourd (includes hyotan, cucuzza, hechima, Chinese okra); Momordica spp (includes balsam apple, balsam pear, bittermelon, Chinese cucumber); muskmelon (includes cantaloupe); pumpkin; squash, summer; squash, winter (includes butternut squash, calabaza, hubbard squash, acorn squash, spaghetti squash); watermelon
FRUITING VEGETABLES (EXCEPT CUCURBITS)	Tomato, bell pepper, and one cultivar of nonbell pepper Eggplant; groundcherry (Physalis spp); pepino; pepper (includes bell pepper, chili pepper, cooking pepper, pimento, sweet pepper); tomatillo; tomato
Capsicums/ Pepper group	bell/sweet/chilli pepper,paprika, pimento, piquante
Tomatoes	Tomato (standard size and one cultivar of small tomato) Bush tomato; cocona; currant tomato; garden huckleberry; goji berry; groundcherry; naranjilla; sunberry; tomatillo; tomato; tree tomato; cultivars, varieties, and/or hybrids of these
HERBS AND SPICES	Basil (fresh & dried); black pepper; chive; and celery seed or dill seed Allspice; angelica; anise, anise, star; annatto (seed); balm; basil; borage; burnet; camomile; caper buds; caraway; caraway, black; cardamom; cassia bark; cassia buds; catnip; celery seed; chervil (dried); chive; chive, Chinese; cinnamon; clary; clove buds; coriander leaf (cilantro or Chinese parsley); coriander seed (cilantro); costmary; cilantro (leaf); culantro (seed); cumin; curry (leaf); dill (dillweed); dill (seed); fennel (common); fennel, Florence (seed); fenugreek; grains of paradise, horehound; hyssop; juniper berry; lavender; lemongrass; lovage (leaf); lovage (seed); mace; marigold, marjoram; mustard (seed); nasturtium; nutmeg; parsley (dried); pennyroyal; pepper, black; pepper, white; poppy (seed); rosemary; rue; saffron; sage; savory, summer and winter; sweet bay; tansy; tarragon; thyme; vanilla; wintergreen; woodruff; wormwood
LEAFY VEGETABLES (EXCEPT BRASSICA VEGETABLES)	Celery, head lettuce, leaf lettuce, and spinach Amaranth (Chinese spinach); arugula (roquette); cardoon; celery; celery, Chinese; celtuce; chervil; chrysanthemum, edible-leaved; chrysanthemum, garland; corn salad; cress, garden; cress, upland; dandelion; dock (sorrel); endive (escarole); fennel, Florence; lettuce, head and leaf; orach; parsley; purslane, garden; purslane, winter; radicchio (red chicory); rhubarb; spinach; spinach, New Zealand; spinach, vine; Swiss chard
LEGUME VEGETABLES (SUCCULENT OR DRIED)	Bean (Phaseolus) (succulent & dried), pea (Pisum) (succulent & dried) and soybean Bean (Lupinus) (includes grain lupin, sweet lupin, white lupin, and white sweet lupin); bean (Phaseolus) (includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean); bean (Vigna) (includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean); broad bean (fava); chickpea (garbanzo); guar; jackbean; lablab bean; lentil; pea (Pisum) (includes dwarf pea, edible-podded pea, English pea, field pea, garden pea, green pea, snowpea, sugar snap pea); pigeon pea; soybean; soybean (immature seed); sword bean
TUBEROUS ROOT CORM VEGETABLES	Includes cassava: bitter and sweet Chinese artichoke,Ginger, sweet potato, Potato Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; canna, edible; cassava, bitter and sweet; chayote (root); chufa; dasheen (taro); ginger; leren; potato; sweet potato; tanier; turmeric; yam bean; yam, true
ROOT AND TUBER VEGETABLE GROUP	Carrot, potato, radish, and sugar beet Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; beet, garden; beet, sugar; burdock, edible; canna, edible; carrot; cassava, bitter and sweet; celeriac; chayote (root); chervil, turnip-rooted; chicory; chufa; dasheen (taro); ginger; ginseng; horseradish; leren; parsley, turnip-rooted; parsnip; potato; radish; radish, oriental; rutabaga; salsify; salsify, black; salsify, Spanish; skirret; sweet potato; tanier; turmeric; turnip; yam bean; yam, true.
LEAVES OF ROOT AND TUBER VEGETABLES	Turnip and garden beet or sugar beet Beet, garden; beet, sugar; burdock, edible; carrot; cassava, bitter and sweet; celeriac; chervil, turnip-rooted; chicory; dasheen (taro); parsnip; radish; radish, oriental (daikon); rutabaga; salsify, black; sweet potato; tanier; turnip; yam, true

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syngenta®

Beans

Fresh and delicious

Momentum

Type

A medium-large bean suitable for fresh and processing market.

Momentum is a widely adaptable, dwarf type bean of medium to tall height and is ideal for open field production. This variety is vigorous and has a high heat tolerance making it suitable for use in stressful conditions.

Coupled with its concentrated setting, this ensures it is suitable for growers seeking earliness and high yield.

Features/benefits

- High plant vigor.
- Deep green colored pods.
- Suited for the fresh and processing market.
- BCMV resistance.

Average grading percentage (TM 120)

Ecology	Open field
Earliness	Medium
Maturity	55 days (650 heat units)
Plant Type	Medium vigor Erect plant
Pod Shape	Round Straight Fleshy
Pod Length	14 - 16 cm
Shelf Life	Long
Plant Vigor	High
Pod Colour	Dark green
Disease Resistance	HR: BCMV

Palati

Type

Medium-fine to large segment.

Palati is a medium dark-green bobby bean suitable for fresh market and processing. The pods are 14 – 16 cm long, straight and fleshy. Approximately 90% have a diameter greater than 9 mm.

Palati has a strong upright and open plant habit with an excellent yield potential. Pods are easy to pick.

Features/benefits

- Strong upright plant habit.
- Suitable for fresh market and processing.
- Stringless, straight and fleshy pods.
- Good yield potential.

Average grading percentage (TM 120)

	mm	%
EF	5.0 - 6.5	
VF	6.5 - 8.0	
F	8.0 - 9.0	10
MF	9.0 - 10.5	80
LG	>10.5	10

Earliness	Medium early
Maturity	57 days 640 heat units
Plant	Medium vigorous Upright open plant habit
Pod Shape	Round Straight Fleshy
Pod Length	14 - 16 cm
Pod Colour	Medium dark green
Disease Resistance	HR: Bean common mosaic virus (BCMV) IR: Halo blight (Psp 1-2), Rust (Ua)

Beetroot

Filled with flavor

Boltardy

Ecology	Open field
Variety Usage	Fresh (bagging and bunching)
Plant Type	Medium tall
Root Colour	Red
Plant Vigour	High
Root Shape	Globe
Tolerance	Bolting

Type

A round shape red beet suitable for the fresh market. Boltardy is an early maturing type of beet produced in the open fields.

The variety has high vigour and forms roots that are globe shaped and suitable for the fresh market both as bags and bunches. The variety is also known for high yield and good internal colour and quality.

Features/benefits

- High plant vigour.
- Deep, uniform, red colour.
- Fresh market ready.
- Good bolting tolerance.

Borecole

Healthy goodness

Winnetou

Type

A blue-green coloured, fine curled kale suitable for the fresh market.

Winnetou is a vigorous variety and ideally suited for open field production. This variety has moderate vigour, good standing ability and excellent winter hardiness. Winnetou is also known for its high quality fine curled leaves and high yield potential.

Features/benefits

- Medium plant vigour.
- High quality, blue-green leaves, suited for the fresh market.
- Earliness.
- High yield.

Ecology	Open field
Variety Usage	Fresh Market
Plant Type	Medium large frame
Earliness	Late
Plant Vigour	Medium
Head Size	Big
Field Standing	High
Culture	Autumn – winter production

Broccoli

Packed with flavour

Batory

Type

A medium maturing broccoli suitable for the fresh and processing market. Batory is suited for open field production.

The variety has high vigour and forms big heads suitable for processing. It is also known for its earliness and high yield. Batory has a high yield potential with an excellent floret recovery rate. Recommended plant density is 3 - 4 plants/m2.

Features/benefits

- High plant vigour.
- High total yield and floret yield.
- Large heads.
- Suited for the processing market.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium
Maturity	75 – 80 days
Plant Type	Medium, vigorous
Head Size	Large dome shaped with good quality florets
Average head weight	400g +
Field Standing	Very good
Plant Vigour	High

Broccoli

Packed with flavour

Monclano

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium
Maturity	75 - 80 days
Head Size	Large heads with fine beads
Average head weight	250-300g
Field Standing	Good
Plant Vigour	High

Type

A hybrid Broccoli variety with Clubroot resistance. Monclano is a vigorous growing variety with firm head quality. Monclano is ideal for processing but can also be used for fresh market.

The plants have good vigour and the variety is known for its high field holding capacity and high yield potenial. Recommended plant density is 3 - 4 plants/m2.

Features/benefits

- Club root resistance.
- High field holding capacity
- Suited for processing and fresh market.

Monopoly

Type

A medium early hybrid for production in autumn and winter. Monopoly is a hybrid of medium vigour for fresh market and processing.

The plants are very uniform, have good vigour and produce dark-green, dome-shaped heads of high quality. Monopoly can be sown in late summer and autumn for harvest in late autumn, winter and early spring. Recommended plant density is 3 - 4 plants/m2. Together with Montop it makes for year-round, top quality production.

Features/benefits

- Vigorous, healthy plant.
- Very good shape of head with good colour.
- Slightly longer spears make work easier and add weight to fresh-cut and processed product.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium
Maturity	80 days
Plant Type	Medium size, upright
Head Size	Large, dome shape with high position
Average head weight	400g +
Field Standing	Very good
Plant Vigour	High
Culture	Sow in late summer and autumn for harvest in autumn, winter and early spring.

Broccoli

Packed with flavour

Monrello

Type

A late hybrid for production in autumn and winter. Monrello is a hybrid of strong vigour for fresh market and processing. The plants are very uniform, long leaf stems, have good vigour and produce compact, dark grey-green to slightly bluish-green, dome-shaped heads of high quality. Monrello can be sown in late summer and autumn for harvest in late autumn, winter and early spring. Recommended plant density is 3 - 4 plants/m2.

Features/benefits

- High yield potential.
- Good head shape and firmness.
- Good shelf life.
- Excellent vigour and field standing ability.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Late
Maturity	90 – 110 days
Plant Type	Strong and vigorous with long stems
Head Size	Large, dome shaped head, green in colour with uniform, medium bead size.
Average head weight	400g +
Field Standing	High
Plant Vigour	Medium
Culture	Open field Sow in late summer and autumn for harvest in autumn, winter and early spring.

Montop

Type

A medium early hybrid for production in summer and autumn. Montop is a vigorous hybrid for fresh market and processing.

The plants are very uniform, have a good vigour and produce dark green, dome-shaped heads of high quality, ideal for punnets. Montop can be sown in spring and early summer for harvest in late summer and autumn. Recommended plant density is 3 - 4 plants/m2.

Features/benefits

- Vigorous, healthy plant.
- Very good shape of head with good colour. Strong against hollow core and cat-eye.
- Suited for fresh market, fresh-cut and processing.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium early
Maturity	65 – 75 in days summer and 85-90 days in winter
Plant Type	Medium, vigorous, with good head elevation
Head Size	Large dome shape with fine beads
Average head weight	400g +
Field Standing	Moderate
Plant Vigour	High
Culture	Sow in spring and early summer for harvest in summer and autumn.

Brussels sprouts

Adorable and sweet

Brussels sprouts

Adorable and sweet

Abacus

Earliness	Early
Maturity	125 days
Plant	Medium strong vigour Very good standing ability Medium tall and sturdy plant Uniform cylindrical sprout- setting Strong bolting tolerance
Sprouts	Smooth Firm Round Medium to dark green Mild flavour
Disease Resistance	HR: Foc: 1

Type

An early hybrid for production throughout the year. Abacus is an early hybrid with medium strong vigour, medium tall sturdy plants which produce uniform, medium to dark-green, round, and firm sprouts in a cylindrical setting.

The quality of the sprouts on the stem remains high during the harvesting period. Very uniform grading. The strong bolting tolerance makes Abacus very suited for early sowing and plantings. Suitable for mechanical harvesting.

Features/benefits

- Suited to machine harvesting.
- High yields of high quality sprouts.
- Smooth, round, firm, medium to dark-green and uniform graded sprouts.
- Long harvest window.
- Suited for fresh market and processing.
- Recommended plant density 3 - 3.5 plants/m2.

Brussels sprouts

Adorable and sweet

Maximus

Earliness	Medium early
Maturity	145 days
Plant	Medium strong vigour Very good standing ability Medium tall and sturdy plant Cylindrical sprout-setting Strong bolting tolerance
Sprouts	Smooth Firm Round Dark green Mild flavour Well suited for pre-pack 52% smaller than 30mm
Disease Resistance	HR: Foc: 1

Type

A medium early hybrid for production throughout the year. Maximus is the leading medium early (brussels sprout/ export?) hybrid with medium strong vigour and medium tall sturdy plants which produce dark green, round, firm sprouts in a cylindrical setting.

The quality of the sprouts on the stem remains high during the harvesting period even under un-favourable conditions. The strong bolting tolerance makes Maximus very suited for early sowing and plantings. 52% of the sprouts are smaller than 30 mm in diameter. Suitable for mechanical harvesting.

Features/benefits

- Suitable for mechanical harvesting.
- High yields of high quality sprouts.
- Smooth, round, firm, dark green and fine graded sprouts.
- Suited for fresh market and processing.
- Long harvest window.
- Recommended plant density 3 - 3.5 plants/m^2.

Cabbage

Relish the versatility




Carbonara

Type

An early type for cabbage suitable for the fresh and processing market. Carbonara produces large cabbage heads and is grown in the open fields.

The variety has high vigour, good field standing ability and large heads suitable for fresh market growers. The variety is also known for earliness and high yield making it a suitable choice for processors.

Features/benefits

- High plant vigour.
- Large heads.
- Suited for the processing market.
- Strong bolting tolerance.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium early
Maturity	90 – 100 days (Summer) 110 – 120 days (Winter)
Plant Type	Large frame
Head Size	Large, transverse elliptic in shape
Average head weight	5kg
Field Standing	High
Plant Vigour	Strong
Disease Resistance	HR: Foc: 1

Fabiola

Type

An early type cabbage ideal for the fresh market segment. Fabiola produces medium sized round cabbage heads suited to supermarkets and is grown in the open fields.

The variety is suited to tropical and subtropical regions, has high vigour and matures early. It has good field standing ability and large heads. The variety is also known for its consistent high yields.

Features/benefits

- High plant vigour.
- Very good heat tolerance.
- Uniform round heads.
- Suited for the fresh market.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Early
Maturity	60 – 70 days (Summer) 80 – 90 days (Winter)
Plant Type	Compact
Head Size	Medium
Average head weight	2.5kg
Field Standing	Good
Plant Vigour	High
Disease Resistance	HR: Foc: 1

Intello

Type

A large framed cabbage suitable for the fresh and hawker market. Intello produces medium to large cabbage heads and is suited to open field production.

The variety is vigourous and produces highly uniform medium to large heads. The heads have a medium dark green colour and are slightly elliptical ensuring its suitability for the fresh and hawker market. Intello has high bolting tolerance and a good field standing ability.

Compared to other varieties, some field tolerance towards Black Rot has been observed.

Features/benefits

- High plant vigour.
- Large heads.
- Suited for the fresh market.

Ecology	Open field
Variety Usage	Fresh
Earliness	Medium early
Maturity	85 – 95 days (Summer) 100 – 110 days (Winter)
Plant Type	Large
Head Size	Medium - Large
Average head weight	3 - 5kg
Field Standing	Medium
Plant Vigour	High

Klabishi

Type

Medium-late white cabbage hybrid for the fresh market and hawker use. Klabishi is a vigorous, large-framed, medium-late hybrid with a long growing cycle. Very attractive dark-green head and dark-green bluish leaf colour. Ideal for the hawker market.

Compact circular to semi-globe head shape with a short core. Good standing ability in the field and strong against cracking. Excellent heat tolerance. Suited for harvesting of large heavy heads and also small-medium heads (higher plant population). Winter plantings should be harvested by early August for best returns Compared to other varieties, some field tolerance towards Black Rot has been observed.

Features/benefits

- Adaptable, compact white cabbage for the fresh market and hawker use.
- Vigorous with large frame and attractive head and leaf colour.
- Heat tolerance.
- Strong against cracking.

Ecology	Open field
Variety Usage	Fresh
Earliness	Medium late
Maturity	85 - 95 days (Summer) 120 - 130 days (Winter)
Plant Type	Large frame with blue-green colour
Head Size	Large circular to semi-globe
Average Head Weight	>4kg
Field Standing	High
Plant Vigour	High

Novoton

Type

Medium-late white cabbage hybrid for the fresh market and hawker use.

Novoton is a vigorous, large framed, medium-late hybrid with a long growing cycle. Upright plant with a large grey-green frame and leaf colour. Medium-coarse fineness of leaf layers. Very large, uniform filled, circular to semi-circular heads with a medium-short core.

High bolting tolerance and strong against internal disorder. Long harvest window.

Features/benefits

- Adaptable, compact white cabbage for the fresh market and hawker use.
- Vigorous with large frame and attractive head and leaf colour.
- Very large sized head.
- Strong against cracking.
- Long harvest window.

Ecology	Open field
Variety Usage	Fresh
Earliness	Medium late
Maturity	100 - 120 days (Summer) 125 - 140 days (Winter)
Plant Type	Vigourous with a large frame
Head Size	Large
Average head weight	>5 kg
Field Standing	High
Plant Vigour	High
Disease Risistance	IR: Foc: 1

Reball

Type

Medium-early red cabbage hybrid for the fresh market. Reball (CMS) is a vigorous, strong plant with a compact growing habit. Uniform, round to slightly high round, medium-sized heads with a short core. Strong waxy layer.

Good internal colour, quality and ideal for pre-packing. Good field holding ability. Can be harvested as a red baby cabbage, depending on size requirements.

Features/benefits

- High quality round to slightly high round, compact red cabbage for the fresh market.
- Excellent internal quality.
- Ideal for the bagging and pre-pack market.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium early
Maturity	90 – 100 days (Summer) 110 – 120 days (Winter)
Plant Type	Compact
Head	Medium round to slightly high round Compact Strong against cracking
Average head weight	1.5 kg
Field Standing	High
Plant Vigour	High

Carrots

Get a dozen for a dime

Champion

Earliness	Medium early
Maturity	115 - 125 days (Summer) 125 - 155 days (Winter)
Foliage	Vigorous Rather long Light to medium-green
Root	Depending on plant density and soil type, 16 - 24 cm Slender Cylindrical Deep orange internal and external colour Small-sized core
Disease Resistance	IR: Ad

Type

A medium-early hybrid of the Nantes type. Champion is a medium-early hybrid of the Nantes type for the fresh and pre-pack market planted in late summer, autumn and winter.

Champion is a very uniform, slender and cylindrical carrot up to 24 cm long with a blunt rounded end. The smooth skin is orange as is the internal and external colour. The core is small sized. Champion has a relatively good field standing ability and can be harvested mechanically.

Optimum results at maturity when Champion showed blunt rounded ends to the end of harvest.

Features/benefits

- Deep orange-red colour.
- Strong, rather long, foliage - ideal for mechanical harvesting.
- Excellent *Alternaria* resistance.
- Strong against splitting and breakage.

Cauliflower

Essence of elegance

Clarify

Ecology	Open field
Variety Usage	Fresh
Earliness	Early
Maturity	65 - 75 days
Field Standing	Good
Plant Vigour	High

Type

A medium cycle variety with Clubroot resistance.

Clarify is a hybrid variety that is suited for areas with Club root problems but also good in other conditions. The variety produces big heads and boasts high field standing ability. Clarify is suitable for fresh market.

Features/benefits

- Club root resistance
- Large heads

Bonny is exclusively distributed by Starke Ayres

Depurple

Type

A purple coloured cauliflower suitable for the fresh and specialty processing market. Depurple is moderately vigorous and suited to open field production.

The variety has normal vigour and this allows for the development of good quality curds with consistent colour and a high percentage of harvestable heads. Depurple is also known for its reliability in supply and high yield potential.

Features/benefits

- High percentage harvestable heads.
- Uniform and consistent colour.
- Suitable for fresh/processing.

Ecology	Open field
Variety Usage	Fresh/processing
Colour	Purple
Earliness	Early
Maturity	65 – 70 days
Plant Type	Medium frame
Head Size	Medium large
Field Standing	High
Plant Vigour	Medium

Bonny is exclusively distributed by Starke Ayres

Flame Star

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium early
Maturity	80 days
Field Standing	Good
Plant Vigour	High

Type

A medium-early hybrid for production in spring.

Flame Star is a semi-orange variety that provides high yield. The variety is suitable for autumn, winter and spring harvest. Vigorous, medium- early hybrid with a short growing cycle.

The medium plant depicts high vigour and good field standing ability. Flame Star is suitable for fresh market and processing

Features/benefits

- Stable semi orange color
- Easy to grow plant

Korlanu

Type

A medium-early hybrid for production throughout the year. Korlanu is a vigorous, medium-early hybrid with a medium-long growing cycle.

The vigorous plant has very good cover leaves with a good twist in the top which provide excellent curd self-protection. The leaves are dark green. The plants produce high-quality, flat-round curds with nice tight florets. Curds are deeply situated in the plant for optimum protection. Korlanu is suitable for both fresh market and processing.

Features/benefits

- Vigorous, healthy plant with large erect leaves.
- Well-protected, firm and heavy, high-quality curds.
- Stress-tolerant, reliable producer under all weather conditions.
- Suitable for both fresh market and processing.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium early
Maturity	75 – 85 days (Summer)
Plant Type	Medium large with an erect habit
Head Size	Large
Average head weight	600g
Field Standing	High
Plant Vigour	High

Planner

Type

An early hybrid for production in the summer and autumn. Planner is a vigorous, early hybrid with a medium-short growing cycle.

The leaves are medium-green. The plants produce high-quality, well-transverse elliptical curds with nice tight florets. Planner is suitable for fresh market.

Features/benefits

- Vigorous and healthy plant.
- High marketable yielding variety for warmer conditions.
- Quick maturing.
- Excellent curd quality, smooth texture, well tucked.

Ecology	Open field
Variety Usage	Fresh
Earliness	Early
Maturity	75 – 85 days
Plant Type	Medium large plant
Head Size	Large, shallow dome
Average head weight	0.4 - 1 kg
Field Standing	High
Plant Vigour	High
Culture	Sow in late winter for harvest from spring, summer and early autumn

Spacestar

Type

A medium-early hybrid for production in late summer to winter and autumn.

Spacestar is a vigorous, medium-early hybrid with a short growing cycle. The vigorous plant has good curd protection surrounded by medium erect outer leaves. The leaves are medium green. The plants produce high-quality, flat-round curds with nice tight florets.

The curds sit deep in the plant and are very firm, heavy and well-protected by the inner leaves. Spacestar is suitable for both fresh market and processing.

Features/benefits

- Vigorous, healthy plant with medium-erect leaves.
- Well-protected, firm and heavy, high-quality curds.
- Reliable production and suitable for both fresh market and processing.

Ecology	Open field
Variety Usage	Fresh/processing
Earliness	Medium early
Maturity	90 – 100 days (Winter)
Plant Type	Medium large plant with upright leaves
Head Size	Large
Average head weight	0.4 - 1.2 kg
Field Standing	Good
Plant Vigour	Strong
Culture	Sow in spring for harvest from early summer to autumn and early winter

Cucumber

The hydrate delight

Bomber

Earliness	Medium Early
Plant	Medium strong vigour Medium Internodes Hardy plant
Fruit	Excellent quality Straight, cylindrical fruit spineless, with minimal ribbing
Average fruit length	30 - 34 cm
Average fruit weight:	0.4 kg - 1.2 kg
Culture:	Passive and active greenhouse
Disease Resistance	HR: Cca / Ccu / Px / CVYV IR: Gc / CMV / CYSDV

Type

Bomber is a long cucumber for active and passive greenhouses. It is a strong, vigourous variety with a good disease package, especially powdery mildew. Fruit are long, uniform and of high quality.

Bomber is an early hybrid with long fruits, ideally suited for active greenhouses or under plastic in warm months. Medium strong plant with high yield. The fruits have an attractive dark-green colour. They are regular and unique shaped fruit with smooth neck and slightly ribbed. Bomber is primarily grown in the summer.

Features/benefits

- Excellent powdery mildew resistance.
- Strong hardy plant with good vigour.
- Long cycle production.

Cucumber
The hydrate delight

Imanol

Earliness	Medium early
Plant	Vigorous Good fruit setting Withstands unfavourable conditions well
Fruit	Excellent quality Bright green Uniform Cylindrical Straight, with thin necks Slightly ribbed and spineless
Average fruit length	30 - 35 cm
Average head weight	0.4 kg - 1.2 kg
Disease Resistance	HR: Cca / Ccu) IR: Gc / Px

Type

A 100% female parthenocarpic hybrid. Imanol is a medium-early hybrid with long fruits, suitable for culture under glass or plastic. The rather vigorous plant remains open and easy to work in, promoting air flow.

The fruits have a bright-green colour, good shape, slightly ribbed and are 30 - 35 cm long in winter. Imanol is a high-yielding plant even under relatively cold conditions.

Features/benefits

- Rather vigourous plants with a very good productivity.
- Uniform, cylindrical-shaped fruit with thin necks.
- Withstands unfavourable conditions such as low light and cooler temperatures well.
- Ideal variety for winter production.

Hot Pepper

Feel that Heat

Compadre

Type

A hot Jalapeno pepper that is widely adaptable and cold tolerant with continuous setting of fruits throughout the growing season.

It is a hybrid variety suited to both the fresh and processing markets. Fruits are smooth and uniform with consistent quality.

Features/benefits

- High plant vigour.
- Good fruit setting.
- Excellent fruit quality.

Earliness	Medium Late
Maturity	75 - 80 days
Average Fruit Weight	35g - 40g
Plant	Strong vigour Good cover Good continuous setting Strong pungency
Disease	HR: TMV / Xcv: 2, 5

Lettuce

Fresh and crisp

Ice Wave

Ecology	Open field
Variety Usage	Fresh/processing
Season	Spring, Summer and Autumn*
Disease Resistance	HR: Bl: 16-35EU / Nr: 0 / TBSV

** Area dependent. Consult local seed specialist.*

Type

A large iceberg lettuce that is suitable for the fresh and processing market.

The variety is suitable for the summer period and produces suitably sized green coloured heads

Features/benefits

- High plant vigour
- Good resistance package
- Long harvesting period.

Ice Vic

Ecology	Open field
Variety Usage	Fresh/processing
Season	Spring and Autumn*
Disease Resistance	HR: Bl: 16, 18-24, 27, 28, 30-32 / Fol:1, 2

**area dependent. Consult local seed specialist.*

Type

A large iceberg lettuce that stands out for its basal training, closure and precocity.

It is suitable for the fresh and processing market.

Features/benefits

- Dual purpose variety
- Good resistance package

Waikiki

Ecology	Open field
Variety Usage	Fresh/processing
Season	Spring, Summer and Autumn*
Disease Resistance	HR: Bl: 16-29, 32, 34EU / Nr: 0 / Fol:1, TBSV

** Area dependent. Consult local seed specialist.*

Type

A large iceberg lettuce that is suitable for the fresh and processing market. The variety is also known for earliness, high plant vigour and suitable head size.

Waikiki depicts good shape and plant vigour, excellent basal closure and uniformity. Waikiki has a good resistance package and tolerance to bolting and internal burn.

Features/benefits

- High plant vigour.
- Good resistance package
- Suited for the processing market.

Celestal

Ecology	Open field
Variety Usage	Fresh/processing
Season	Area dependent. Consult local seed specialist.
Tolerance	Twisting
Disease Resistance	HR: Bl: 16-28, 30-32 / Nr: 0 IR: LMV:1

** Area dependent. Consult local seed specialist.*

Type

A large cos type lettuce with good Bremia resistance. Suitable for the fresh and processing market.

The variety has improved shape and twisting tolerance and is suited to the fresh and processing market. The variety is also known for earliness, high plant vigour and medium dark colour intensity.

Features/benefits

- High plant vigour.
- Bl resistance.
- Suited for the processing market.

Extratos

Ecology	Open field
Variety Usage	Fresh/processing
Season	*Area dependent.
Disease Resistance	HR: Bl: 16-28, 30-32 IR: LMV: 1

** Area dependent. Consult local seed specialist.*

Type

A little gem, cos type lettuce. Suitable for the fresh and processing market. It is produced in open field.

The variety has good head quality with excellent Bremia resistance and is suited to the fresh and processing market. The variety is also known for earliness and high plant vigour and can be produced in winter and spring. The plant has a medium compact size with a dark green leaf colour.

Features/benefits

- Dark green colour.
- Excellent disease resistance.
- Suited for the processing market.

Merinos

Ecology	Open field
Variety Usage	Fresh/processing
Season	*Area dependent.
Disease Resistance	HR Bl: 16-33 / TBSV

** Area dependent. Consult local seed specialist.*

Type

A little gem, cos type lettuce with smoother leaves than Extratos. Suitable for the fresh and processing market. It is suited for open field production.

The variety has smooth leaf quality and has dark green colour. The variety is compact, vigourous and can be produced in winter and spring. The variety produces a constant shape plant.

Features/benefits

- Good colour contrast in the heart.
- Excellent disease package.
- Consistent shape.

Pivotal

Type

A midi cos lettuce for the winter segment. It is ideally suited to open field production and can be used for both the fresh and processing market segments.

The variety has large diameter and dark green leaves. The variety is also known for its tolerance against bolting and tip burn. This variety experiences virtually no twisting during its growth cycle.

Ecology	Open field
Variety Usage	Fresh/processing
Season	*Area dependent.
Tolerance	External tip burn, bolting
Disease Resistance	HR: Bl: 16-29, 32, 34EU / Fol:4

** Area dependent. Consult local seed specialist.*

Features/benefits

- High plant vigour and earliness.
- Tolerance to tip burn and bolting.
- Suited for the fresh market and processing segment.

Claragio

Ecology	Open field
Variety Usage	Fresh/processing
Season	*Area dependent.
Tolerance	Bolting
Disease Resistance	HR Bl: 16-33, 35EU / Nr: 0/ Fol:4

** Area dependent. Consult local seed specialist.*

Type

A red multi leaf Batavia (“one cut”) type of lettuce. Suitable for the fresh and processing market. It is produced in the open field.

The variety has excellent triple red colour and is suited to the fresh and processing market. The variety is also known for earliness and high bolting tolerance. It has a medium size frame.

Features/benefits

- High plant vigour.
- Excellent triple red colour.
- Suited for the processing market.

Michelagio

Ecology	Open field
Variety Usage	Fresh/processing
Season	*Area dependent.
Compactness	Medium large
Disease Resistance	HR: Bl: 16-35 / Nr: 0/ TBSV IR: LMV: 1

** Area dependent. Consult local seed specialist.*

Type

A green “one cut” type lettuce suitable for the fresh market and industry. It is produced in an open field ecology.

The variety has a medium-large compactness that makes it suitable for the processing market. The variety has strong leaves with good size and shape. The leaf colour is dark to very dark green.

Features/benefits

- High yielding.
- Strong leaves.
- Good compactness.
- Suited for the fresh market and industry.

Gladiore

Ecology	PGH
Variety Usage	Fresh and processing
Season	*Area dependent.
Disease Resistance	HR: Bl: 16-32

** Area dependent. Consult local seed specialist.*

Type

An indoor segment butterhead lettuce suited for both the fresh and processing markets. This variety also thrives in the late autumn and early spring periods.

The variety has a brilliant green colour, with compact head that is nicely filled possessing high internal quality.

Features/benefits

- Suited for the fresh market and industry.

Meteore

Ecology	Open field
Variety Usage	Fresh
Season	*Area dependent.
Tolerance	Frost
Disease Resistance	HR: Bl: 16-35EU

** Area dependent. Consult local seed specialist.*

Type

A medium sized butterhead lettuce suited for both the fresh and processing segment. Mainly produced in the open field in summer and under protection in winter.

The variety has tolerance to frost that makes it suitable for winter growing. The variety has a medium dark green colour, with good volume and filling and a high quality presentation. It is suited to the fresh market and industry.

Features/benefits

- Excellent tip burn tolerance.
- Frost tolerance.
- Suited for the fresh market and industry.

Melon

Juicy and fragrant

Athena

Type

Hybrid Cantaloupe. Athena is an innovative early hybrid cantaloupe for production in the open field. The medium-vigorous to strong plants produce high yields of high quality.

The oval fruits with minor sutures and coarse netting weigh from 1.5 - 2.5 kg. The firm orange flesh with crisp texture keeps its sweet flavour even after long-distance shipping or a few days at the produce stand.

Features/benefits

- Oval fruits with coarse netting.
- Firm flesh with crisp texture, keeping its sweet flavour even after long-distance shipping.
- Good shipper.
- Fruits tend to stay firm even when harvested at full slip.

Earliness	Early
Maturity	75 Days
Plant	Medium to strong vigour Good cover
Fruit	Oval Minor sutures Coarse netting Small seed cavity Orange flesh colour Firm flesh with crisp texture
Average fruit weight	1.5 - 2.5 kg
Tolerance	Sulphur burn
Disease Resistance	HR: Px: 1, 2US / Fom: 0, 1, 2 IR: Gc: 1 / Px: 2

Onion

Layers of flavour

Banko

Earliness	Late
Plant	Strong foliage Medium to thick neck
Bulb	Very uniform round shape bulbs Strong brown skin colour Medium- to large-sized bulb Good bulb firmness Medium pungent taste Good storage ability Medium-small basal root attachment
Disease Resistance	Good general foliar disease resistance

Type

An intermediate day onion for production in open field.

Banko is a late intermediate day onion with very uniform round-shaped bulbs. Strong brown-skinned colour with a very high yield potential. Very firm bulbs with good storage ability. Tight bulb outer scales.

Features/benefits

- Very uniform, medium- to large-sized, firm, strong brown skinned bulbs.
- Good storage ability

Rootstock

Choose the right root

Rootstock
Choose the right root

Carnivor (Melon & Watermelon Rootstock)

Type

Carnivor is a vigourously growing interspecific rootstock with a very high cold tolerance. This easy to graft rootstock has a good affinity and can be used on melon, however with a specialty on watermelon.
Great fruit setting ability while promoting fruit weight at the same time.

Disease Resistance	HR: Co: 1 / Fon: 1, 2 / Fom: 0, 1, 1-2, 2 IR: Fon: 0

Strong tosa (Watermelon, Melon & Cucumber Rootstock)

Type

Strong Tosa is the new F1 rootstock for cucumber, watermelon and melon grafting. C. maxima x C. moschata intraspecific hybrid. Holds an excellent vigour and is very tolerant to low temperatures. It is well adapted to conditions that require high vigour (e.g. sandy soils). Fairly good tolerance to “sudden wilt”. It is easily grafted with all techniques nowadays used. Strong Tosa offers high germination and very uniform plants. Strong Tosa visibly increases the fruit dimensions (+ 10-20 %).

Disease Resistance	HR: Co: 1 / Fon: 1, 2 / Fom: 0, 1, 1-2, 2 IR: Fon: 0, 2

Snap pea

Edible sweetness

Sugar Lady

Earliness	Medium late
Maturity	73 days 950 heat units
Average bloom node	15 - 15
Plant	Semi-leafless vine

Type

Sugar Lady is a medium to late maturity, round-podded green snap pea suitable mainly for the fresh market.

The semi-leafless vines are approximately 80 cm tall. To obtain high yield and quality pods the product should be handled delicately during harvest and packing.

Features/benefits

- Straight, round, large pods.
- Easy to pick.
- Slow seed development.

Snow pea

Delightfully sugary sweet

Snow pea

Delightfully sugary sweet

Snow wind

Type

Edible flat-podded pea.
Snow Wind is a rather late, flat-podded dark- green snow pea suitable for both fresh market and processing (freezing).

The semi-leafless vines are approximately 75 - 80 cm tall. To obtain high yield and quality pods the product should be handled delicately during harvest and packing.

Features/benefits

- Straight, flat, dark-green pods.
- Easy to pick.
- Slow seed development.

Earliness	Medium late
Maturity	70 days 890 heat units
Average bloom node	15 - 16
Plant	Semi-leafless vine Medium-strong vigour 75 - 80 cm tall
Pod	9 cm long Blunt Fleshy Slow seed development
Pod colour	Dark green
Peas per pod	8
Pods per axil	2
Disease Resistance	HR: PSbMV IR: Ep / BLRV / BYMV / Fop: 1, 6

Sweet corn

Supersweet

Garrison

Type

This super sweet yellow hybrid variety produces excellent fresh market capabilities for the mid-season slot, with a comprehensive disease package. The cylindrical cobs look great in tray packs.

Features/benefits

- High yield
- Good disease package
- Excellent Tip fill

Earliness	Early to Medium early
Maturity	79 days 920 heat units
Average bloom node	15 - 16
Plant	Medium growth Approx. 210 cm tall First ear at approx. 85 cm
Cob Size	Average length 20 cm Average diameter 5 cm Average number of rows 16 Very good tip-fill
Season	Mid-season
Husk Appearance	Green Good flag leaves Adequate cover
Usage	Fresh market Processing as frozen kernels
Disease Resistance	Bm / Et / Ps (Rp1-d), Ps (Rp1-i) / Pst / MDMV

Moreland

Type

Yellow super sweet hybrid for both fresh market and processing. Moreland is an open field cultivar with good quality ears and high yields. Average to good tip-filling of the cob and its excellent sweet taste is remarkable.

Features/benefits

- Strong high yielding plant.
- Dual purpose based on harvest cycle.
- Good disease package.
- Rust resistance (extra Rust gene).

Earliness	Medium early
Maturity	84 days
Cob Size	Average length: 20 cm Average diameter: 5,6 cm Average number of rows: 18-20
Season	Full season
Husk Appearance	Dark golden yellow colour
Usage	Fresh market Processing as frozen kernels
Disease Resistance	HR: Et / Ps: (Rp1-d), Ps: (Rp1-g), Ps: (Rp1-i) / Pst IR: Bm

Sweet corn
Super sweet

Overland

Earliness	Medium
Maturity	85-90 days
Cob Size	Length: 19-23 cm Depth: 12-13 mm Diameter: 5.5-6.0 mm Average of 18 rows
Season	Summer and Winter
Husk Appearance	Medium to dark green Good flag leaves Adequate cover
Usage	Fresh market Processing as frozen kernels
Disease Resistance	HR Et / Ps: (Rp1-i) IR: Bm

Type

Yellow super sweet hybrid for both fresh market and processing. Overland is an open field cultivar with good quality ears and high yields.

Average to good tip-filling of the cob and its excellent sweet taste is remarkable. Suitable as a main season producer.

Features/benefits

- High quality, excellent uniform ears.
- Average to good tip-fill.
- Kernels have an attractive yellow colour.
- Good disease tolerance.
- Very good yield for fresh and processing market.

Shinerock

Type

This very late segment, super sweet hybrid has given great performances. Shiny kernels and standing like a rock.

Shinerock combines excellent plant habit with a high yield and excellent ear quality. The perfect hybrid for the late season.

Features/benefits

- Very late maturity.
- Broad disease package.
- Strong plant.
- Good holding.

Earliness	Early to Medium early
Maturity	84 days
Plant	Medium growth Approx. 280 cm tall
Cob Size	Average length: 20 cm Average diameter: 5.3 cm Average number of rows: 18 Very good tip-fill
Season	Excellent plant for late season
Husk Appearance	Dark golden yellow colour
Usage	Fresh market Processing as frozen kernels
Disease Resistance	HR: Bm / Ps (Rp1-g), / MDMV: A IR: Et / Pst / Ps

Sweet pepper

Bursting with flavour

Admiral

Type

A blocky hybrid pepper turning yellow at maturity. Admiral is a medium-late variety producing high quality blocky fruits.

The medium-tall plants have good setting. The blocky, mostly four-lobed fruits have thick walls and an excellent quality. The average fruit weight is approximately 225g. Admiral is suited for culture under plastic and in the open field.

Features/benefits

- Large deep blocky fruits with smooth skin and thick walls.
- Excellent disease resistance enhances yield potential.
- Continuous fruit set.

Earliness	Medium late
Maturity	85 - 90 days
Plant	Medium-sized bush Medium-strong vigour Erect plants Excellent cover Good fruit setting Large deep blocky Mostly 4 lobed Thick wall Firm
Fruit	Average size 11.5 x 11.5 cm Medium dark-green turning yellow at maturity Smooth skin
Average Fruit weight	190g - 235 g
Disease Resistance	HR: PVY: 0 / Tm: 0 / Xcv:1, 2, 4, 5

Sweet pepper
Bursting with flavour

Balta

Type
A blocky hybrid pepper turning red at maturity. Balta is a strong, open growth habit plant with good foliage cover. Continuous fruit setting and production.

Uniform fruit size and shape. Fruit is blocky, green to red with high quality. Very large-sized fruit: 11 x 10 cm. Fruit mass: > 230 g. Thick fruit wall. Balta is aimed at areas where virus pressure might be a problem and suited for culture under plastic.

Features/benefits
- High quality and good production potential.
- Consistent set of mostly 3 - 4 lobed, blocky fruit.
- Very large-sized fruit.
- Thick walls and uniform in shape.
- Calyx not touching fruit.
- Multiple virus resistance.

Earliness	Medium Late
Maturity	80 - 85 days
Plant	Strong vigour Good cover Medium internodes Good continuous setting
Fruit	Large deep blocky Mostly 3 - 4 lobed Thick wall Firm Average size 11 x 10 cm Medium to dark-green turning red at maturity Smooth skin
Average Fruit weight	> 230 g
Disease Resistance	HR: PVY: 0, 1, 2 / Tm: 0 IR: CMV / Lt / TSWV: 0

Sweet pepper
Bursting with flavour

Cannon

Type
A blocky hybrid pepper turning red at maturity. Cannon is a strong, open growth habit plant with medium foliage cover. Productive, with excellent continuous fruit growth and minimum pruning needed. The fruit of Cannon is uniform and has a blocky fruit shape.

Turns dark-green to red at maturity with excellent firmness and vine storage. Medium-large sized fruit: 9 - 11 cm x 8.5 - 10 cm. Fruit mass: 175 - 250 g. Mostly 3 - 4 lobed with very thick fruit walls.

Features/benefits
- High quality and production potential.
- Consistent set of mostly 3 - 4 lobed blocky fruit.
- Medium-large sized fruit.
- Very thick walls and uniform in shape.
- Calyx not touching fruit.

Earliness	Early
Maturity	68 - 75 days
Plant	Strong vigour. Good cover Medium internodes Good continuous setting
Fruit	Medium-large blocky Mostly 3 - 4 lobed Very thick wall Firm Average size 9-11 x 8.5-10 cm Medium to dark-green turning red at maturity Smooth skin
Average Fruit weight	175 - 250 g
Disease Resistance	HR: PVY: 0, 1 / Tm: 0-2

Crusader

Type

A blocky hybrid pepper turning red at maturity. Crusader has consistently delivered beautiful, high quality fruit for green and red harvests. This dark-green pepper has shown excellent adaptability.

It typically produces blocky, 4 lobed, large and extra-large sizes that hold their shape and firmness under a range of conditions. With high resistance to bacterial leaf spot races 1 - 3, Crusader provides insurance against disease outbreaks.

Earliness	Medium late
Maturity	80 - 85 days
Plant	Very good cover Large leaf Upright plant Medium compact
Fruit	Sweet blocky 4-lobed Excellent firmness Dark-green to red Superior fruit quality
Average Fruit weight	220 - 250 g
Disease Resistance	HR PVY: 0, 1, 2 / Tm: 0 / Xcv: 1-3

Features/benefits

- Reliable yields and grower-friendly. Proven adaptability, blocky, 4 lobed, large and extra-large fruit.
- Hold their shape and firmness under a range of conditions.
- Beautiful, high-quality fruit throughout the harvest season with good cover and continuous fruit setting.
- Strong disease resistance package.

Indra

Type

Blocky F1 hybrid turning red at maturity. Indra is a medium-early, very productive variety with a concentrated harvest of shiny, high-quality, blocky fruits.

The fruits have a medium thick wall and hardly any shoulder. The average fruit weight is 170-225 g. Indra can be grown under cover and in the open field. World-wide this variety has proved its reliability.

Features/benefits

- Very productive variety.
- Shiny, high-quality fruits.
- Standard variety in many markets world-wide.

Earliness	Medium early
Maturity	75 - 80 days
Plant	Strong and vigorous Very good cover Good fruit setting
Fruit	Deep blocky 3 - 4 lobes Hardly any shoulder Thick walled Firm Average size 12 x 10 cm Medium dark-green turning red at maturity Very attractive shiny colour
Average Fruit weight	170 - 225 g
Disease Resistance	HR: PVY: 0 / TEV / Tm: 0 / TMV / ToMV

Jupiter

Type

Blocky pepper turning red at maturity. Jupiter is a medium-early, consistently high- yielding variety which produces large, very blocky fruits. The fruits are predominantly 4 lobed and are well-covered by the medium strong plant. The fruits have a medium thick wall.

The average fruit weight is 170 - 225g. Jupiter is recommended for open field production and green picking.

Features/benefits

- Uniform, very blocky fruit.
- Proved variety for consistently high yields of large, well-shaped fruits.
- Standard variety in many markets world-wide.

Earliness	Medium early
Maturity	75 - 80 days
Plant	Medium strong Dense canopy Good cover Good fruit setting
Fruit	Very blocky Predominantly 4-lobed Medium thick-walled Firm Average size 11 x 11 cm Medium dark-green turning red at maturity
Average Fruit weight	170 - 225 g
Disease Resistance	HR: Tm: 0 / TMV

Lafayette

Type

A blocky hybrid pepper turning yellow at maturity. Lafayette is a medium-late variety producing high quality blocky fruits. The medium-tall plants have a good setting. The blocky, mostly 4 lobed fruits are very uniform, have thick walls and an excellent quality at full maturity.

The average fruit weight is approximately between 210 - 230g. Lafayette is suited for culture under plastic and in open fields. This variety is aimed at areas where virus pressure might be a problem or where culture under plastic is required.

Features/benefits

- Very firm, large blocky fruits with smooth skin and thick walls that turn yellow at maturity.
- Excellent disease resistance package which enhances yield potential.
- Uniform fruit size and shape.
- Continuous fruit set.

Ecology	Open field/ protected
Variety Usage	Fresh
Earliness	Medium late
Maturity	75 - 85 days
Plant	Medium size bush Strong vigour Erect plants Excellent cover Good fruit setting
Fruit	Large blocky Mostly 4 lobed Thick wall Very firm Average size 12 x 11.5cm Medium dark green, turning yellow at maturity Smooth skin
Avergae Fruit weight	210 - 230g
Disease Resistance	HR: PepMoV / PVY: 0, 1, 2 / Xcv: 1-3

Kiiroi

Earliness	Early
Maturity	80 - 85 days
Fruit	Deep blocky 3 - 4 lobes Thick walled Firm Medium light-green turning yellow at maturity Very attractive shiny colour
Plant	Strong and vigorous Good fruit setting
Disease Resistance	HR: Tm: 0-3 IR: TSWV: 0

Type

Blocky F1 hybrid turning yellow at maturity. Kiiroi is an early variety with a harvest of small-medium sized yellow fruits. Kiiroi is primarily for growth under plastic.

The variety is targeted at the fresh market. This hybrid boasts medium to strong setting with a production of blocky yellow coloured fruits.

Features/benefits

- Very productive variety.
- Shiny, high-quality fruits.

Sobek

Earliness	Medium late
Maturity	80 – 85 days
Fruit	220 - 250g 3 - 4 lobes Thick walled Medium dark-green turning red at maturity Very attractive shiny colour
Plant	Strong and vigorous Good fruit setting
Disease Resistance	HR: PVY: 0 / Tm: 0-3 IR: TSWV: 0

Type

Blocky F1 hybrid turning red at maturity. Sobek is a variety with very high yield and very good setting of large sized red fruits.

Sobek is primarily for growth under plastic. The variety is targeted at the fresh market. The variety boasts very strong plant vigour

Features/benefits

- Export yield
- Good resistance package
- Fruits with long shelf life

Squash

Reap the rewards

Afrodite

Earliness	Early
Maturity	45 - 50 days
Plant	Vigour Erect leaves Open plant Productive
Fruit	Medium-dark green Uniform cylindrical shape Small and neat flower scar Attractive quality Good shelf life
Average Fruit size	Length: 10 - 20 cm Diameter: 3.5 to 4 cm
Disease Resistance	IR: CMV / WMV / ZYMV

Type

A medium-dark green cylindrical hybrid traditional variety for open field cultivation. Vigorous, with medium-long internodes. Its high precocity yielding marketable fruits and its high productivity rate make it ideal for use in open fields with spring seed sowing and lead to excellent yields, even in a short growing cycle. Medium-dark green classic fruit, with a regular cylindrical shape, even when longer and larger than usual.

Afrodite continues to be a variety that is highly appreciated by the food industries, due to its small flower scar, excellent post-harvest preservation times, resistance during transport and handling.

Features/benefits

- Suited for culture under plastic and in the open field.
- Vigorous, open plant with erect leaves.
- Earliness and yield.
- Very uniform medium dark-green cylindrical fruits with good shelf life.

Athos

Type

Dark green cylindrical hybrid. Athos has a large medium-strong open bush growth. Dense medium foliage cover and upright growth habit. Uniform cylindrical, high quality, straight fruit with a shiny dark-green fruit colour and low number of speckles.

Medium-short peduncle and small-neat blossom end scar. High yield potential and good shelf life. Improvement over Raven due to its virus and powdery mildew resistance.

Features/benefits

- Vigorous and open plant.
- Produces cylindrical, straight, shiny, dark green fruits.
- Ideal for open field cultivation at the end of summer and autumn, even in areas subject to strong viral pressure and powdery mildew.

Earliness	Early
Maturity	45 - 50 days
Plant	Bush Medium-strong vigour Open plant Dense medium foliage cover Erect leaves Very productive
Fruit	Dark green shiny colour Cylindrical, straight shape firm Uniform and high quality Small and neat flower scar Good shelf life
Average Fruit size	Length: 11- 21 cm Diameter: 2.0 - 3.5 cm
Disease Resistance	IR: CMV / WMV / ZYMV / Gc / Px

Quine

Type

Medium, dark green cylindrical fruit. Suited for local and export market. Quine is a medium dark- green variety, with a strong plant and erect leaves.

Good tolerance to virus diseases and powdery mildew means this is a very productive variety.

Features/benefits

- Vigorous, healthy plant.
- Moderate number of speckles.
- Good shelf life, not tapering.
- High yield.

Earliness	Early
Maturity	40 -45 days
Plant	Bush Strong vigour Open plant Medium foliage cover Erect leaves Productive
Fruit	Cylindrical Firm Uniform Medium to dark green colour Long peduncle Small blossom end scar Attractive quality Good shelf life
Average Fruit size	10-20 cm in length 2.5-3 cm diameter
Disease Resistance	IR Gc / Px / CMV / WMV / ZYMV

Starship

Earliness	Medium early
Maturity	45 - 50 days
Plant	Medium vigour Compact Open plant Productive
Fruit	Bright dark, green, firm, average sized fruit Dish-shaped with scalloped edges Flavourful and tender

Type

Dark green hybrid summer squash. Starship is a medium early, bright dark green, scallop summer squash hybrid for production under plastic and in the open field.

The medium vigorous plants have an open habit and produce tender, tasty, bright dark green fruits which are very well adapted for use in the baby vegetable segment. When harvested young Starship will prove to be a prolific producer of small, flavoursome fruits which are easily picked due to its open plant habit.

Features/benefits

- Fruits are tender and full of flavour.
- Easy to harvest due to open habit.
- Very attractive product as baby vegetable. Early and prolific producer of small-sized bright dark green fruits.
- Even more attractive when packed in combination with Sunburst.

Sunburst

Earliness	Medium late
Maturity	45 - 50 days
Plant	Medium vigour Compact Open habit
Fruit	Bright yellow with dark green blossom end Dish-shaped with scalloped edges Flavoursome and tender

Type

Bright yellow hybrid scallop summer squash. Sunburst is a medium late, bright yellow, scallop summer squash for production under plastic and in the open field.

The medium vigorous plants have an open habit and produce tender, tasty, bright yellow scallop fruits on a green stem. When harvested young Sunburst will prove to be a prolific producer of small, flavoursome fruits which are easily picked due to its open plant habit.
uits which are easily picked due to its open plant habit.

Features/benefits

- Prolific producer of small bright yellow fruits on green stems and with a dark green blossom end.
- Fruits are tender and flavoursome.
- Easy to harvest due to open plant habit.
- Very attractive product as baby vegetable. Even more attractive when packed in combination with Starship.

Tomato

Share the passion

Chibli

Type

A determinate blocky-round hybrid tomato for fresh market and processing. Chibli is a medium early determinate hybrid with medium-sized, blocky-round fruits for fresh market, hawker trade and processing use.

The very vigorous plant with good cover produces high yields of early quality fruits with good shipping ability. Chibli is mostly grown flat as a bush culture for the fresh market but is also used, due to its good brix, by processors for paste.

Features/benefits

- Ideal for fresh market and paste-processing.
- Can be harvested over a long period as the plant covers the firm fruits well.
- Exceptionally high yields.
- Nematode resistance.

Earliness	Medium early
Maturity	120 days from sowing
Plant	Determinate Very vigorous Good cover High yielding
Fruit	Blocky-round Medium-sized Non-greenback Smooth and firmJointed
Average Fruit weight	90 - 110 grams
Disease Resistance	HR: Fol: 0-1 (US1-2) / V / Va, Vd IR: Ma, Mi, Mj

Kilele

Type

A determinate type of tomato that produces red square elongated fruits suitable for the fresh market. Kilele is a square shaped type of tomato produced in the open field.

The variety is also known for high yield, fruit firmness and healthy foliage. Kilele has a long harvest window assisting to maximize its yield potential.

Features/benefits

- TY resistance.
- Firm fruits.
- Open field planting.
- Very good shelf life.

Ecology	Open field (bush or staked)
Earliness	Medium early
Maturity	75 - 80 days after transplant
Variety Usage	Fresh
Plant	Determinate
Fruit	Elongated shape No green shoulders Smooth fruit
Average Fruit weight	120-130grams
Disease Resistance	HR: Fol: 0-1 (US1-2) / S / V / Va, Vd, Ma, Mi, Mj / TMV: 0 / ToMV: 0-2 IR: TYLCV

Momtaz

Type

A determinate type of tomato suitable for the fresh market. Momtaz is a saladette type of tomato produced in the open field.

The variety produces red square elongated fruits suitable for the fresh market. The variety is also known for strong vines, firm fruits and very good yield.

Features/benefits

- Firm fruits.
- Open field planting.
- Excellent disease package including TYLCV.

Ecology	Open field
Earliness	Medium
Plant Type	Determinate
Variety Usage	Fresh
Plant	Medium strong vigour Strong to very strong setting
Fruit	Red colour Square shape No green shoulders
Average Fruit weight	130 - 140grams
Disease Resistance	HR: ToMV: 0-2 / V / TMV: 0 / Fol: 0-1 (US1-2) / Va: 0 / Vd: 0 IR: Pst / TYLCV / Mi / Ma / Mj

Jimbo

Type

An indeterminate hybrid tomato for fresh market. Jimbo is an indeterminate, vigorous, medium-compact growth habit variety with an excellent foliage cover. Large sized fruit with fruit mass: 170-190 gr.

Flattened globe shaped fruit with no green shoulders. Good fruit quality and excellent firmness. Maintains excellent fruit size throughout the growth period. Jimbo is aimed at areas where virus pressure might be a problem.

Features/benefits

- Very vigorous and long growth cycle.
- Good fruit quality.
- Large-sized fruit.
- Very productive.
- Multiple virus resistance.

Earliness	Medium early
Maturity	90-100 days from transplanting
Plant	Very strong indeterminate Very vigorous Excellent foliage cover
Fruit	Flattened globe shaped fruit Firm Jointed Large sized No green shoulders Uniform shiny colour Excellent fruit size throughout growth period
Average Fruit weight	170-190 gr
Disease Resistance	HR: Ff: A-E / Fol: 0-1 (US1-2) / V / Va: 0, Vd: 0, Ma, Mi, Mj / ToMV: 0-2 / TSWV IR: For / TYLCV

Newton

Type

An indeterminate hybrid tomato for fresh market. Newton is a relatively compact plant with short internodes. This means more trusses per stem by the time the crop is topped or reaches the trellising wire. Excellent fruit shelf life.

Newton has approximately 6-7 fruit per truss and should not need truss pruning. However, in open-field plantings of Newton it has potential for both large fruit and value pack-sized fruit from the same truss. Newton has the characteristic of maintaining a good fruit size late into the cropping cycle without any truss pruning.

Features/benefits

- Vigorous plant that adapts very well to open field and under protection.
- High yield.
- No truss pruning.
- Very uniform fruits (shape and size), almost 80% of total harvest same size caliber.

Earliness	Medium early
Maturity	90-100 days from transplanting
Plant	Indeterminate vigorous plant that adapts very well to open field and under protection. Compact plant
Fruit	Globe shape Jointed Intense red colour Very uniform fruits (shape and size) Good cracking tolerance LSL Small-neat calyx- and blossom scar High pack out
Average Fruit weight	150-170 gr
Disease Resistance	HR: Ff: A-E / Fol: 0-1 (US1-2) / S / Ss / V / Va, Vd / ToMV: 0-2 IR: For

Staffie

Type

An indeterminate hybrid tomato for the fresh market. Staffie is an indeterminate vigorous growth habit variety with an excellent foliage cover. Large sized fruit with fruit mass: 180-200gr. Round to flattened globe shaped fruit with no green shoulders. Very good shiny fruit colour in both mature and turning stages.

Excellent setting under high temperatures. Very good fruit quality and firmness. Unique truss presentation and maintains excellent fruit size throughout the growth period. Staffie is aimed at areas where virus pressure might be a problem.

Features/benefits

- Vigorous and long growth cycle.
- Outstanding fruit quality and uniformity.
- Unique truss presentation.
- Large-sized fruit.
- Very productive.
- Virus resistance.

Earliness	Medium early
Maturity	90-100 days from transplanting
Plant	Strong indeterminate Vigorous Excellent foliage cover
Fruit	Round to flattened globe shaped fruit Firm Jointed Large-sized No green shoulders and shiny colour Excellent uniform fruit size Unique truss presentation
Average Fruit weight	180-200 grams
Disease Resistance	HR: Fol: 0-1 (US1-2) / V / Va: 0, Vd: 0 / ToMV: 0-2 IR: For / Ma, Mi, Mj / TYLCV

Rifle

Type

An indeterminate type of tomato suitable for the gourmet market. Rifle is deep red, with excellent fruit quality and a wide disease resistance package, reducing the risk of these pathogens and insects effecting your crop, allowing worry free growing.

The variety is an open field type of plant that produces high quality fruit with long shelf life. The variety has very strong setting, is highly productive, known for high yield.

Features/benefits

- Good yield potential.
- Excellent uniformity.
- Excellent disease resistance package with TYLCV, F3, TSWV, N.

Ecology	Open field
Variety Usage	Fresh
Earliness	Medium
Plant	Indeterminate Vigourous Strong under rainy conditions
Fruit	Medium size Glossy red, smooth, uniform colour Deep globe shape Firm
Average Fruit weight	150-170 grams
Disease Resistance	HR: S / Ss / ToMV: 0-2 / TMV: 0 / Fol: 0-2 (US1-3) / Vd / Va / TSWV IR: TYLCV, Ma Mi Mj

Watermelon

Refreshing and sweet

Watermelon
Refreshing and sweet

Farao (Seeded)

Earliness	Medium early
Maturity	75 - 85 Days
Plant	Strong plant vigour Very good vine growth habit
Fruit	Elongated to blocky shape Elongated to blocky shape Dark red flesh texture High sugars content Small brown seeds Very good interior quality Firm and flavourful Medium-green with broad, medium dark-green stripes.
Average Fruit weight	9- 14 kg
Disease Resistance	IR: Fon: 0, 1 / Co:1

Type

Hybrid, elongated, Crimson Sweet type seeded watermelon. Farao is a high yielding, medium-early, elongated, Crimson Sweet F1 seeded watermelon. Strong plant vigour with a very good vine growth habit. Shown excellent uniformity and fruit set with high interior quality. Produces large elongated blocky shaped fruits. Medium-green with broad, medium dark-green stripes. Medium thickness but durable rind for long distance shipping.

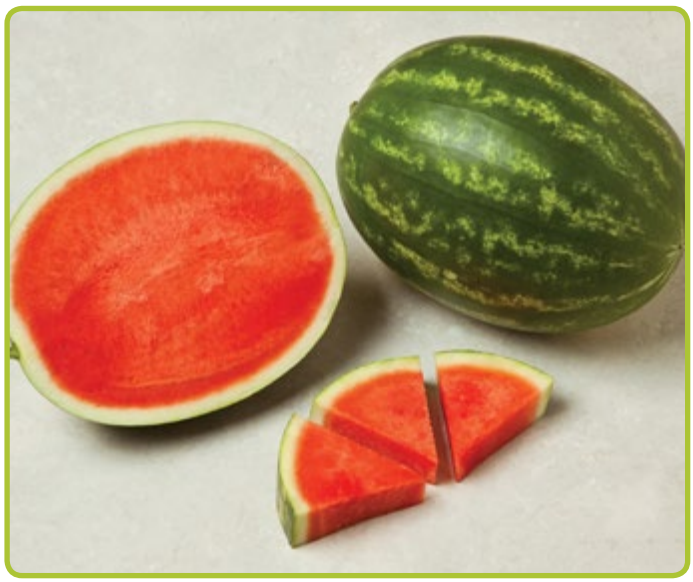
Characterized by flavourful, dark red flesh texture with high sugars and small brown seeds.

Features/benefits

- Large hybrid elongated Crimson Sweet type seeded watermelon with strong plant.
- Vigourous and continuous fruit-set.
- Very good interior quality.
- Firm, flavourful and high sugars.
- Improved disease resistance.
- High yield.

Watermelon
Refreshing and sweet

Fascination (Triploid)



Earliness	Medium early
Maturity	75 - 85 Days
Plant	Strong plant vigour Good cover and vine growth habit
Fruit	Uniform fruit size and blocky shape Very firm, attractive dark red flesh texture High sugars Very small pip size Great flavour High quality fruit Very deep, rich green skin with broad, medium dark-green stripes.
Average Fruit weight	7 - 9 kg
Disease Resistance	IR: Co: 1 / Fon: 1

Type

Hybrid Crimson Sweet type triploid watermelon.

Fascination* is a medium-early, high yielding, Crimson Sweet F1 triploid watermelon. Strong plant vigour with a very good vine growth habit. Shown excellent uniformity and fruit set with high fruit quality. Produces medium-large blocky shaped fruits. Very deep, rich green skin with broad, medium dark-green stripes and classy rind appearance.
Medium thickness but durable rind for long distance shipping. Characterized by flavourful, attractive dark red, firm flesh texture with high sugars and very small pip size. Good potential for Fresh Cut industry

Features/benefits

- Hybrid triploid Crimson Sweet type watermelon with strong plant vigour and continuous fruit-set.
- Excellent interior quality, flavour and high sugars.
- Very firm and very small pip size.
- Improved disease resistance.
- High yield potential.
- Good potential for Fresh Cut industry.

Watermelon
Refreshing and sweet

Prince (Seeded)

Earliness	Medium early
Maturity	75 - 85 Days
Plant	Medium-strong plant vigour Good cover and vine growth habit Excellent seedling vigour
Fruit	Uniform fruit size and blocky shape Firm, deep red flesh texture High sugar content Medium black spotted internal seeds. Flavourful and high quality fruit. Dark skin with a dark Jubilee stripe.
Average Fruit weight	8 - 10 kg
Disease Resistance	IR: Co: 1 / Fon: 1

Type

Hybrid Jubilee type seeded watermelon. Prince is a high yielding medium-early Jubilee F1 seeded watermelon with an excellent seedling vigour. Medium-strong plant vigour with a very good vine growth habit. Shown excellent uniformity and fruit set with high fruit quality.

Produces medium-large blocky shaped fruits. Prince has a medium thick rind and dark skin with a dark Jubilee stripe.

Durable rind for long distance shipping. Characterized by flavourful, firm, deep red flesh texture with high sugars and medium black spotted seeds.

Features/benefits

- Hybrid Jubilee type seeded watermelon with strong plant vigour and continuous fruit-set.
- Very good interior quality.
- Firm with great flavour and high sugars.
- Excellent seed vigour.
- Improved disease resistance.
- High yield.

Crop Guidelines

Production

Beans
Fresh and delicious

Introduction

Bush beans, generally known as beans or green beans, are a very important crop in the average South African household. Beans originate from South American regions and wild varieties still exist in these areas today.

The early domestication of beans resulted in smaller plants with reduced internode length, suppressed climbing ability, fewer but thicker stems and fewer but larger leaves. This selection resulted in what is generally described as bush beans today.

Large seeded varieties were selected over the smaller seed size of wild varieties. Pods with lower fibre content were also selected. The bean as we know it today is the result of years of selection from over 50 herbaceous species in the Phaseolus genus.

As indicated by the domestication and production areas world wide, the common bean (green bean) is a warm season annual and is grown primarily in subtropical or temperate areas, in the highlands, or during the cool, dry season in tropical areas. The optimum temperature for growth ranges from 15 - 21 °C; the maximum is near 27 °C and the minimum around 10 °C. Germination is poor when soil temperature is less than 15 °C, and plants grow slowly at temperatures below 20 °C. High temperatures result in flower and pod abortion. In addition to this it is important to know that seedling emergence is epigeal, which allows no opportunity for re-growth after frost or sunburn.

Beans are best grown in well-drained sandy loam, silt loam, or clay loam soils with high organic matter and where moisture is not limiting. Yield is reduced by short periods of water stress, particularly at flowering and pod fill. Beans grow well in soils with pH of 5.2 - 6.8.

The first pair of leaves, the primary leaves, are entire, whereas subsequent leaves are pinnately trifoliate. The flowers of the bean plant are pedicelled and borne on auxiliary racemes that originate from thickened nodes. In green beans the colour of the flowers is mostly white to creamy with typical legume morphology. The five petals are differentiated into two fused petals that form the keel, two wing petals and a standard. The keel is coiled into 2 - 3 spiral turns and contains one free and nine fused stamens and one pistil. The ovary typically contains 5 - 8 ovules.

Plants are mostly determinate with 5 - 9 nodes on the central axis and two to several branches originating from the lower nodes - these are called bush types. Common beans can fix nitrogen symbiotically with Rhizobium phaseoli but the growth period is not long enough to significantly assist production and therefore nitrogen fixation is not a major factor in production.

Growth cycles

The following stages of development can generally be described for a bean planting:

STAGE	DESCRIPTION
V1	EMERGENCE: appearance of cotyledons on the soil to the unfolding of the leaves
V2	PRIMARY LEAVES: full unfolding of the primary leaves to the unfolding of the 1st trifoliate leaf
V3	1ST TRIFOLIATE LEAF: full unfolding of 1st trifoliate to the unfolding of 3rd trifoliate
V4	3RD TRIFOLIATE LEAF: full unfolding of 3rd trifoliate to the appearance of 1st floral bud
R5	PREFLOWERING: appearance of 1st floral bud to the opening of 1st flower
R6	FLOWERING: opening of 1st flower to the expansion of the ovary after fertilisation
R7	POD DEVELOPMENT: expansion of the ovary after fertilisation to the elongation of the pod to its full size before increase in seed weight
R8	POD FILLING: from the beginning of seed weight and size increase to the development pigmentation of seeds and onset of leaf senescence
R9	MATURITY: onset of senescence to complete senescence and drop in moisture to +15%

From the above descriptions it is clear that green beans should be harvested during the end of stage 7 and the onset of stage 8. The ideal would be at the end of stage 7 to ensure maximum pack out rate and quality.

Beans
Fresh and delicious

Phases and stage of the developing bean plant

GERMINATION	EMERGENCE	PRIMARY LEAVES	1ST TRIFOLIATE	3RD TRIFOLIATE	PREFLOWERING	FLOWERING	POD GROWTH	POD FILLING	MATURATION
V0	V1	V2	V3	V4	R5	R6	R7	R8	R9
VEGETATIVE PHASE				FORMATION OF VEGETATIVE STRUCTURES					
				REPRODUCTIVE PHASE					

PLANTING 1ST FLOWER BUD
HARVESTING

Marketing channels

Beans can be graded into the following size categories for different market segments.

Average Grading Percentage

Description	Pod diameter (mm)
EXTRA FINE - EF	5 - 6.5
VERY FINE - VF	6.5 - 8
FINE - F	8 - 9
MEDIUM FINE - MF	9 - 10.5
LARGE - LG	> 10.5

The local market is mainly active in two grades, F - MF, which are generally referred to as fine (F) or bobby beans (MF). These are typically marketed through the chain stores as pre-packed product. The bulk market grades MF - LG, which are sometimes also referred to as bobby or bulk beans, are mainly marketed to the fresh market and the processing trade - fresh, frozen or canned. Export markets prefer extra or very fine grades. Market trends are changing towards a finer type of bean, primarily because of the influence of the export trade and local chain stores. The demand for the bigger beans remains and these some- times achieve better returns on the market than the finer types.

Yield potential

Yield varies dramatically between farms and it is sometimes not a good tool to use in promoting a variety. Rather refer to the potential of the variety than stating it as an actual performance.

Average Yield Potential

Bean type	Yield PC	
	TOTAL (t/ha)	PACK OUT %
EXTRA FINE - EF	5 - 7	30 - 50
VERY FINE - VF	6 - 8	50 - 60
FINE - F	8 - 10	50 - 60
MEDIUM FINE - MF	10 - 14	80 - 90
LARGE - LG	12 - 14	80 - 90

Growing green beans

Soil

Bush beans can be grown in all soil types but best are grown in fertile soils with a good structure, water retention and drainage. Fairly light soils with adequate humus and a pH-KCL of approximately 6.5 are ideal. Heavy soils can give problems during harvest, especially under wet conditions. Heavy soils are also not as aerated as lighter soils.

The bean plant is sensitive to high chalk and salt content. It is, however, fairly tolerant to pH levels, optimum pH level is 6.1 to 7.6. Above all, the roots are sensitive to compaction or poor soil preparation as well as excessive water levels. In germinating, the bean has to push its cotyledons out of the soil (epigeal germination) and is thus very sensitive to conditions in the soil surface at this stage.

Climate

Beans are well adapted to many conditions but they do not like extreme high temperatures (> 30 0C), especially in combination with wind. This will cause flower abortion. For germination the soil temperature must be at least 10 °C.

Beans
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Low soil temperatures result in poor yields and plants are killed at temperatures below 0 °C. Beans also do not tolerate continuous high humidity. Under high humidity the risk of fungal and bacterial diseases increases dramatically.

Growth and development

Growth and development can be split into three stages:

- sowing - germination
- germination - flowering
- flowering - harvest

To achieve a reasonable germination, a temperature of at least 10 °C is needed. Depending on the temperature, it will take 5 - 20 days before the plants emerge from of the soil. A few days after the plants appear they will stretch their cotyledons.

The time from emergence till flowering is 30 - 40 days. In this period the plant is established. First single leaves are formed. After this it looks like the plant is not growing but then the root system is establishing. After establishment of the root system, trifoliate leaves are formed and soon after formation of the second trifoliate leaf, new leaf and flower buds can be observed. In general, flowering starts after the third trifoliate leaf has been established. The period from flowering till harvest is 20 - 30 days. On the main stem, in the centre of the plant, 3 - 5 large trifoliate leaves are formed.

In the axils of these leaves two flower stems are formed, one with two, four, six or eight flowers, and another with two flowers and an axil on which a trifoliate leaf will appear. After a while, on this axil, again two flower buds will be formed and the cycle will be repeated. The plant continues branching and forming flowers and trifoliate leaves as described above.

The first and second flower levels will produce more flowers while later flower buds will produce less flowers. Under cool and wet conditions, the flower formation will continue. Under dry circumstances and/ or when the root system is weak and/or when there is a lot of competition between the formed pods and/or strong wind, young leaves can be lost along with the further development of flowers in the leaf axils.

For single (mechanical) harvest flowering should have stopped approximately 10 days before harvest. Low night temperatures (<12 °C) stimulate growth from the axils.

When a high plant density is used, the pods will be produced mainly in the top of the plant. At a row distance of 50 cm the pods will be somewhat higher in the plant than at a row distance of 75 cm. Many flowers will abort due to bad pollination at too low temperatures (<15 °C) or too high temperatures (> 25 °C). In addition pollinated pods may abort due to competition with other pods. At high temperatures seed developement is more stimulated than pod development, and subsequent pods formed under such conditions will be less fleshy. Pods formed at lower temperatures and higher humidity will become bigger and more fleshy.

Sowing

Soil temperature at sowing should be at least 10 °C. Sowing is done in a surface-dried soil, after a good rainfall or sprinkler irrigation. The crop is grown in rows which can be single or double according to preference. The rows are planted in ridges or beds to ensure the soil of the seedbed is friable and to avoid waterlogging in heavy rains. These systems also separate the growing area and that being used for human/tractor passage thus avoiding compaction.

Beds are mostly 0.75 m wide and 0.2 - 0.25 m high. The path between the beds is also 0.75 m wide. When two rows are planted on a bed the row distance should be 0.5 - 0.6 m. Seed spacing in the row 5 cm.
Sowing depth is 1 - 2 cm unless the soil is extremely dry. Seed use depending on TSW /ha 50 - 70 kg. The optimal plant density is 25 - 35 plants/rn2. Beans grow better in surface-loosened soils. Mechanical or hand tilling should only be light to avoid damaging the topmost roots. If hoeing and earthing-up is applied for the first time, they are carried out 20 days after sowing with the application of fertiliser and slight earthing up. A second hoeing and earthing-up operation is carried out 15 days later.

Beans
Fresh and delicious

Fertilisation
According to soil analysis.
A soil analysis must be done, and fertilization should be recommended accordingly. In order to obtain the right balance of nutrients we have to deduct the amounts of available nutrients in the soil from the recommended figures.
Never apply organic fertilisers prior to sowing beans. However, a good organic fertiliser on the previous crop will be very benificial to the beans.
The fertilisers used, either in single or compound form, should contain no chlorine components.

Nitrogen
The nitrogen (N) requirement for beans is 150 - 200 kg N/ha.A high nitrogen application increases the chances of germination damage. It would be better to apply nitrogen before sowing and another application just before flowering.

An excess of nitrogen can lead to an over-development of foliage at the expense of pod formation. Depending on soil type and analysis 50 - 100 kg N is given before planting. A top dressing of 50 kg N/ha 20 days after sowing and another 50 - 100 kg N/ha at the begining of flowering, when a good number of flowers which can develop to pods have already appeared, can be very beneficial.

Bush beans can live in symbiosis with bacteria of the species Rhizobium leguminosarum biovar phaseoli. Root nodules will develop. The root nodules will have a pink colour when they are active. When root nodules are active an amount of 50 - 70 kg N/ha can be released. This quantity will be used when there is less than 40 kg N/ha available for the plant. When active bacteria are present the N application can be decreased by 50 - 70 kg N/ha. To benefit from the Rhizobium bacteria there should be enough active bacteria present, the pHKCL should be $\geq$ 5.0 and the soil should have a good humidity while still well aerated. Rhizobium bacteria are much more effective in tropical and sub-tropical regions than in temperate and European climates.

Phosphate
For the development of the root system and flowers, bush beans need the correct amount of phosphate (P). When P-level is low an application of 175 - 250 kg P205 /ha can be desirable, at normal P-level an application of 100 - 200 kg P205 /ha will be sufficient. The phosphate is always given before sowing.
Phosphate deficiency can be observed on soils with low pH. It is recognised by a weak growth, small leaves, thin branches and small pods. The top leaves stay green while the older leaves turn yellow. Leaf tissue along the veins turns brown. Correction at this stage is impossible.

Potassium
Beans are sensitive to chloride.
The average potassium need varies depending on the soil analysis 150 - 250 kg K20 /ha.

Magnesium
If insufficient magnesium is available in the soil, this can be given with the potassium fertiliser in the form of sulphate of potash-magnesia.

Magnesium deficiency can be observed as chlorosis on the leaves between the veins. Mainly the older leaves are affected. The veins stay green while the leaf tissue turns light green to yellow and later brownish. Also the pods can have a brownish colouring. Magnesium deficiency is mainly seen on soils with a low pH and/or too high potassium application.

Manganese
The symptoms of manganese deficiency are similar to magnesium deficiency but can be seen on the younger leaves. Manganese deficiency is mainly observed on soils with a high pH and in dry conditions. A foliar spraying can solve this problem.

During cool and humid conditions manganese surplus can also occur on soils with a low pH. The youngest leaves turn yellow while the veins stay green. On the older leaves white spots, which later turn brown, occur. The best solution is to increase the pH by using lime.

Beans
Fresh and delicious

Fertilisation Scheme

	N	P_2O_5	K_2O
Before planting	50 - 100	100 - 200	150 - 250
20 days after sowing	50		
At flowering	50 - 100		
Total	**150 - 250**	**100 - 200**	**150 -250**

Irrigation

Several methods are practised according to the amount of water and equipment available. Often furrow irrigation is used, good levelling is called for. As irrigation water does not come in contact with the foliage the incidence of fungal diseases is reduced.
When using sprinklers, avoid high pressure sprinklers and heavy drips. Plant treatments may be required more frequently.

In areas where water is scarce some growers start using drip irrigation.
Irrigation on freshly-sown ground is never advisable; this is why prior irrigation is so important. From sprouting up to the flower stage, irrigation is limited in order to encourage root development. With the appearance of the first flowers, irrigation should become more abundant but keep in mind that beans do not like 'wet feet'.

The volume of irrigation will depend on the soil's water content and the crop's root development. A wellestablished crop with deep root systems needs less frequent watering than a poorly-established crop with shallow roots.
Sensitivity to water shortage is marked during two periods:

- During the sowing - sprouting period (15 days): risk of poor crop density or staggered sprouting.
- In the pre-flowering period: malformation of pods.

Harvest

Starts approximately 55 - 65 days after sowing. For hand harvest, pods should be harvested three times a week for fine and bobby beans. For extra fine beans and filet type beans, daily harvesting might be needed to obtain a higher percentage of pods with a diameter under 6.0 mm. The less damage done to the plants during harvest, the higher the total yield will be. Flowering will last longer if beans are harvested younger. The harvest period may last between eight and twenty days, depending on the variety used.

For single (strip) or mechanical harvest, pods are ready to be harvested when the so-called 'seed percentage' is about 12%. The seed percentage figure is obtained by taking 20 of the most deve-loped pods out of a sample. The weight of the shelled seed out of those 20 pods over the weight of the 20 whole pods (with seeds) is the seed percentage.

The 12% represents a combination of the optimal yield of the best quality together with the best shelf-life and transportability. Above 12% indicates a low quality but higher yields, below 12% indicates a higher quality but lower yields.

Another method to determine correct maturity is by slicing the pod lengthwise. The length of an individual seed being equal to the distance between the seeds indicates correct maturity. This last method can be used for harvest by hand.

Average yield depends on the type of bean which is grown:

- extra fine beans, diameter < 5.5 mm, 5 - 7 t/ha of which 30 - 50% exportable.
- fine beans, diameter between 6.5 and 8 mm, 6 - 10 t/ha of which 50 - 60% exportable.
- medium grades (bobby beans), diameter > 8mm, 8 - 12 t/ha of which 80 - 90% exportable.

After picking and washing, the pods must be vacuurn-cooled and dried straight away to ensure longer freshness (to prevent browning). This is particularly important when a long period of transport is necessary. The ideal storing temperature is 8 °C.

Weed control
When weeds are controlled mechanically, this must be carried out at a very shallow level. Beans root close to the surface, so any root damage will cause serious stagnation in growth, especially during dry weather. Chemical weed control is a good alternative provided the correct herbicides are used in accordance with the label instructions. For use of all chemicals it is advisable to contact your local agrochemical supplier.

Pests and diseases
Beans are attacked by a range of insects on the leaf, flowerbuds and the pods. They are also susceptible to various fungal diseases which are more likely to occur in periods of high humidity (this can also occur after a good irrigation, especially when sprinkler irrigation is used).

A preventive spraying programme and weeding (many insects, fungal-, bacterial diseases and viruses host on weeds) may overcome most of the problems. Fungal and bacterial diseases develop easily under humid conditions, keep the leaves and flowers dry and/ or use a preventive spraying programme. Spraying of insecticides and fungicides can be mixed. Viral diseases are transmitted by insect bites. A preventive spraying programme against insects may reduce the risk.

During seedling stage damage can be caused by:
Pythium sp. Fusarium spp. Thanatephorus (Rhizoctonia)
Chalara Phoma

During growth guard against fungal and bacterial diseases:
Botrytis cinerea Sclerotinia sclerotiorum
Pleospora herbarum Uromyces appendiculatus (rust)
Colletotrichum lindemuthianum (bean spot),
Phoma exigua var. Divers
Isospora Xanthomonas phaseaoli (blight)
Pseudomonas syringae pv. phaseolicola (blight)

Most common pests are:
Aphis fabae, Myzus persicae (aphids),
Sitona lineatus L. (beetle),
Tetranychus urticae (mites)
Delia platura (bean fly)
Collembola Thysanoptera (thrips)
Calocoris norvegicus Acanthoscelides obtectus Say (beetle)

Viruses
BCMV (Bean common mosaic virus) BCTV (Beet Curly Top Virus)

Growing pole beans

Except for the placing of stakes so that the pole bean is supported, cultural practices do not differ greatly from growing bush beans. Pole beans are only used for fresh market purposes and repeated hand harvesting takes place.

Broccoli
Packed with flavour

Production Guide: Broccoli

Classification:

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Magnoliopsida
Order:	Brassicales
Family:	Brassicaceae
Genus:	Brassica
Species:	*Olearacea*
Variety:	*Italica*

1. Introduction

The genus Brassica is an economically important group of plants from an agricultural perspective. The common food crops that are part of this genus include cabbage, cauliflower and broccoli, Brussels sprouts, amongst others. Brassica oleracea var. italica commonly known as broccoli has its origins in Italy and this vegetable is considered to be one of the most nutritious vegetables in the world. Broccoli has amongst the highest concentration of magnesium, iron and calcium amongst all vegetables. Broccoli also has very high quantities of vitamin A and vitamin C.

2. Climatic requirements

The brassica family is quite cold resistant making them ideal cool season crops. They do require some cold to initiate flowering. Broccoli can withstand freezing temperatures for a short period and even tolerate light frosts

- Optimum soil germination temperature 27 °C.
- Optimum growing temperature 15.0 - 22 °C.

Temperatures above 27°C will delay maturity and promote vegetative growth, whilst temperatures between 1.5°C and 10°C will hasten maturity. Extremely high or extremely low temperatures may induce bolting in Broccoli; this is when broccoli will prematurely produce an undesirable long flower stalk.

3. Soil requirements

Well drained loamy soils are preferred as they can drain easily, but retain capillary moisture creating conditions that can sustain the plant with water through the season but dry enough to limit the spread of clubroot. A rooting depth of approximately 450 - 600mm is recommended and pH 6.0 - 7.0.

4. Planting periods

Depending on geographical location, broccoli can be planted throughout the year in South Africa. Heat tolerant varieties can be planted in the warmer periods. Planting should be avoided in areas susceptible to heavy frost as this can damage young seedlings.

5. Planting

Planting can be done by direct sowing or by transplanting seedling. In South Africa the latter method of planting is the norm. Direct sowing has more risks with germination and uniformity of the final plant stand in addition to the fact that the plants are in the ground for 4 -5 weeks longer.

Seedlings should be grown in a well-aerated medium, which has good water holding capacity and at a pH of around 6.5. The seed trays should be placed in a germination chamber, at 20 °C with high relative humidity. Immediately apon germination the seedlings should be moved to the seedling tunnel. Here the seedlings are grown using frequent , fine misting irrigation for 3 – 4 weeks. One week prior to transplanting the seedling trays can be moved outdoors to acclimatise and “harden” the seedlings for better success in the field.

The seedlings can be planted by hand or mechanically. Planting by hand is common in South Africa however, this can be time consuming and can result in problems such as

- incorrect depth of planting
- root compaction if planting holes are not deep or

large enough for the seed plug
- seedlings can wilt if soil is not compacted properly after planting as there is not enough contact with the soil
- "J rooting". A condition whereby seedlings are not planted vertically in the soil and the seedling needs to bend to grow vertically and this can adversely affect the overall performance of the crop.

A precision planter is recommended to place single seedlings at a uniform depth.

6. Plant population and spacing

A general spacing of between 20 000 and 40 000plants per hectare is recommended. The planting configuration is between 25 – 40cm in the row and a spacing of 60 – 75cms between the rows. During periods conducive to high disease pressure it is recommended to space the plants wider to allow for air circulation and leaves do not remain wet for too long.

7. Fertilization

In order to maximise the crop potential and minimise wasteful fertiliser use it is essential that growers have soil samples analysed to determine the nutrient status of the soil. From the soil analysis results a fertilization programme can be developed. Soil analysis should be done every season or new planting.

3.5.1 Fertilization guideline

- Nitrogen: Broccoli requires 130 - 150kg/ha of actual Nitrogen. Apply 60 - 80kg/ha prior to planting and incorporate well. Apply the remaining N as side dressing at 10 days and again 30 days after transplant. In wet or sandy conditions the remaining Nitrogen can be side dressed weekly. If a manure has been incorporated prior to planting then the amount of N fertiliser should be reduced accordingly.
- P: Plant uptake is 50-60kg/ha per season. Bring soil levels to 40 mg/kg and then incorporate 50-60kg/ha pre-plant.
- K: Plant uptake is 250kg/ha per season. Bring soil levels to 130 mg/kg then incorporate 125kg/ha pre-plant and 125kg/ha 28 days after transplant

Microelements:

- Ensure adequate supply: Manganese (Mn), Zinc (Zn), Copper (Cu)
- Caution toxicity: Boron (B), Molybdenum (Mo), Iron (Fe)

3.6 Irrigation

Total water requirement is approximately 440 mm per crop cycle. As a guide, apply 10 to 15 mm per week for the first third to half of the growing season, and about 25 mm per week thereafter for winter production. Corresponding figures during summer would be 20 to 25 mm and 40 to 50 mm, respectively. Ensure the soil remains moist at all times.

3.7 Other cultivation practices

3.7.1 Weed control

Weed control is extremely important, and the land under cultivation should be cleared of weeds before planting by using the recommended herbicides. Weeds create competition and compromise yield.

3.7.2 Mulching

The use of plastic mulch, in conjunction with drip irrigation, will increase soil temperature, accelerating plant growth and development. Other benefits include conservation of soil moisture and reduction in compaction and crusting of soil, leaching of fertilizer, drowning of crops, soil moisture evaporation and competition from weeds.

4. Harvesting and marketing

Mature heads are cut from the stem with a sharp knife a few centimetres below the head. Heads can be pre-

packed or sold loose for the fresh market. Store in a cool dry place (preferably refrigerated), to reduce the effects of field heat after harvesting. The ideal is to have a high first cut percentage, (80% +). This can be achieved through good management and choosing a cultivar that produces uniform heads. If the cultivar does not mature uniformly, further costs such as irrigation and labour are incurred for each subsequent cut.

5. Post harvest

Good quality broccoli should be compact (the head should be firm to hand pressure) and the florets (beads) should be closed and dark or bright green in colour. The stalk should be cleanly cut at the required length. No yellow florets should be present and there should be no discolouration on the stem bracts.

5.1 Storage

To achieve sufficient shelf life in broccoli, maintaining low temperature is very important. Shelf life times:

- 0°C with > 95% R.H. - 21-28 days
- 5°C with > 95% R.H. - 14 days
- 10°C with > 95% R.H. - 5 days.

Temperature management during harvesting, packing and distribution is a critical aspect in broccoli production. Liquid-icing and hydro-cooling are techniques commonly used to reduce the temperature of broccoli.

Brussels sprouts

Adorable and sweet

Growing Brussels Sprouts

Scientific name: Brassica oleracea var Gemmifera
Brussels sprouts are a member of the brassica family and are related to cabbages and cauliflower.

Climate

Brussels sprouts are the most cold tolerant of the brassica crops. Brussels sprouts grow within temperature ranges of 7 to 24 °C but produce the best yields at 15 to18 °C. Bolting however can occur if the crop experiences temperatures below 7°C for periods longer than a month. In South Africa they can be grown in most areas but do prefer regions with cool to cold winters. Ultimately it is ideal to sow or transplant in the warmer autumn time so as to produce a large, healthy frame, but late enough so the cool conditions are favourable for high quality sprout development.

Soil

They should be grown in well-drained loams, peaty sands or gravelly loams. A neutral to slightly alkaline soil is optimum; apply lime if the pH is less than 6.0. Sandy soils do require slightly different management techniques. Before planting on sandy soils, broadcast and incorporate 30 cubic meters of compost per hectare and ensure the fertiliser is applied in smaller quantities but more frequently to counter the effect of leaching which is more prominent in sandy soils.

Crop Rotation

As for all the Brassica family, good crop rotations are critical for optimal Brussels sprouts production. Ideally rotations should be longer than three years and should exclude all Brassica's (cabbage, kale, cauliflower, Broccoli) from being planted either before or after as diseases common to this family are easily transmitted. Further to this certain crops can provide a residual nutrient reserve in the soil which can be beneficial to Brussels sprout production.

Sowing

Brussels sprouts can be direct seeded, however the spacing and bed configuration make the overall success rate better when seedlings are transplanted instead. A population of between 25000 and 30000 plants per hectare is normal. Spacing of the plants varies (depending on climate) from 65 – 120cm between rows and 30 – 80cm within the row. Where there is a possibility of high disease incidence, wider plant spacing can help. For processing Brussels sprouts a denser planting regime (eg 60cm x 60cm) can help produce a more uniform single harvest.

Fertilisation

Due to the varying nature of soils, it is always advisable to base any fertiliser program on a sound soil analysis to ensure the crop receives the optimal quantity and ratio of nutrients.

Nitrogen

In total approximately 130 – 180kg N/ha is required for Brussels sprout production. However this amount should be reduced if manure has been added to the soil. Half of the Nitrogen should be applied just prior to sowing or transplanting. The remainder should be side dressed in two applications, the first 10 – 14 days after planting and the last application 4 – 6 weeks later. In sandy soils or in wet conditions additional side dressing may be required.

Phosporus

Due to its general immobility in the soil, broadcast or band any needed phosphorus before planting and work in. A soil test will determine the level of phosphorous requirements. Phosphorous is important for root development and cool, wet soil conditions hinder its uptake.

Potassium

Dependent on a soil analysis the potassium requirement for Brussels sprouts is approximately 115-160kg K2O/ ha. Apply 30 – 40% of the potassium prior to planting split the remainder into three equal side dressings 3 – 4 weeks apart.

Brussels sprouts

Adorable and sweet

Sulphur

Brussels sprout crops have a high need for sulphur, and often on sandy soils, low in organic matter; soil sulphate levels may be low. The optimal requirement for sulphur is 10 – 20kg S/ha as a sulphate throughout the season.

Micronutrients

Boron, Managanese and molybdenum are all very important in the production of Brussels sprouts.

	FOLIAR APPLICATION	SOIL APPLICATION
ELEMENT	**Element Kg / 1000 ℓ**	**Element Kg/ Ha**
Boron (B)	0.1 – 0.3	1.0 – 3.0
Manganese (Mn)	0.5 – 1.0	-
Molybdenum (Mo)	0.1 – 0.25	-

Irrigation

Steady, even growth of this crop is necessary for high quality and yields. Brussels sprouts require a regular water supply of 25 – 35 mm per week, or, a total of 450mm during the growing season. Shortage of water is detrimental for sprout formation. The ideal methods of irrigation application are overhead sprinkler and dripper irrigation. The soil type will not affect the quantity of water required, more the frequency at which it is applied.

Weeds

Brussels sprouts have a very shallow root system and as such competition by weeds can be very detrimental to a good yield. As such numerous shallow cultivations are an essential part of a weed control program. Good weed control requires integration of cultural and chemical methods. Brussels sprouts should be planted in land free of perennial weeds. Care must be taken to avoid fields where residual herbicides from previous years persist in the soil as crop injury may occur.

Diseases

Clubroot (*Plasmodiophora brassicae Wor.*) .) is a very important soil borne disease which affects all Brasssica crops including Brussels sprouts. Symptoms include small to large swellings and other malformations of the roots. This causes water and nutrient flow to be constrained within the plant, causing leaves to wilt, turn colour and look stunted. The disease thrives best in moist, cool, acidic soils; that is when the pH is below 7. Once land is infected, fungal spores can remain for up to 20 years and infect any Cole crop subsequently planted.

Control

- Apply lime to raise the pH of the soil to at least 7.2.
- Isolate for as long as possible or do not plant brassica crops for seven years.
- Do not apply clubroot infested manure.
- Rotate crops and fields as a preventative measure before club root occurs. Allow at least three years between growing susceptible crops.
- Clean and disinfect all equipment used on infested land.
- Control susceptible weeds whenever possible.
- Use clubroot free transplants.

Grey Leaf Spot and Black Leaf Spot *Alternaria brassicae* (grey leaf spot): (grey leaf spot): This fungal pathogen causes small and light brown or grey lesions and A. *brassicola* (black leaf spot) causes larger and darker lesions. These diseases are seed and soil borne. Small black spots (1 to 2 mm in diameter) appear on leaves, later turning into a tan colour with target-like concentric rings. When the spots dry out, the tissue falls from leaves, resulting in a ‘shot-hole’ appearance. Cool temperatures, rain and high humidity favour the development of this disease. The disease causes small brown sunken lesions and decay of Brussels sprouts

buds (several layers deep) under very wet conditions. Alternaria is a secondary fungus; it usually invades the plant after it has been injured by other pests or management practices.

Control

- Use clean, certified seed.
- Practice long rotations between *brasssica* crops
- Avoid overhead irrigation and make sure to incorporate plant debris.
- Good air circulation is needed in the field, as well as in storage. Keep storage temperature at 0°C and relative humidity at 92 % to 95%.

Downey Mildew (*Peronospora parasitica*):): Infected plants show white, hairy masses in areas on the lower sides of leaves, stems and heads. Top leaves turn purple, then yellow or brown later on. Infection is favored by wet, cool weather, especially during prolonged periods of leaf wetness.

Control

- Good air circulation and water drainage.
- Crop rotation with non-brassica plants
- Incorporating plant debris

Damping Off : There are several soil borne fungi that cause Damping off, *Rhizoctonia* and *Pythium* are two of the most common diseases of Brussels sprouts. Pre-emergence damping off occurs when seeds are attacked and decay, as well as when plants germinate, but fail to emerge. Post-emergence damping off occurs when the stem of 2 to 5cm tall plants are attacked. A water soaked area completely encircles the stem near the soil line and the seedling wilts and topples over.

Control

- Use sterilized soil or soil that has not previously had brassicas for several years
- Use treated seeds
- Planting spacing should allow for adequate light and air circulation.
- Factors such as deep planting, reduced seed vigour and excessively cold, hot, moist or saline soils that delay seed emergence should be avoided.
- Ensure adequate supply of calcium, potassium and nitrogen
- Excessive nitrogen can promote the disease.
- A field rotation with non-brassica crops should be practiced for at least three years.

Blackleg: (*Phoma lingam*). This is seed borne disease in which the early symptoms show as small spots on leaves of young plants. On the stems these spots appear more linear and surrounded by purplish borders. Stem lesions at the soil line usually extend to the root system causing dark cankers and the fibrous root system may be destroyed. This results rapid wilting and death.

Control

- Use clean, certified seed, or seed which has been hot water treated.
- This pathogen can survive in the soil for three years. Practice a 4 year crop rotation.
- Eliminate brassica weeds and thoroughly incorporate plant debris.
- Good air penetration and water drainage is critical. Maintain a dry leaf environment.

Black Rot (*Xanthomonas campestris*) is a bacterium that can live in the soil for up to one year in the absence of a brassica crop. It is usually spread by splashing rain or irrigation water and promoted by hot, humid conditions. Infection may also spread through the veins into the main stem and leaves of the head, making the product unmarketable. Symptoms first appear as lesions located at margins of leaves. This tissue turns yellow and the lesion progresses toward the center of the leaf, in a v-shaped area.

Control

- Use clean, certified seed, or seed which has been hot water treated.
- This pathogen can survive in the soil for three years.

Practice a 4 year crop rotation.
- Eliminate brassica weeds and thoroughly incorporate plant debris.
- Good air penetration and water drainage is critical. Maintain a dry leaf environment.

Insect Pests

Brussels sprouts are affected by numerous pest and many of these pests also affect other brassica crops such cabbage and cauliflower. These pests include:

- Aphids
- diamond-back moth
- Bagrada bug
- American bollworm
- cabbage webworm
- greater cabbage moth
- red spider mite
- cutworms
- Plusia looper
- thrips
- nematodes.

Control can be achieved by practicing crop rotation. Always try to keep the field clean and free of weeds as weeds could serve as a host for many pests.

Topping

This is a process whereby growers remove the terminal bud from the top of the plant. By removing the apical dominance this way the plant will reduce the energy used in vertical growth and channel it towards sprout growth and development. This will also help speed up the development of the later maturing sprouts at the top of the stem. This is usually done when the bottom sprouts have attained a diameter of 25mm. This process is especially important for processing companies who wish to harvest a crop in one harvest and to have a harvest that is relatively uniform in size.

Harvesting

The sprouts, which resemble baby cabbages, form at the base of the petiole each leaf up the length of the stem.

At maturity each plant can produce between 80 – 100 sprouts with a diameter between 2.5 and 4.0cm. This relates to a yield of approximately 1kg per plant.

The lower most sprouts start to mature the earliest and can be harvested from 90 – 95 days, these have tight clasping leaves and must be green in colour. If the outer leaves are turning yellow the sprouts are over mature. The best quality sprouts with the sweetest taste are those produces when the days are warm and sunny and the nights experience light frost. If the temperatures are too high the sprout leaves loosen and the taste deteriorates resulting in a more inferior product.

Harvesting can be done by hand or by machine. With hand picking only mature sprouts are picked by hand and placed in baskets prior to transport to the washing and packing process. This hand picking can be done repeatedly every 7 – 14 days depending on the prevailing weather conditions.

Machine harvesting involves the removal of the entire plant where the entire stem in placed in the hopper and the side shoots, leaves are stripped off and the sprouts plucked and channeled into collection bins to be washed, packed and stored. This process can be done in the cleaning and packing facility or in the field with specially designed “sprout combine harvester”.

Storage

Brussels sprouts can last for up to a month if stored under ideal conditions. Ideal storage conditions for Brusssels sprouts to maximise storage time is temperatures of 0°C and a relative humidity of 95-100%.

Cabbage
Relish the versatility

Growing cabbage

Soil
Cabbage is grown in well-drained, fertile soils which have good water-holding capacity. The variety grown should match the available soil type. White and red cabbage for fresh market use (the early varieties) are grown in light soils, autumn varieties in sandy-loam soils, and storage white and red cabbage are best grown in heavy clay soils.

Savoy cabbage varieties grown mainly for fresh market use are also grown in light sandy-loam soils, while the medium-late varieties grow best in heavier soils. Because of the risk of club-root for all cabbages, especially in lighter soils, the pH must be at least 6.5 in light and sandy-loam soils and approximately. 7 in the heavier loam/clay soils. Cabbage appreciates a humus-rich soil. The crop makes heavy demands on water management. In general the groundwater level should be at least 80 cm beneath the surface. When the water table is too high the yield is adversely affected because the resulting lack of air in the soil causes the roots to die. In light soils sprinkling will give an increase in yield. Drying out of the soil can cause stagnation in growth, reduced yield and bursting when growth restarts.

Soil preparation
When direct drilling of the seed is practiced the seedbed must be fertile and humus-rich, have a good water holding capacity and an open structure. The top layer should be finely worked to achieve these conditions. For planting out, the soil should not be made too fine. Heavy soils should be ploughed before winter while lighter soils should not be allowed to dry out. Drying out can be prevented by using the harrow or a drag to form a friable top layer. Weed-free fields are preferable. Fertilisers should be worked in shallowly before planting.

Fertilisers
Cabbage produces a mass of leaves and therefore needs plenty of nutrition. Nitrogen and potassium are given in large amounts. Excessive fertilisers applications however, especially nitrogen, increase the risk of heads bursting Fertiliser requirement depends on the level of available nutrients in the soil. A soil analysis will help in planning the correct fertiliser amounts. Nitrogen (N) plays an important role in achieving a regular growth pattern and high yields of good-quality heads. The form in which N is given will depend upon the cabbage variety. The early (summer) varieties have a short growing period and therefore need a quick acting N-fertiliser. Two applications are usually given, one before planting out and the other six weeks later. Be careful not to scorch the young leaves when applying the fertiliser. In general, late cabbages (e.g. the storage type and late savoy cabbage) are given slow-acting fertilisers.

Autumn varieties have a longer growing period and the basic fertiliser used is calcium ammonium- nitrate or a compound fertiliser. For an extra application a quickacting fertiliser can be used.

Storage cabbage must have even, not over-rapid growth. Calcium nitrate is often used; this is applied a few weeks ahead of planting-out. In general, early cabbage needs 100 - 150 kg N/ha, as basic fertiliser; autumn cabbage needs 150 - 200 kg N/ha basic fertiliser plus an extra application of 20 - 60 kg pure N, and storage cabbage needs 120 - 170 kg of the basic fertiliser and again an extra application of 30 - 60 kg pure N.

Cabbage which is harvested late in autumn can be given quite high amounts of N. Applications of 350 kg N/ha in total are not uncommon when heavy heads are required. The appearance of the crop is often a good guide to the need for a fertiliser boost. In all cases this must be given before the heads start to form. Fertiliser applications given too late in production increase the risk of bursting.

The phosphate requirement is usually fairly large, 100 - 150 kg P_2O_5 should be applied depending on the level of fertiliser present in the soil. The amount of potash given has always been considerable. When there is a heavy N application the potash requirement increases. Applications of 250 - 300 kg K_2O /ha are fairly normal.

Coated seed of White, Red and Savoy Cabbage
The raising of healthy plants is improved by the use of ‘blue coat metalaxyl’ - seed. The naked seed is film-coated with a fungicide so that improved plant

establishment is achieved as the seedlings are protected against soil-borne diseases and Downy mildew during their first weeks after emergence. Another advantage is that less fungicide is used in comparison to field spraying. Also because the seeds are bright blue it is easy to check on the sowing result.

There is no difference in the result and speed of germination between naked seed and coated seed. But 'blue coat metalaxyl' gives good disease control in the first difficult weeks so that uniform healthy young plants are obtained. If disease pressure is high observe the plants carefully and apply a corrective chemical spray if necessary.

Sowing

The tendency now is to buy seeds per count instead of per weight. The thousand seed weight per variety can vary considerably. In general early white cabbage has larger-sized, heavier seeds than the storage cabbage. The number of plants per ha becomes an increasingly important criteria. To achieve the correct number of plants it is easier to buy the seeds per count.

When e.g. 20 000 plants are needed, sow 30 000 seeds (or two seeds at once) and thin out later to achieve the correct plant density. For an early spring sowing in frames, the seedbed should be prepared several weeks in advance. The tilth can then dry and warm up.

Give the seed bed a basic fertiliser application of 5 - 7 kg 12:10:15 (N:P:K) / 100 m2. Seedlings can be raised in various ways, in most cases the seed is broadcast. Precision drilling aims at uniform seed distribution at the desired spacing and depth.

Precision drilling results in uniform plant material - this saves labour at selecting and planting out stages. Covering the seedbed with plastic foil immediately after sowing gives the emerging seedlings extra protection, this can increase the percentage of seedlings raised and can be of special interest when hybrid seed is being used. Other sowing techniques are to let seedlings be raised by specialist plant-raisers or, if the grower has the equipment, to do it himself. Seedlings are sown in modules or paper pots.

Modules are a type of seed tray with individual cells, in which a growing medium (e.g. peat mix) is pressed. Each soil 'plug' receives one seed. With special machinery these 'plugs' are taken out and planted.

For paper pots, which are usually deeper, other machinery is used to plant each individual paper pot containing the raised seedling. To save labour, time and cost, growers can drill directly in the field. The new hybrids are high in germination energy, have a uniform emergence and develop regularly. Make sure that the soil is well prepared and that precision drilling machinery is used which efficiently sows the calibrated seed. This saves labour as thinning out is then superfluous.

Sowing and planting dates

Various types of culture can be distinguished: early, medium early, autumn, storage and winter.

Early

Early cultures are preferably sown in frames, under heated glass or under plastic. Sowing can take place from February to mid-March. Planting out is then from end April to beginning of May.

Medium early

The plants can be raised in either heated or cold glass houses or in frames. The latter makes it easier to hardenoff and there is less risk of raising elongated, weak plant material. Sowing is usually in March and planting out in the first half of May. Some varieties can be used as a second crop; in this case both sowing and planting dates are later.

Autumn and storage

Although often raised in frames, direct sowing in a seedbed is quite common. Sowing is then in March and planting out end of May to beginning June. The planting out date has a greater effect on the yield than the sowing date - later planting increases the loss in yield.

Winter

White and red cabbage are harvested before winter. Late savoy cabbage can withstand winter conditions better.

Cabbage
Relish the versatility

Sowing is done in an outdoor seedbed. Direct drilling in the field at the correct plant density can also be done. Precision sowing is preferable, also in the seedbed. Sow in spring or early summer and transplant five weeks later. Just before transplanting, water the seedbed for good root establishment in the field.

Planting out
Planting out can be done by hand or machine. The latter is preferable as it is faster and the plants become established more quickly.

Plant distances vary greatly depending on the cabbage variety being grown. Over-generous spacing in combination with heavy fertiliser applications can give rise to abnormalities. As a general rule early varieties should be planted densely and autumn varieties thinly, storage cabbage in between these two extremes.

Winter cabbage again at a wider spacing. The different uses for the cabbage also affect the density. For fresh market crops, 40 000 - 60 000 plants/ha are planted out, with approximately 30 000 - 40 000 plants/ha for storing purposes, and approximately 25 000 plants/ha for industry. Late savoy cabbage is spaced at 30 000 plants/ha for fresh market use.

Weed control
Weeds can be controlled chemically or mechanically. However, please note that savoy cabbage is somewhat sensitive to such active agents as propachlor, desmetryn and metazachlor. Weeds in the seedbed can be controlled using propachlor shortly after sowing and before emergence. The weed killer has a better effect on a moist soil. Propachlor is used similarly on the production field.

Pests and diseases
Several sorts of insects attack cabbage crops. The following is a descriptive list of the most important pests. For control of these ask your local pesticide agent to advise you on the appropriate insecticide for your problem.

Weevils (*Ceuthorrhynchus* specs.)
These beetles lay their eggs in the plant. The damage is caused by the developing larvae. The symptoms can be galls on the root-neck as with the gall weevil (*C. pleurostigma*) or galls on the growing point whereby this is often destroyed (*C. rapae*).

Leaf roller
These highly active maggots attack the leaves and spin them together.

Cabbage moth (*Plutella xylostella*)
The cabbage moth in its larval stage eats numerous (small) holes in the leaves. Many insecticides can be used to control this larvae but not all chemicals are suitable for all types of cabbage so read the instructions carefully before spraying.

Cabbage root fly (*Delia brassicae*)
The cabbage root fly lays its eggs in the soil round the base of the plant from the end of April to October. The maggots which hatch out attack roots and stems. Serious attack may cause loosening of the plant in the soil and it will eventually fall over. Another symptom is that the leaves first stand erect with a leaden colour and then wilt during the day.

Cabbage gall fly (*Contarinia nasturtii*)
Typical of attack by cabbage gall fly maggots is the spiral turning of the leaves around the axis of the plant, often the heart is destroyed and side shoots start to form. Control measures should start at the end of May when the eggs are laid.

Mealy cabbage aphid (*Brevicoryne brassicae*)
This can cause serious damage to the crop, especially in warmer regions. If necessary start preventive measures in the seed bed. It is important to regularly inspect the field and follow this up by the necessary control measures.

Storage
White and red cabbage storage hybrids can be stored from a few months to more than six months. Storage takes place under controlled conditions. Storage temperature should be between 0 and 1 °C with a relative humidity of 90%. Savoy cabbage can be stored up to three months. The temperature in the cool cells should be between 0 and -1 °C.

Carrots
Get a dozen for a dime

Growing carrots

Introduction
Carrots can be grouped according to their presentation on the consumer market. The Nantes forcing types are mainly used as a washed, bunched product with foliage for the fresh market. The use of finger carrots for the industry is also seen. The larger Berlicum and Flakkee types are mainly used for slicing, dicing and dehydrating purposes but here again we see these types used for the fresh market after storage. All year-round production is therefore possible.

Depending on its market use we have to choose the right variety and the correct sowing density. Dense sowing gives slender carrots while wide spacing gives large carrots. Planning the correct sowing date and staggered sowing can give a harvest when the market wants it and at the same time help us to use the labour force efficiently. Harvest requires intensive labour compared to labour needs throughout the culture.

Soil
Carrots demand more of the soil than is usually the case. Soils should be free of stones, well drained, capable of good moisture retention, rich in potassium and magnesium, without any obstructing hard layers, it must not be not prone to forming a surface crust and not too heavy. This means that deep sandy-loam to clay-loam soils which are well penetrable are the most suitable. If these soil types are not available, then good soil preparation is essential. Making ridges will help, especially for the later, larger-sized varieties. On heavier soils raised beds will help the production of Nantes types.

Do not give organic matter before sowing as this could result in branched roots and excessive foliage development. However, soils without any organic matter are also to be avoided as their structure and texture are detrimental to good root development. Therefore give organic material several months in advance and grow crops that use up a great deal of nitrogen and loosen up the soil prior to carrot production. Use clean and healthy soils. Treat the soil with a chemical to avoid soil-borne diseases but do not do this immediately prior to sowing carrots. It is better to grow another crop in between to lessen the negative effects of the soil treatment. A crop rotation of one in four is advisable. Soil pH should be 5.8 - 6.5. Best soils are sandy-loam soils with a good consistency which keep their structure despite the use of heavy machinery. The top soil layer should have good moisture retention and good drainage.

Soil preparation
Plough deeply to break up any root-obstructing firm layer in the soil and harrow the top layer at least twice to obtain a fine seedbed. Making raised beds and ridges has already been mentioned. In order to firm the ridges they should be prepared well in advance so that the soil can settle. Use a roller to help this process.

Ridges are made at a distance of 50 cm for one-row sowing and 75 cm for tow-row sowing. The general trend in South Africa is however to sow on beds 1.2 -1.8 m wide, with several rows on each bed. Give inorganic fertilisers before preparing the soil to avoid a salt concentration in the soil which is too high at time of sowing.

Fertilisers
The need for nitrogen (N) is relatively low. Just before sowing apply approximately 70 - 80N/ha. When N deficiency becomes apparent during the culture (e.g. through leaching) then a corrective N top-dressing can be given.

When soil analysis shows the soil to be in good condition apply phosphate, potassium and magnesium one month before sowing. Under these conditions an application of 75 kg P205 /ha, 200 - 250 kg K20/ha and 80 kg MgO/ ha should be sufficient. MgO is quite often given in a combination with K20. When the soil is shown to be too acid incorporate lime into the dry soil at least 3 - 4 months before sowing.

Sowing
Carrots are always sown by means of direct drilling. Today carrot seed is calibrated to fit the pneumatic precision sowing machine so that the correct density is achieved immediately. To prevent damage from e.g. carrot fly this seed is also available in a coated

form. This coating makes the seed dust-free ensuring an uninterrupted sowing process. At the same time an insecticide and fungicide are added to the coating for trouble-free emergence of the seedling.

We can therefore supply carrot seed as naked seed, calibrated seed and calibrated coated seed. The calibration fractions lie between 1.25 mm and 1.75 mm. Carrot seed is available in weight units (e.g. per kg) or as number of seeds (e.g. 10 000 seeds, 100 000 seeds or 1 000 000 seeds). If sown too early there is a chance of bolting due to cold conditions unless precautions are taken in the form of sowing under frames or foil to raise the soil temperature. The risk of bolting is greatest when the young plant reaches the 5-8 stage.

Sowing rates vary according to the type of carrot which one wants to produce. The method of growing (level, beds, ridges) and the sowing machinery used also influence the sowing rate. However, in all cases, the sowing depth is 1 - 1.2 cm in a seed bed which is low in salts. Carrots are sensitive to a high salt concentration at germination.

When we know what the plant density should be, we can calculate the sowing rate. Nowadays the sowing rate is usually expressed in number of seeds /ha instead of kg/ha. Please bear in mind the field factor which influences the rate of emergence in the field. The field factor depends on local conditions more than anything else. If it is found to be 70% we have to sow 770 seeds /m2 to obtain the plant density of 540 required for early carrots. The sowing methods also depend on the planned harvest method. Raised beds are laid out in such a way that a tractor-mounted harvest machine can lift the roots.

Normally the beds are 1.5 m wide, consisting of eight rows and a distance in the row of 2 cm. Sowing rate on the two outer rows of the bed is increased by 15% as there is more room for expansion on the edges of the bed. For sowing on ridges there is the one-row method for the larger carrots and the two-row method for the Nantes types. The top of the ridge is given a 15 cm wide, flat top in which two rows are sown, 7 cm apart. Finally we would like to draw your attention to spacing the sowings. Sowing at two-weekly intervals, from early spring till summer, using the right varieties will ease the workload and ensure a continuous supply.

Weed control

A combination of chemical and mechanical weed control should give the best results. Excessive chemical use may cause weeds to become difficult to control. For broad-leaf weeds use metoxuron on soils which have more than 20% silt and 2% humus between sowing and one week after sowing. Chlorbromuron and linuron can be used before emergence of the carrot seedlings and until the carrot seedling reaches the 2 - 4 true leaf stage.

The use of a surfactant in combination with the above herbicides will reduce the surface tension, resulting in larger, wider droplets, thereby increasing the effect without increasing the dosage rate. Inter-row applications are preferable in order not to damage the young carrot plants. Earthing up the ridges can control the weed problem and also prevent greening of the carrot tops.

Diseases

Carrot fly (*Psila rosae*)

The larvae of the carrot fly eat their way into the carrot, starting at the base but later working their way up. Eventually the carrot is disformed with sunken, browncoloured, constricted rings and dried-up foliage. The carrot fly can reach three metamorphoses in a year and is controlled by treating at larvae stage.

Control:

- Use treated, coated seed.
- Incorporate chlorfenvinphos or carbofuran into the soil before sowing at 10 - 15 cm depth for three months control.

Carrot miner fly (*Napomyza carotae*)

The larvae eat their way in at the foliage inplant after starting in the leaf stems.

Control:

- No chemical control possible.
- Earth up to cover the top of the roots.

Cavity spot (*Pythium* spp.)

Rotting spots on the carrot. Caused by an anaerobic situation in the soil.

Control:

- Improve soil structure with good drainage.

- Lower plant density under wet soil conditions.

Leaf spots *(Alternaria dauci*)
Grey-black longitudinal spots on the leaves, sometimes with a yellow centre or border. The leaf points turn black and eventually the whole leaf. This disease develops well at 20 °C in older leaves.
Control:
- Keep the growth in the plant to have young, strong leaves.
- Spray with iprodione when first symptoms appear. Repeat every two weeks till four weeks before harvest.

Sclerotinia rot (*Sclerotinia sclerotiorum*)
Spores from apothecia (minute fungi) at surface level are ejected, and settle on tissue, resulting in rotting at inplant and top of the carrot.
Control:
- Spray vinchlozolin preventative before heavy leaf development to destroy the apothecia.

Black spot disease (*Stemphylium radicinum*)
Round irregular spots with a clear border on the root, close to the top. Tissue becomes green- black to black and rots away.
Control:
- Use coated, treated seed (treated with iprodione).

Storage diseases
In storage infected, weak carrots, can be attacked by various secondary diseases such as *Botrytis, Sclerotinia*, etc.
Control:
- Store only healthy carrots.
- Store under condensation free conditions.
- Spray carrots with iprodione before storing (e.g. on the conveyor belt).

Harvest
Harvesting in cool, wet conditions can cause problems for storage carrots. However, a harvest in dry weather will yield carrots with less tare. In general two harvesting methods are used, as well as hand lifting. One method is root lifting, the other top lifting.

In the root lifting method the machine cuts underneath the roots, lifting them in the following operation. Sorting and cleaning then takes place, usually in the shed, after which the end product is packed. Top lifting is done by either one row or multi-row machines. Here we should choose varieties with a strong leaf attachment. Sometimes a mowing operation of the foliage can be considered, taking care not to damage the carrot top. Root lifting completes the operation. Another possibility for late varieties is to postpone the harvest and cover the crop in the field with straw against frost. Harvest can then take place later.

Please ensure that Nantes types are harvested when they are fully matured to avoid roots splitting after harvest. The later larger-sized carrots can be harvested at a more immature stage. Handle the carrots carefully to prevent any damage. Reduce the dropping height as much as possible to ensure healthy, disease-free carrots.

Storage
Washed carrots should never be stored. Storage of carrots is normally restricted to the later types. After harvesting, store the unwashed carrots under controlled conditions The soil adhering to the carrots will prevent them drying out and act as a shield.

When stored under ventilated conditions, maintain a temperature of 2 - 3 °C at a relative humidity of 90 - 95% in order to prevent condensation. Air-conditioning will give better results. Cool down to 0 - 1 °C with 90 - 95% relative humidity.

Carrots grown in light soils are less suitable for storage than carrots from a heavier soil. Syngenta has exercised the utmost care in compiling this brochure.

The data should however be handled by the user in accordance with his own knowledge and experience of local circumstances. We therefore cannot accept any liability in connection with this brochure.

Cauliflower
Essence of elegance

Growing cauliflower

Soil
Cauliflower must be able to grow in undisturbed, cold, wet soils and those liable to dry out are unsuitable. For early cauliflower, light, early soils are most suitable; for summer and autumn cauliflower, sandy- loam with good water-holding capacity and light clay soils are preferable. The risk of clubroot is greater on sandy soils than on heavier soils. For sandy soils a minimum pH of 5.6 is advised.

In spite of its deep rooting, cauliflower makes heavy demands on the water management. Growth stagnation can easily arise during a period of drought. It is therefore recommended to bring the upper 20 - 30 cm up to field capacity directly after planting. In general the following irrigation has to take place after formation of the sixth or seventh leaf. The amount of water used increases with the increase of leaf surface. As a result, a steady increase of water use, can be observed from this stage onwards. A shortage of water, which will result in growth stagnation, can now become a risk.

The plant must be able to make sufficient foliage, because the size of the head is dependent upon the leaf mass. Good plant development can only take place when the plant can grow undisturbed. Therefore growth stagnation should be avoided.When the soil is not completely covered by the plants an irrigation of 20 - 25 mm can be given when approximately 60% of the available water on sandy soils is used. For sandy-loam and clay soils the irrigation should be given when approximately 40% of the available water is used.

A remarkable increase of water use again can be observed when the soil is almost covered and when head formation starts. Good water management in this period can improve the quality and grading enormously. On sandy soils irrigation should take place when approximately 20% of the available water is used. On sandy-loam and clay soils the irrigation should take place when approximately 25% of the available water is used. Irrigation has to take place till the moment of harvest if there is no natural rainfall. The largest amount of water will be needed during the weeks in which the head is formed, and in this period the plant is very vulnerable. Dehydration during this period results in poor quality at sorting and browning of the heads. Bracting can occur when head formation takes place during a warm and dry period. It is also possible that loose heads are formed. This is most probably the result of explosive growth, which can occur after a drought period when it either rained a lot or after an abundant irrigation and due to this a high amount of fertilisers are released. On fertile soils it is recommended to apply top dressings depending on the stand of the crop. When head formation takes place during a warm and dry period it is also recommended to irrigate in small quantities on a regular basis.

A good rotation scheme for cauliflower is 1 - 4. Especially on clubroot sensitve soils this rotation scheme should be practised. Cauliflower should never be planted after another brassica crop. When rotation is not practised the risks of clubroot, *Leptosphaeria maculans (Phoma lingam), Rhizoctonia solani* and nematodes increase dramatically.

Growth and development
After germintion and cotyledon-stage the first true leaf is developed. Under good growing conditions it takes two weeks between initiation of a true leaf to become visible. During plant propagation approximately 15 leaves are initiated of which 4 - 5 are larger than 1 cm at the moment of planting.

After planting the initiation of new leaves stops for a short while. When the plant has established itself, after planting initiation of the new leaves, it starts again and will continue for approximately
5 - 6 weeks. Competition between the plants starts when the first leaves have reached a maximum size, when planted at a distance of 75 x 55 cm.

When the total number of leaves stays stable head formation starts. The total number of leaves varies between varieties. In the juvenile stage of the plant, this is till the initiation of approximately the 18th - 20th leaf, no head formation can occur (approximately three weeks after planting). After this period head formation can start. Initiation of head formation is very much dependent on temperature. Higher temperatures will delay the head formation.

Cauliflower
Essence of elegance

Growing days and harvest period
It is essential to know the number of growing days to ensure good harvest planning. To avoid the plants of a late fall crop dying off due to frost before harvest one has to take the growing period into account. Late varieties have to be planted early while early varieties can still be planted on a later date.

A concentrated harvest is preferred otherwise the grower has to go through the crop many times to cover the heads and to harvest.

Head protection
The better the self-protection is of a variety, the less labour is needed for covering (protecting) the heads. Covering the heads from the light is a must to harvest white heads. When covering is not done well, the heads will discolour and turn yellow and/or red.
To be able to cover the heads of varieties which do not have a good or enough self-protection the plant should develop enough leaves under all circumstances.
The leaves also give the heads some protection against other bad weather conditions.

Premature head formation can occur in summer crops when plants do not develop enough leaves. Leaves may not break off when covering the heads and when harvesting. An erect plant habit with non-brittle leaves is therefore preferred.

Sowing
Syngenta market normal and precision cauliflower seed. The normal seed has a minimum germination of 80% while the precision seed is graded at 0.25 mm per grading and has a germination > 90%. Both types of seed can be delivered with various seed coatings against pests and diseases. Cauliflower seed does not germinate below 3.3 °C. The optimal germination temperature ranges from 15 - 21 °C.

A traditional method is to sow in a seedbed and later transplant out at the required distance. However, new techniques and methods are developing rapidly. Other sowing techniques are to have the seedlings raised by specialist plant-raisers or, if the grower has the equipment, do it himself. Seeds are sown in modules or paper pots. Modules are a type of seed tray with individual cells in which a growing medium (e.g. peat-mix with pH-KCL of > 6) is pressed. Each cell receives one seed. With special machinery these 'plugs' can be taken out to be planted. With paper pots, which are usually deeper, other machinery is used to plant out the individual paper pots containing the raised seedlings.

Extra early sowing
Depending the climatic conditions these sowings can take place under very cold outside conditions. Where growers have heated glass at their disposal sowing can be carried out in mid winter, at a temperature of 15 °C. After emergence the temperature is reduced to 10 - 12 °C to avoid spindly seedlings. Temperatures below 8 °C during the young plant stage should be avoided as this can cause non-heading plants. Plants should be as well hardened off as possible by planting-out time. Planting out takes place when soil and weather conditions permit.

Summer cultures
For summer culture cauliflower can be sown from the begining of spring onwards. The greater possibilities for ventilation make frames more suitable for raising plants than Dutch lights. 2 - 2.5 g seed/m^2 will be needed, thin out to 250 plants/m^2. When plants are 2 - 3 weeks old the glass or plastic can be removed, depending on the weather conditions. In this way well-hardened plants can be planted out 4 - 4.5 weeks after sowing. (Plants of this size are also suitable for machine planting.)

Autumn and winter cultures
For these cultures the plants are raised in an outdoor seedbed. Sowing is done in the first half of June in the northern hemisphere and mid-December in the southern hemisphere. The plants must be planted out at five weeks. It is perfectly possible to sow the autumn and winter cultures directly in-situ. This avoids the growth stagnation which occurs at planting out. High demands are made of the seedbed. It must be fine, even and firm, particularly for machine drilling.

Cauliflower
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Planting
Planting can be done by hand or by machine. There are various types of planters available. The different brands of planters are often made to plant plants propagated in a specific module type. The choice of planter therefore influences the type of module used for plant propagation. For extra early and early crops a planting distance of 75 x 50 cm (26 000 plants/ha) is mainly used. For summer and early autumn crops a planting distance of 75 x 55 cm (23 000 plants/ha) is used and for late autumn and winter crops 75 x 60 cm (21 000 plants/ha).

For growing baby cauliflower a plant density of 50 x 30 cm (66 000 plants/ha) can be used. Just before planting, the plants should be well irrigated, some nitrogen can be added to the irrigation water.

By covering the crop after planting with a perforated plastic film or Agryl film the extra early and early plantings can be harvested up to 10 days earlier. The covering also protects the plants against bad weather conditions and frost which increases the quality of the heads.

Crop planning
Crop planning is necessary to make the most efficient use of all production factors. Labour and land are in general the limiting factors when growing cauliflower. To be able to plan, it is important to know the average number of growing days of each variety uses as well as the number of days needed for plant propagation when one produces its own plants. Besides it is important to know the reaction of the varieties in different times of the season, they need more or less days to grow.

An important issue for planning is to know when frost can be expected as cauliflower is very sensitive to frost at the moment of harvest.

A grower can use three different ways to plan:
1. Use of different varieties with a different number of growing days and sow at the same time
2. Use one variety at different sowing times
3. Combination of 1 and 2

Crop planning is also greatly influenced by weather conditions which are not in our control.

Fertilisation
Fertiliser requirements depend upon factors such as soil type, previous crop, organic fertiliser, variety grown, etc. A good fertiliser programme can only be given on the basis of soil analysis.

Nitrogen
Nitrogen (N) feritilsation is critical for cauliflower as it needs to grow steadily. Not enough results in yield losses and poor quality, while too much will give no extra returns and is bad for the environment.

Cauliflower has a fairly large N-requirement (200 - 250 kg N/ha). Applications are therefore necessary and are usually given 3 - 4 and 6 - 8 weeks after planting. In the summer N is often given in the form of calcium ammonium nitrate as this is slower acting than calcium nitrate. The nitrate form is preferable in the autumn. As a rule, winter cauliflower is given no nitrogen before the winter and only just after winter when regrowth starts a heavy application is applied.

Phosphate
A phosphate (P) application has a favourable effect upon crop growth and head quality. When the P-level is low an application of 100 - 150 kg $P_2 0_5$/ha can be desirable. The phosphate fertiliser is usually given before planting out when the soil is finally worked.

Potassium
Cauliflower is sensitive to chloride. It is therefore advisable to use single fertilisers. The potassium need is fairly high; 200 - 300 kg $K_2 0$/ha and is given before planting.

Magnesium
The availability of magnesium for the plant can be influenced by the amount of potassium in the soil. When magnesium levels are good to low and potassium levels are high to very high one should increase the magnesium application by 50 - 100 kg/ha. A total application of 50 - 150 kg MgO/ha will be sufficient.

Cauliflower
Essence of elegance

	N	P_2O_5	K_2O	MgO
Before planting	75 - 100	100 - 150	200 - 300	30 - 100
1st top dressing (3 - 4 weeks after planting)	75 - 100			20 - 50
2nd top dressing (6 - 8 weeks after planting)	50			
Total	**200 - 250**	**100 - 150**	**200 - 300**	**50 - 150**

Fertilisation scheme

Boron

Boron is essential for cauliflower. A deficiency causes browning of the head, at the same time double heads are possible. Boron deficiency can be prevented by sprinkling 15 - 20 kg Borax 10%/ha.

Molybdenum

A molybdenum deficiency causes twisted leaves, called whiptail, resulting in no heading. This deficiency disease can be prevented by applying 20 g ammonium molybdenum/m3 potting soil or 1 g/m2 in the seed bed. If not sufficient, spray young plants with 2 g in solution /100 m^2 as a foliar spray.

Harvest

In general 75 - 90% of the plants give marketable heads. During warm weather conditions it is best to harvest cauliflower early in the morning.

Cauliflower is harvested by hand, costing a great deal of time and labour, particularly because of the covering and the fact that cutting is done over a period.
There are two methods of cutting:

- the whole crop in the field;
- cropping in the field and trimming for market in the shed.

There are all sorts of variations on both methods, these differ from region to region. The cauliflower must be harvested before it grows away at the sides. The correct time for cutting depends upon the condition of the crop, the market situation, the price etc. At cutting the head must be neither grasped nor placed one on top of the other. Finger marks and bruising always result in brown staining after a couple of days. When the heads have to be transported over a long period and distance then it is better not to remove the surrounding leaf. These leaves provide excellent protection. Weed control can be done mechanically and with chemicals. In the production field glyphosate, paraquat and glufosinate ammonium can be used. Sometimes a combination of paraquat and diquat gives a better result than paraquat by itself. Herbicides which are registered for application in cauliflower against broad-leaved annual weeds are metazachlor and propachlor. For use of all chemicals it is advisable to contact your local agrochemical supplier.

Diseases and pests

Various strains of Altemaria, Leptoshaeria, Thanatephorus (*Rhizoctonia*) and Botrytis can cause damage during seedling stage. During growth in the field guard against fungal and bacterial diseases:

Mycosphaerella brassicicola (ringspot)
Alternaria brassicae and Alternaria brassicicola
Peronospora parasitica (downey mildew)
Leptosphaeria maculans (Phoma lingam)
Plasmodiophora brassicae (clubroot)
Albugo Candida (white rust)
Xanthomonas campestris (blackrot)

Most common pests are:

Phyllotreta species
Contarinia nasturtii
Aleyrodes proletella
Delia radicum (cabbage fly)
Pieris brassicae, Pieris rapae, Mamestra brassicae, Plutrella xylostella (caterpillars)
Brevicoryne brassicae (aphids)
Ceuthorrhynchus pleurostigma, C. rapae, C. quadrudens

Of the soil diseases some nematodes can cause damage in cauliflowers:

Heterodera schachtii (beet cyst eelworms - nematodes)
Heterodera cruciferae (cabbage cyst eelworms - namatodes) *Ditylenchus dipsaci* (nematodes)
(These guidelines also apply to Broccoli)

Cucumber
The hydrate delight

Growing cucumbers

Tunnel Cucumbers in South Africa

Information Package on Basic Principles

The tunnel cucumber field is perceived to be very technical and only for the specialist. To a degree this is true but this information package addresses the principles for successful production and addresses the details at growers' level.

The knowledge of specialists in every field - especially those from the AIPP at Stellenbosch University - should also be used to get an even better understanding of the challenges and the solutions. (www.sun.ac.za/agron)

1. Environmental parameters

a. Radiation or light

Sunlight provides the energy which drives the plant through photosynthesis. Excessive light can damage the photoreceptors in the leaf, thereby inhibiting the factory of the plant and limit photosynthesis. The more common situation is that light levels are too low with- in the plant canopy where the action takes place usually a function of overcrowding or incorrect pruning of the plants. The net effect of this is that the plant becomes a net user of sugars rather than a net producer of them. The leaf is in effect competing with the rest of the plant-fruits, growing points, flowers, etc. for the sugars and therefore production suffers.

b. Temperature

In general growers try and manage temperature and it is often blamed for a lot of the problems that they face daily. While temperature is important it is actually humidity that plays a bigger role in successful production. In broad terms the temperature regime should be aimed at

Night	18 - 20 °C
Day - Winter	21 - 22 °C
Summer	28 - 30 °C

Temperature in general affects the growth rate of the plant. Low temperatures will slow growth and the plant takes longer to come into production. Abnormally-low temperatures or long periods of low temperature can have the following effect on plants:

- Reduced metabolism and translocation
- Low and possibly abnormal photosynthesis
- Reduced water and nutrient intake - even more so when the root zone is cold.

High temperatures on the other hand can cause the plant to grow too fast and burn it out:

- Negatively influence the respiration of the plant, energy is required and sugar is used
- Fewer sugars available for growth, flowering
- Production suffers

Plants cool the leaves by losing water - evapotranspiration. If temperatures exceed the lethal limit or plants are unable to lose water for prolonged periods plant tissue is damaged.

c. Humidity

The water vapour content of the atmosphere surrounding the plant has a profound effect on many of the plant processes. The plant loses water through the pores in the leaves -stomata. This process helps to cool the leaves and the water moving through the plant from the roots provides the pathway for the nutrients to be relocated. Water is lost from a high-to-low gradient, the outside is drier than the air within the stomata and evapotranspiration takes place. If the outside is of similar or higher humidity, little or no movement will take place as the stream of water is interrupted. Cooling cannot take place and nutrient flow is slowed or stopped. Nutrient deficiencies- especially calcium occur and growth is negatively influenced. A similar effect takes place when the outside is too dry and no gas exchange takes place.

Other effects of high humidity are:

- Soft leaves which are more susceptible to diseases
- Increased incidence of DM and ALS
- Spiny fruits

The ideal Relative Humidity (RH) should be 70 - 75%.

2. Irrigation

Fully-developed crops of cucumbers can use in excess of 5 - 8 litres per plant. Water is frequently supplied throughout the day and the art is to manage the needs of the crop on a daily basis and not to follow a pre-set programme that is not in touch with the daily occurrences.

A recently-transplanted seedling uses far less water than a full-grown plant. If the same amount is released for the younger plant the first would be wastage but it could also lead to water logging and this results in root diseases, which could be ill-afforded in a new crop. The better method is to irrigate until a runoff of 10 - 15% is visible from the bottom of the bags, irrespective of the amount of water applied. The water usage is therefore replaced and plant needs are kept in balance but it needs more management input.

3. Basic fertilisation

The simplest way of feeding tunnel cucumbers is through irrigation. All irrigation is done with a nutrient solution of which various options are available from specialists. The fertiliser is either made up as concentrations and blended in the water line by way of injector pumps or is made up as a dilution and used to irrigate the plants. The EC (electro conductivity) should be around 1.8 - 2.4 ms/cm and always allow for a runoff of 10 -15% to leach out excess salts and prevent the EC in the bag from reaching lethal limits. It is a good idea to periodically flush the system to prevent salt build-up but the practice should never alternate fertigation with clean water. This will only lead to salts washed out of the system before the nutrients can be taken up by the plant.

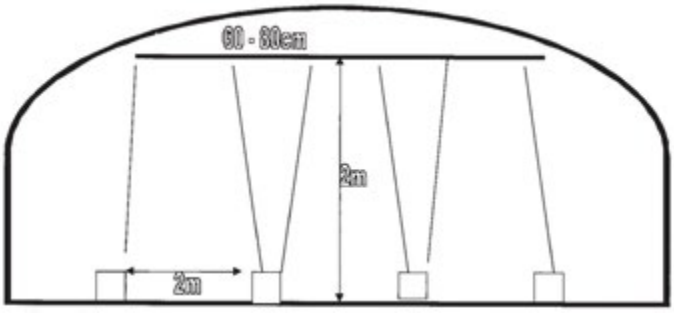
4. Seedlings and transplanting

Seed is usually sown in trays of 72, 98 or 128 cavities at temperatures of 26 - 28 °C. The medium should be clean and well drained. The mix could be made of bark like commercial seedling growers or when seed is sown directly into the bag the same sawdust that will be used in the commercial planting. Peat and perlite are also used as they have good water-holding capacity. Chemicals to protect against damping off is normally added as a drench.

Once the cotyledons are fully expanded (5 - 10 days) the seedlings are transplanted into the growing bags filled with wood shaving, peat or perlite. Be careful when sawdust is used as the tannins could burn the seedlings. Between 3 - 4 weeks from sowing the plant should be developed between 5 - 8 true leaves. The plant is now strong and can easily be moved to the production tunnel. Alternatively the seedling could be moved after transplant or sown directly in the production tunnel. The availability of available tunnel space will in most cases call for the correct action.

5. Spacing

The spacing used varies from grower to grower and between seasons but a general guideline of between 1.6 - 2 plants/m2. Too low a population will reduce the return per area, but too high a population causes a great many management headaches. The canopy will be too dense, making working with the crops difficult and possibly leading to more disease pressure in the tunnel and reducing light penetration. Leaves receiving too little light cannot produce sugars and so the production drops. Flowering is reduced and fruit is aborted.



A plant spacing of 1.6 plants/m2 is standard for the typical 8 x 30 m plastic tunnels. Numerous configurations are possible and each grower has their own solution.

6. Pruning and training of the Cucumber Plant

Cucumbers are a vine crop and need to be supported - whether it is the long cucumber or short / gherkin cucumber. The plants are trained up a string to an overhead wire or cable. The training system should evenly space the plant canopy over the available area of the tunnel to maximise ventilation and light penetration - typical Y format fits best in most tunnel systems. A good pruning system aims to maintain a good balance between vegetative growth and fruit set. All growing points - shoots, leaves, flowers and fruits - compete for a limited pool of resources. Fruits are the strongest competitors at the expense of the rest of the plant. A heavy fruit load therefore reduces the ability of the plant to set new growth and limits the production.

The umbrella system described below is an easy system to understand. These principles are easy to implement. It provides the correct balance and also provides for continual production of new shoots and flowers. The steps are:

i. All side shoots. Flowers and fruits are pruned out for the first about 80 cm from the medium (bag), this gives the plant sufficient time to channel all the energy into the shoot growth.
ii. From about 80 cm to the wire/cable fruits are allowed to set on alternate nodes. ('1 on, 1 off'). All side shoots are pruned off until at the wire/cable where two are allowed to develop and form the primary laterals which are trained over the wire/cable and allowed to hang down.
iii. Just above the wire the main stem is pruned off. This promotes the growth of the primary laterals.
iv. The strongest two laterals are allowed to develop and the rest are pruned out. In the same way the tertiary laterals are allowed to develop from the secondary laterals.
v. While the fruit matures on the main stem and primary laterals the secondary laterals are allowed to develop.
vi. This cycle is continued until disease pressure or economy forces a new planting.

Many growers over-emphasize the main stem fruit and force a fruit from each node, not realising that this places great strain on the resources of the plant. The result is that growth slows down as the plant goes over the wire and most of the fruitlets are aborted. The natural reaction then is to focus their attention on the nutrient levels but the damage has been done and the results are less production and even higher costs.

A factor that is often neglected in cucumbers, as is the case in tomatoes is to remove unmarketable fruit. Any curved, insect or wind-damaged fruit should be taken off the plant as it competes for the limited resources.

7. Disease

a. Powdery mildew

i. High humidity with warm temperatures ii. Common in summer

b. Downy mildew

i. High temperatures with humidity ii. Free water on leaf surfaces
iii. Condensation can lead to DM

c. Botrytis

i. High humidity ii. Free water
iii. Enters through wounds

d. Angular leaf spot (ALS)

i. Warm temperatures ii. Wet condition
iii. Not to be confused with DM

e. Phytium

i. Waterlogged bags

8. Pests

a. Whitefly
b. Thrips

9. Sanitation

Maintaining a clean environment around the plants and the structures can go a long way in making a crop a successful crop and a productive effort. The following points could assist in making a difference:

a. Use varieties with open habits - easier to work in and more air flow for ventilation.
b. Restrict the number of workers per tunnel. Always

use the same person(s) in a tunnel with dedicated tools per tunnel.
c. Sterilise tools, boots, wash hands regularly. d. Avoid free standing water.
e. Use new or at least sanitised bags for new crop. f. Control weeds in and around tunnels.
g. Clear tunnels quickly after crops are terminated to prevent disease build-up.
h. Clean and sanitise the tunnel before the new crop is put into bags in the tunnel.
i. Burn old plants / diseased plants immediately - do not let them lie around the farm. j. Cover doorways and ventilation openings with insect screens.
k. Remove fruits timeously to prevent secondary infections.

Growing pickling cucumbers

Soil

Pickling cucumbers can be grown in nearly all types of soil providing aeration and drainage are satisfactory. The pH should be between 6.0 and 7.5. Lighter soils, friable to below the root system and rich in organic matter, have preference over heavy soils. When cucumbers are grown on the same land several times in succession there is an increased risk of attack by Phomopsis sclerotioides (Black root rot). A crop rotation of at least one in four is therefore advisable.

Fertilisers

Uninterrupted and well-balanced growth is important in a pickling cucumber plant production. An even and regular supply of nutrients is therefore necessary.

Organic fertiliser

Experience shows that pickling cucumbers react well to organic fertilisers as these improve the structure of the soil. An application of farmyard manure of up to 50 t/ha or chicken manure up to 20 t/ha is therefore recommended.

Applications exceeding the above amounts may increase the salt concentration in the soil too much. Organic fertilisers should be incorporated well in advance of sowing or planting, toprevent the possibility of burning the roots.

Nitrogen

Pickling cucumbers need about 130 kg nitrogen (N)/ha during its production. 80 kg N/ha should be given as a basic fertilizer and 50 kg N/ha as a total top-dressing. The top- dressing should start after the very first harvest and be repeated every 14 days. Apply the top- dressing on a dry crop. Too much nitrogen in the soil at the start of the culture produces over- vigorous plants which in turn will reduce the yield. Please bear in mind that a correct application of fertilisers will be greatly influenced by the state of the soil and its available nutrients. Soil analysis, regularly repeated, will prove useful.

Phosphate

Phosphates (P) are extremely important for a fruit-bearing crop such as pickling cucumbers. Depending on the P-level in the soil 150-250 kg $P_2 0_5$ /ha is given in the form of a compound fertiliser or superphosphate.

Potassium

The need for potassium is high. 150-200 Kg K 0/ha should be sufficient for a soil with an adequate K-level. When cultures are taking place over a long period it is recommended to split the application in two.

Pickling cucumbers are sensitive to chlorine. Please use fertilisers which are free of chlorine. Otherwise apply the potassium well in advance of sowing or planting to reduce the risk of plant damage.

Magnesium

The need for magnesium (Mg) with pickling cucumbers is fairly high. Symptoms of magnesium deficiency are yellow leaf edges and spots on the leaves. Magnesium deficiency can cause the crop to be susceptible to secondary diseases.

Pickling cucumbers need about 50 kg MgO/ha. Application can be in the form of a magnesium fertiliser or in a compound fertiliser (e.g. with a nitrogen fertiliser mixture).

Sowing

Direct sowing.
Pickling cucumber plants are sensitive to cold conditions. To prevent problems at emergence sowing should not

take place before the soil temperature reaches 12^{0}C.

Raising young plants

By using young plants, raised under protection, harvest can be expedited by about two weeks. Raising takes place in 6 cm^3 or 8 cm^3 soil blocks. Two seeds are sown in each block. The young plants can be set out 2 - 3 weeks after sowing. Its development stage should be at minimum two and maximum three real leaves. Setting-out should only be done when there is no longer any risk of night frost. When planting out the young plants, soil should cover the stem up to its first leaf as roots will develop from this stem.

Growing systems

Flat culture

The most widely-used method is still the flat culture. Optimal plant density is 30 000 plants per ha. (250 cm x 13 cm). During the culture it is necessary to lay out, regularly, the runners over the available space. Avoid damaging these runners during the culture as this will stop the fruit setting. Even raising the runners at harvest can interrupt growth.

Vertical culture

Vertical culture has some advantages over a flat culture:

- higher yields are possible
- fewer disease problems
- fruits remain clean
- easier and quicker picking at harvest.

Optimal plant density is about 30 000 plants/ha at a distance of 150 cm x 20 cm or 135 cm x 25 cm.

Practice has shown that a vertical culture can be erected as follows:

- a pole at 3 m intervals
- bottom wire at 15 - 20 cm
- upper wire at 1.5 - 1.8 m
- vertical wire at 20 - 25 cm tied to upper and bottom wire.

The runners, from 50 cm length onwards, should be guided upwards along the wires. As they grow longer, they should be guided through the mesh at least once a week and, when grown under favourable conditions, sometimes twice a week. When the runners reach the upper wire, they should be tied and guided down the wire structure. Beware of damaging the runners.

Trimming

The bottom runners can be trimmed when significant ageing is seen. If the crop grows too vigorously some bottom leaves can be cut out to restore the balance.

Pollination

The placing of one or more beehives is recommended. Through the bee activity, pollination will be improved resulting in a lower percentage of crooked or otherwise-misformed fruits. Please remove the beehives temporarily when a pesticide is sprayed. Parthenocarpic hybrids will set fruit without the use of bees.

Foil

The use of plastic foil has an advantage:

- higher yields
- better fruit quality.

Soil covered with foil will warm up quicker. This increases the root activity which can result in a higher yield of better-quality fruits. Foil will reduce soil evaporation so that more moisture will become available for the crop. To make optimal use of foil for warming up the soil, it is necessary to place the foil at least two weeks before sowing or planting.

Windbreaks

Pickling cucumbers are sensitive to wind damage. Sufficient windbreaks are necessary to protect the crop. If the windbreak does not exist in some natural form a crop such as maize, beans, etc. can be sown or an artificial windbreak can be erected.

Irrigation

The need for water, especially at fruit setting, is very high. Under normal circumstances a crop of pickling cucumbers can evaporate 30 000 litres of water/ha/day. To achieve uninterrupted growth it is important to replenish this loss of moisture. Irrigate at least 2 - 3 times a week.

Irrigation with cold water is not recommended as it can lower the soil temperature. A lower root activity is the result. At soil temperatures below 16^{0}C the plant will stop growing. As pickling cucumbers cannot stand a high salt

concentration be careful to check that the irrigation water is fresh and very low in salts.

Harvest
Regular picking (2 - 3 times a week) is necessary. In so doing, plant stress due to over-large fruits can be avoided. Large fruits demand a lot of the plant's energy resulting in fewer new fruits. For the same reason remove crooked and misshapen fruits as early as possible.

Weed control
Next to chemical weed control, mechanical weed control offers some advantages. Pickling cucumbers have a very superficial root system so care must be taken not to damage the shallow roots. With mechanical weed control the soil is opened up again which will improve the soil aeration.

Pests and diseases
Cucumber mosaic virus (Cucumber Virus I)
A virus transmitted by aphids, which is widespread and can give a considerable yield reduction. At first yellow spots appear on the leaves which transform to the characteristic mosaic pattern. At an advanced stage the leaves deform and eventually die off. The plant will be stunted. Control: use tolerant varieties.

Angular leaf spot (*Pseudomonas lachrymans*)
Angular spots with a somewhat-transparent edge appear on the leaves, turning brown at a later stage. In the morning bacteria-filled droplets can be observed on the underside of the leaves. An- gular spots appear on stems and fruits.

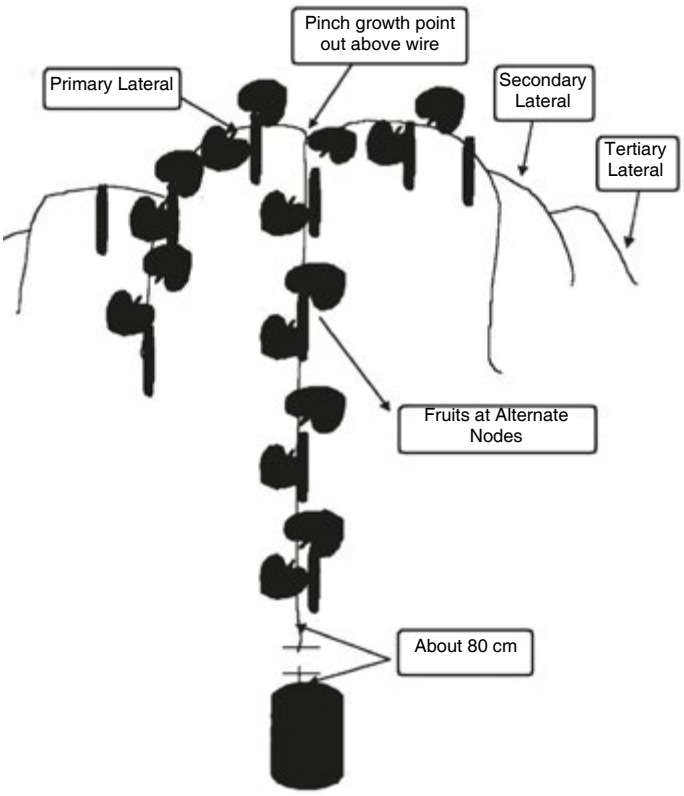
Powdery mildew (*Sphaerotheca fuliginea*)
White woolly patches appear on the leaves, spreading rapidly in warm humid weather, so that the leaf becomes covered with a floury layer. Powdery mildew can also appear on stems and fruits. Control: use tolerant varieties.

Downy mildew (*Pseudoperonospora cubensis*)
Leaves show yellow angular spots between the veins. The underside of the leaf shows blotches covered with a purplish fungal mould.

Anthracnose (*Colletotrichum lagenarium*)
In wet sections of the crop anthracnose can cause a great many problems. On the leaves yellow- green spots appear which spread very rapidly and cover the whole leaf surface causing the leaf to die off.

Scab (*Cladosporium cucumerinum*)
Small water-soaked spots appear on leaves and stem and, eventually, on the fruit. These spots turn yellow-brown at a later stage. Crop is most susceptible during cold and wet weather. Control: use resistant varieties.

Damping-off diseases (*Rhizoctonia, Pythium*)
Causes germination rot before emergence and so-called damping-off after emergence. This occurs in unfavourable weather conditions when the soil is wet and emergence retarded.



Lettuce
Fresh and crisp

Growing lettuce outdoors

Soil
Lettuce has a superficial root system. A good soil structure in the top layers is therefore necessary. The very top surface should be a fine dry tilth while just below the surface, the soil must retain enough moisture to sustain the water uptake by the roots. If this condition is achieved the plant will be healthy as the lower leaves will not be in contact with a wet top surface. Therefore, very heavy soils and very light soils should not be used.

Best soils are peaty and sandy-loam soils with a pH of 6.5-7.0. A regular addition of well decom- posed organic material and a meticulous preparation of the top layers are needed to achieve the best soil structure. Organic material can be given in the form of farmyard manure, cattle manure with straw, etc. Quantities of 70 ton per ha are normally sufficient.

As lettuce is salt-sensitive, soils with a very low salt content are preferred. To create a healthy let- tuce and to work as economically as possible, choose fields, which have been weed-free for some years. When good soil conditions are difficult to create, 40 cm wide ridges can be made. This will help to obtain the right soil structure in the top layers and furrow-irrigation can be applied.

Fertilizers
Lettuce responds well to organic fertilizers. Make sure that the organic material is non-chlorine. In- organic fertilizers should also be non-chlorine. Incorporate the organic material well in advance so that enough time is given for decomposition.

This will improve the soil structure and the nitrogen and phosphate applications from the organic matter will be evenly released throughout the growing period. In producing an average yield of 35 tons per ha a lettuce crop takes up ±60 kg N, 30 kg P_20_5 , 100 kg K_20, 30 kg CaO, and 10 kg MgO. Generally speaking therefore lettuce needs low levels of nitro- gen and phosphate and higher levels of potassium. Depending on the pre-fertilization soil analysis results a non-chlorine fertilizer compound containing ±60 kg N, ±40 kg P_20_5 and ±120 kg K_20 could be applied per ha before planting. Although a relatively high potassium application is needed, take care not to give in excess. An excessive application of potassium can cause fixation of calcium and magnesium, as there is interaction between the three elements. If fixation occurs deficiency symptoms of calcium and magnesium can be observed.

In some countries a legal maximum is set for nitrate content in lettuce so special care must be taken not to give too much nitrogen. Nitrogen also plays a role in the filling of the head. Too much nitrogen may cause rot (see: growing lettuce under glass). Normally no fertilizer top dressings are given during the short culture period in the field. Top-dressings are only given as a corrective measure if plants, when inspected, show a deficiency. If a top- dressing is given use soluble fertilizers and apply in the water used for furrow-irrigation. Overhead sprinkling may cause scorched leaves.

Sowing
Direct sowing is not advised except for pellet seed. Many growers use a pressed peat pot or speed- ling system, or purchase these directly from specialist plant-raisers. For more detailed information see: growing lettuce under glass.

Germination temperature
As a result of thermo dormancy, naked and pelleted seeds need to be subjected to a specific temperature range in order to germinate properly. When the soil temperature at germination is higher than ±23°C then there will be no emergence unless the thermo dormancy has been broken.

The best temperature range is 15-20°C. The thermo dormancy problem is overcome by keeping the seed in a cool room for an initial germination period (1-2 days). Initial irrigation in seed trays should be with cold water under hot conditions. After this the seeds in their soil-blocks are placed under shelter. However if the temperature is lower than 15°C, germination will take 7-10 days with an increased risk of fungal diseases. Planting out is usually 4-8 weeks later, depending on the sowing date. This period will be shorter in summer and longer in early spring and late winter.

Lettuce
Fresh and crisp

Planting out
A good selection of young plants should be made so that a quality product can be harvested. The young plants should be hardened-off by means of the right watering programme and by placing the blocks on a plastic sheet to prevent penetration of the young roots into the soil surface. When planting out in the field make sure that the seedling blocks are neither too dry nor too wet and liable to disintegrate.

The field should be well prepared so that the seedlings can continue to grow without disturbance. Watering the field prior to planting out does this. On a good soil an application of 20-25 mm water with an E.C. below 2 is normally sufficient. The aim is to moisten the top 40 cm of soil sufficiently. The seedling blocks are placed on the surface at the correct plant density and pressed firmly into the soil so that the top of the block remains just above the surface. On exposed fields it is advisable to place windbreaks at regular intervals to protect the crop.

Plant spacing
Plant density ranges from 9-16 plants per square metre. Butter head lettuce is more densely spaced than the more voluminous Iceberg and Batavia lettuce. Rosette-like lettuce requires a wider spacing too. The following table can be regarded as a guide, while bearing in mind the kg yield per square me- tre. Plant spacing depends on local circumstances and production method (e.g. flat culture versus ridge or bedded culture).

Nr of plants per m²	Type of lettuce
10-16	green butter head lettuce
10-14	red butter head lettuce
9-11	Batavia lettuce, oak-leaved lettuce
10-11	Cos lettuce
9-11	Iceberg lettuce

Watering
Outdoor production versus production under glass requires a different approach to watering. Outdoors high evaporation and irregular rainfall prevails. At the start of the culture overhead irrigation is normal practice. Good quality water with a low E.C. and at regular intervals, if possible, is necessary. The aim is to achieve continuous, uninterrupted, vegetative growth. Soil coverage by the young plants will be minimal at this stage so care must be taken not to close and compact the top surface.

A regular water application will result in a well-balanced plant. Well-balanced in relation to evaporation, uptake by the roots and soil condition. An un-balanced situation may result in glassiness, tip burn and growth stagnation. Conditions, which are too wet, may increase the risk of diseases. Once sufficient soil coverage has been achieved, furrow irrigation should take over from overhead watering. Iceberg lettuce particularly tends to become too loose in structure if too much water is given overhead.

Two or three weeks before harvest reduce the watering to a minimum so that the head can become firm and compact. If mineral deficiencies show up, soluble fertilizers in the irrigation water can rectify the situation.

Weed control
A contact herbicide like paraquat can be used before planting if the weeds have enough leaf surfaces. It would have been better if the land had been weed-free. An application of a systemic herbicide in a previous crop may be the cause of growth disturbances noticed during culture. Some herbicides may be persistent for some years so a history-check should have been done before deciding to plant lettuce. Once the plants are set out do not use an herbicide. Emerging weeds have to be removed by hand. Normally weeds are no longer a problem once the lettuce plants give sufficient soil coverage.

Disease control
Downy Mildew (Bremia) can pose a big problem but quite a number of varieties possess a wide scale of resistance to many races of Bremia. Similarly for Lettuce Mosaic Virus. Regular growth and well- balanced plants can withstand a fungal attack better than weak plants. Preventive measures have more effect than curative measures. If necessary use aly-phosethyl (Alliette) or metalaxyl (Ridomil) formulas against Downy Mildew. Rot caused by Botrytis, Pythium, Rhizotonia and

Sclerotinia can be prevented by chemicals. Chemicals used are THIRAM (TMTD), vinchlozolin (Ronilan) and ipodrione (Rovral). Correct hygienic measures such as weeding, correct plant density, irrigation control and right choice of variety can result in a reduced use of chemicals. Soft Rots caused by Xanthomonas can also be a problem under damp conditions.

Virus diseases
Use virus tolerant varieties and spray against aphids. Weeding host plants of aphids can prevent virus diseases.

Insects
Avoid parathion-based formulas. Pyrethroid based chemicals can be used against aphids and caterpillars.

Harvest
Harvest takes place when the head has reached its desired weight. Harvest under dry conditions to prevent mud or soil adhering to the base. Clean the heads carefully when cutting. With butter head lettuce remove the bottom leaves, which may develop rot-symptoms.

By packing the heads immediately in plastic bags at harvest and placing them in the box it is possible'to vacuum-cool them so that a good quality is maintained through the distribution channels. By means of cooling-cooling the temperature inside the lettuce can be quickly reduced to 0-1°C. Storage at that temperature with a relative humidity of ±95% prevents condensation in the plastic bag and keeps the lettuce fresh for 2-3 weeks. Lettuce shows a relatively high rate of respiration so conditions contrary to the advised storage method, reduce its storage period.

Melon
Juicy and fragrant

The culture of melon in open field

Soil

The melon is not considered as an exigent plant as far as the soil is concerned. Nevertheless the best results are obtained in deep light soils, well aerated, with good drainage. A pH of between 6.0 and 7.5 is ideal. More acidic soils should be avoided because of the risk of molybdenum.

In soils with a low pH or poor in calcium, chalk should be given before planting because of the negative influence of a lack of calcium on the fruit quality (water core of the fruit).

Preparation of the soil:

The melon plant develops the majority of the root system in the 30 - 40 upper cm of the soil. In a culture without watering the roots can go down to 1 m and more. In order to stimulate the rooting the soil is laboured deeply a few months before planting (fall or winter).

At this stage the organic matter or manure is mixed in the soil together with half of the quantity of the phosphoric and potassic fertilisers. Just before planting the soil is laboured again superficially and now the balance of both fertilisers is brought in.

Plantation and seed rate

The density of planting in open field depends of the type of culture. For non-irrigated crop the density will be between 5 000 and 7 000plants/ha. The distance between the rows can vary from 2 - 2.5 m and between the plants from 0.6 - 0.8 m. In plantations with irrigation the density will be between 8 000 - 18 000 plants/ha. The distance between the rows can vary from 1.8 - 2.2 m and between the plants from 0.3 - 0.5 m.

Fruit setting

The actual varieties of melon are monoecious (male and female flowers on one plant) or andromonoecious (male and perfect flowers on one plant). The male flowers always appear before the female or perfect ones. Bees generally do the pollination and it is therefore useful to place beehives in or close by the field. Two beehives/ha are sufficient.

Feeding in open field with furrow or sprinkler irrigation. The extraction of nutrients of a normal melon production (40 tons / ha) is the following:

N: 155 kg
P_2O_5: 67 kg
K_2O: 277 kg
MgO: 68 kg
CaO: 200 kg

We see that the elements potassium and calcium are very important for melon. In new soils we should add as fertilisers:

Manure in tons/ha: 50-100
N: 250 kg/ha
P_2O_5: 250 kg/ha
K^2O: 350 kg/ha
MgO: 100 kg/ha

For soils that have been planted before, these quantities can be reduced by 25%. As said before the entire quantity of phosphorus and potassium can be given before planting. Applications of nitrogen can start after the setting of the first flowers and can continue up till one month before harvesting. Every 10 days about 40 kg/ha can be given.

Watering

It is important to decrease watering about 10 days before harvesting. This increases the sugar and dry matter content and avoids water core of the melons. Independent of the system of watering (furrow, sprinkler or drip irrigation) the quantity of water can be decreased by 60%. For Galia or other types with netting, it is important to only decrease the amount of water after the melons have formed the net.

Fertigation by drip irrigation:

By fertigation we understand irrigation utilising fertilisers. Using drip irrigation all the phosphorus and half of the potassium can be given before planting during preparation of the soil.
Nitrogen and the rest of potassium will be given through

the drippers dissolved in the irrigation water.

Scheme of fertigation through drip irrigation:

Period	Nitrogen	P_2O_5	K_2O	MgO
Before planting	130	250	170	40
After fruit set	20	-	30	10
8 days later	20	-	30	10
8 days later	20	-	30	10
8 days later	20	-	30	10
8 days later	20	-	30	10
8 days later	20	-	30	10
Total	**250**	**250**	**350**	**100**

When we see that the plant is too vegetative we can decrease the amount of nitrogen and conversely, if the plant is too weak we can increase this element.

The amount of water we have to give depends on many environmental factors such as wind, relative humidity, leaf surface, heath, and kind of soil. The critical phase in which the need for water is high, is situated between the flowering of the female flowers till just before maturity. As said before watering should be decreased or stopped, depending on weather conditions, about 10 days before harvesting.

Plasticmulch.

The use of plastic mulch is generalised in all types of melon cultures.
The plastic film has a thickness of 30 - 40 microns and is 1.2 - 1.4 m wide.
The purpose of the use of plastic mulch is:

- to maintain the humidity in the soil on a constant level.
- to protect the structure of the soil in case of violent rain.
- to inhibit the development of weeds.
- to keep the melons clean.

Insects and diseases:

The most important insects we can find on melons are: aphids, thrips, white fly, spider mites and leaf miner.
As fungal diseases we can find: *Fusarium, Pythium*, Downy and powdery mildew, *Mycosphaerella* and *Anthracnose*.
Viruses: Cucumber mosaic virus, Melon necrotic spot virus, Watermelon mosaic virus (Papaya ring spot virus), Zucchini yellow mosaic virus.

Bacterial diseases affecting melons: Angular leaf spot or *Pseudomonas Lacrhymans* appear only under-humid conditions.

Snow pea

Delightfully sugary sweet

Sugar snap pea

Variety	Maturity in days from sowing	Vine type	Plant height in cm	Pod length in cm and String	Pod colour	Resistances/ Tolerances
Sugar Boys	70	Standard	55 - 65	7 Stringless	Medium to dark green	Powdery mildew CW 1 (PLRV) (PEMV)
Sugar Daddy	72	Standard	70 - 80	8 Stringless	Medium green	Powdery mildew (PLRV)
Sugar Pearl	70	Semi-leafless	60 - 70	8 Stringless	Medium green	Powdery mildew CWI (PLRV)
Sugar Star	68	Standard	70 - 80	7 Stringless	Medium to dark green	Powdery mildew CW 1 (PLRV)
Sugar Snap	72	Standard	115 - 130	8 Stringless	Medium green	CWI
Super Sugar Snap	66	Standard	150	9 Stringless	Medium green	Powdery mildew (PLRV)
Sugar Sweet	64	Standard	60 - 70	6.5-8 Stringless	Medium to dark green	Powdery mildew (PLRV)
( )= tolerant						

Growing peas

Peas are a member of the Papilionaceae family. In this article wrinkle-seeded varieties are dealt with. Peas form a long central root with strong lateral roots. Nitrogen available in the air is fixed through bacterial action in the so-called root-rhizobia.

This nitrogen is available to the plant. The stem length varies per variety. The flowers are formed in the axils, usually two. Early varieties start to form flowers at a lower axil and late varieties at a higher axil.

Soil

Peas can be grown in virtually any soil provided the soil is fertile, has a well-regulated water capacity, and a good structure. As peas form deep roots in penetrable soils, water-logged soils are to be avoided. Drought-sensitive soils are to be avoided too as the side roots are found mostly in the top soil. For late sowings in the season good results are only obtained in light clay soils and soils with a top layer of sand on otherwise well-textured soils. Overly-acid soils decrease the nitrogen-fixation activity. Therefore for sandy soils a pH-KCl of at least 5, and for heavier soils a pH-KCl of at least 6, is necessary.

Soil preparation

Deep-ploughing is advisable. At least to a depth of 25 cm. Plough well ahead of sowing so that the soil has time to settle. Try to prepare a level surface to prevent difficulties when machine harvesting.

Snow pea
Delightfully sugary sweet

Irrigation
Peas are capable of extracting much soil moisture. Nevertheless a low water table (100 cm deep) is necessary otherwise growth retardation will be noticed. Only when very dry conditions prevail could irrigation be of benefit. Irrigation is in fact only necessary if insufficient rain falls at the start of flowering and pod setting. This irrigation in general can increase the number of pods. In other words irrigation at flowering will result in better quality and higher-yielding pods. Before flowering only in very dry conditions irrigation will be of benefit as it will increase the number of pod-bearing axils.

Crop rotation
Soil-borne diseases which can remain in the soil for years, may affect the yield or even the crop. A crop rotation of one in at least six years is recommended. On lighter soils even longer.

Fertilisation
Nitrogen
On average a pea culture needs 140 kg N/ha. Normally its nitrogen-fixation can cater for this need throughout the culture. This fixation can, however be reduced because of low pH, Nematodes, soil fungi, bacteria or a bad soil structure.

Borium and molybdenum deficiency in the soil are causes of non-nitrogen-fixation as some soil insects may feed on the root nodules. Therefore an application of 40 - 60 kg N/ha is recommended before sowing. On too-acidic soils a higher application is necessary.

This initial starting-capital of nitrogen can make the seedlings stronger, thereby reducing the risk of attack by soil fungi and soil bacteria. However too much nitrogen can cause excessive vegetative growth.

Phosphate
On average a pea culture needs 30 - 40kg P_2O_5 per ha. However it is known that peas react strongly to a phosphate application and applications of 100 kg P_2O_5 /ha are considered normal if the soil fertility is good.

Potassium
Peas need on average 60 - 70 kg K_2O/ha. An application of 150 - 200 kg K_2O/ha should be sufficient on good fertile soils. Heavier soils could be given a somewhat higher dosage.

Other fertilisers
Magnesium, especially on lighter soils, must be given. A maintenance application of 50 kg MgO/ha should be applied. If, later on, magnesium-deficiency symptoms are seen a foliar spray can be given. Trace elements manganese and molybdenum should be given if soil analysis indicates a deficiency of these trace elements.

Sowing
Peas can germinate at low temperatures and sowing can start when the soil temperature is 3.5 °C or more. The number of plants per square metre is important but will depend on variety, fertilisation, soil type and other growing conditions. An early variety requires a higher density in general. Varietal characteristics such as degree of stooling (tillering), height and vigour also influence the plant density. The plant density figures in the table at the end of this leaflet are intended only as a guide as these may vary with the seed lot and under local conditions.

When botrytis can be expected adjust the plant density as a high plant density may increase the infestation.
The formula to calculate the sowing rate is:
kg seed/ha = plant density x TCW in g field-germination percentage
For example:
Plant density = 100 plants/m^2
TSW = 200 g
Germination percentage = 90% (For dark green wrinkle-seeded varieties field germination is 15% lower than the laboratory germination figure, depending on the situation and practical experience.) $\frac{100 \times 200}{75} = 267$ kg/ha

Sowing should be done in the level, 3 - 5 cm deep, top soil-layer of a well-structured, ploughed field. Sow approximately 3 cm deep in the moist top layer. Avoid wheel tracks by using low pressure, preferably double,

tractor tyres.

Harvest

To ensure a constant stream of peas to be processed, at harvest several possibilities are open. The optimal time of harvest is determined by the ripeness of the pea and measured by a tenderometer (TM) (The optimal TM-value lasts only a few days). However this figure can change quickly and restricts the harvest to a couple of days. This method does not help much in spreading the harvests. It is better to use early and late varieties, different sowing times, different soil types and different locations.

The difference between early and late varieties at the same sowing-date can be 2-3 weeks. This earliness can be expressed in heat units which is more reliable than the number of growing days.

Heat Units

In a pea culture the duration of that culture depends on the temperature during the culture period expressed in heat units. The sensitivity may vary per variety. The heat units are calculated on the basis of the average temperature over 24 hours per day. This is recorded at a height of 1.5 m in a weather station.

Peas remain inert below a certain temperature. Between sowing and emergence the minimum temperature for growth is 1 °C. The number of heat units is therefore the average day temperature minus 1 °C. Because germination is retarded between 1 °C and 4 °C this period should be calculated at half its value.
For example:

$$\frac{\text{(Average day temperature}}{2}$$

15 °C-4.5 °C) + (4.5 °C-1 °C) = 12.25 heat units

Note: After emergence, the minimal temperature for growth is 4.5 °C. Therefore every day having an average day temperature of above 4.5 °C is calculated at 1.

For example:

Heat units				
Max. (A)	Min. (B)	Average (C)	Before emergence (D)	After emergence (E)
6	0	3	1	
10	4	7	4.25	2.5
20	12	16	13.25	11.5

$\frac{A+B}{2} = C$	$C - 1 = D$	$\frac{(C-4.5 \times 4.5-1)}{2} = E$

The heat units are used to determine the sowing-time. Let's assume that at harvest the average daily temperature is equivalent to 20 °C and at sowing 5 °C. Let's assume again that the harvest of the variety Fonado with 970 heat units is to take place two days later than the variety Skinado with 930 heat units.

Two days at harvest means 2 x (20 - 4.5) = 31 heat units. The difference between Fonado and Skinado is 40 heat units. Fonado therefore should be sown nine heat units earlier. At sowing the number of heat units per day is

$$\frac{(5 - 4.5) + (4.5 - 1)}{2} = 2.25$$ heat units.

Fonado therefore must be sown 9 : 2.25 = 4 days earlier than Skinado to be harvestable two days later.

Diseases

All seed is treated with TMTD to prevent infestation by soil-borne diseases at sowing. Furthermore our early varieties, used in early cultures, are treated with APRON to reduce mildew infestation (*Peronospora viciae*) In areas where *Ascochyta pisi* can cause problems a special seed treatment can be given on request. Our varieties are resistant to *Fusarium oxysporum* and tolerant to the Top yellow virus.

Weed Control

The possibilities for mechanical weed control are limited and herbicides should be used. Perennials must be controlled well in advance. Annuals are controlled by a soil herbicide incorporated into the soil before sowing.

If weeds persist a contact herbicide may be used after emergence. Best results are obtained on moisture-rich soils at this stage. On dry humus-rich soils soil herbicides are less effective and a contact herbicide should be used. Firstly before emergence and again if necessary, after emergence when the pea crop has hardened- off sufficiently.

Soil
Peas can be grown on virtually any soil, provided the soil is fertile, has a well-regulated water capacity and a good structure. Water logged soils must be avoided as well as drought-sensitive soils. Deep-ploughing is advisable. On lighter soils the pH-KCl should not be less than 5, while heavier soils demand a pH-KCl of 6 and more.

Too acid soils decrease the nitrogen fixation activity through non-forming of nodules. To prevent damage through soil-borne diseases apply a crop rotation schedule of at least six years. On lighter soils even longer.

Fertilisers
As peas are capable of nitrogen (N) fixation only small amounts of N should be applied before sowing (40-60 kg N/ha). Where pH-KCl is too low a higher dosage of N is applicable. Too much nitrogen causes excessive vegetative growth. Apply 50-100 Kg P_2O_5 /ha can be applied if the soil fertility is good. Peas need some potassium and 200 kg K_20/ha should be sufficient on good soils. Heavier soils need more potassium. In some cases it is necessary to apply 50 kg MgO and the trace elements manganese (if the light soil has a pH-KCl 5.4 of or more) and Molybdenum (if the soil is iron-rich with a low pH).

Irrigation
Irrigation is advisable if dry conditions prevail during the beginning of flowering and the setting of the pods.

Sowing
Peas can germinate at low temperatures. When the soil temperature is 3.5 °C sowing should start. Plan sowing or use early or late varieties, so as to make economical use of mechanical harvesting and obtain maximum yield. Early sowings promote enough vegetative growth before the onset of flowering, especially when early varieties are used.

Growing Snow (Mangetout) & Snap Peas

In practice there is not much difference in growing between the two. However the snap pea is a more delicate product which is more susceptible to bruising etc.

Soils
Snow and snap peas can be grown in all soil types but alkaline soils with a good structure, a high water-holding capacity and good drainage are best for growing snow and snap peas. In soils with a high percentage organic matter and a strong capillary system snow and snap peas may grow too strong and due to this become prone to various fungal diseases.

The intensive and deep rooting system of snow and snap peas enables the crop to make good use of the available water in the soil. However drought damage can occur on soils with low water retention capacity and/or soils where root development is blocked and where no irrigation system is available.

Growing snow and snap peas on these soil types can be risky without the availability of a good irrigation system. In such cases only very early and early varieties may give a decent result. The pH-KCl of sand and light soils with a high percentage of organic matter should be at least 5.0. On clay soils a pH of 6.0 - 7.0 is desired. Lower pH figures will disable nitrogen fixation by the tubercles on the roots of snow and snap peas. At lower pH figures the tubercles hardly develop or do not develop at all.

At low pH levels one should survey the availability of magnesium. A foliar spray can help to overcome the shortage. When the pH is too low to grow snow and/or snap peas chalk can be given the full precedent to the growing season.

Climate
Snow and snap peas are well adapted to many conditions but they do not like extreme high temperatures (> 30 °C), especially in combination with wind. This will cause flower abortion.
Peas start germinating at 1 °C but at this temperature

the germination is very slow. At germination temperatures of 5 °C it takes five weeks before plants have emerged, at 20 °C this only takes a week. Peas yield best in cool conditions. In hotter areas the flowering period is shorter (also high risk of flower abortion) and subsequent yield is lower.

Growth and development

Growth and development can be split in three stages:

- sowing - germination
- germination - flowering
- flowering - harvest

To achieve a decent germination a temperature of at least 5 - 10 °C is needed. Depending on the temperature it will take 5 - 20 days before the plants come out the soil. The root system consists of the main root and many lateral roots. The development of the root system is highly dependent on the soil structure and available fertilisation, especially phosphate is important. The roots can easily reach to 1.50 m deep but most of the roots are in the first 20 - 30 cm of the soil.

The stem is hollow, rather thin and divided by nodes. The first node is in the soil the second on the edge of soil and air. Depending the earliness of the variety 7 - 15 vegetative nodes are formed before flowering starts. The number of vegetative nodes is influenced by date of sowing and fertilisation. As an average two nodes per week are produced but this is influenced by climatic conditions.

Length and sturdiness of the stem depend on the variety. High humidity and nitrogen levels as well as low light conditions and high temperatures promote abundant vegetative growth and development of long and leafy plants which are prone to diseases.

On the main stem several later shoots (tillers) can develop. The number of tillers depends on the variety and the plant density. Furthermore, frost and bird damage can induce tiller development. The leaves are developed at the same time as the stem. There are two leaf types: standard leaves and afila (semi-leafless).

After development of the vegetative nodes the plant will develop fertile nodes. Most modern varieties develop two and sometimes three or more flowers per node. The flowers are generally white. As an average eight fertile nodes per plant are produced. Depending the earliness of the variety this can be six to approximately 10 fertile nodes per plant. The induction of the flowers at cell- level has taken place eight nodes earlier than the physical appearance of the flower. Thus for early varieties the induction of the flowers takes place at the moment of germination.

The multiple hand-pick harvest method will stimulate the development in the top of the plant. This method will push the plant to extend the flowering period and develop more fertile nodes. When continuous flowering is desired it is important to provide sufficient fertilisation and irrigation to the plants.

During flowering some drought stress helps to achieve maximum flowering and good pollination.
Too much drought stress will shorten the flowering period and lead to abortion of flowers and pods. Too much water supply in this period will result in continuing vegetative development.

The plants can handle some frost but are less tolerant in the period just before and during flowering. The partly-developed flowers can freeze and abort. Snow and snap peas are self-pollinators. Pollination takes place before the plants are opened when the stigma grows through the stamen. Abortion of pods and embryos can occur; this is promoted by high plant densities, high temperatures during flowering and high humidity.

Sowing

Soil temperature at sowing should be at least 5 °C. Sowing is done in a surface-dried soil, after a good rainfall or sprinkler irrigation. The crop is grown in rows, either single or double according to preference. Double rows are usual. The rows are sown in ridges or beds to ensure that the seedbed soil is friable and to avoid waterlogging in heavy rains. These systems separate the growing area from the area used for human and tractor passage, thus avoiding compaction.

The beds are usually 75 cm wide and 20 - 25 cm high.

Snow pea
Delightfully sugary sweet

The path between the beds is also 75 cm wide. When two rows are planted on a bed the row distance should be 30 cm. Seed spacing in the row is 5 cm. Sowing depth is 2 - 3 cm unless the soil is extremely dry. Seed use per ha depends on TSW, for snow peas this will be 60 - 80 kg and for snap peas 50 - 60 kg, this will result in a stand of approximately 300 000 plants/ha.

Fertilisation
According to soil analysis. A recent soil analysis will indicate the nutrients freely available in the soil. Thus to obtain the right balance of nutrients we have to deduct the amounts of available nutrients in the soil from the recommended figures. Never apply organic fertilisers prior to sowing snow and snap peas. However, a good organic fertiliser on the previous crop will be very beneficial to the snow and snap peas.

Nitrogen
In the first two weeks after emergence tubercles are developed in symbiosis with bacteria of the Rhizobium species. During this period the plants have no nitrogen from own fixation at their disposal and use the nitrogen which is stored in the cotyledons.

Generally the need of nitrogen of snow and snap peas is covered by the fixation of the tubercles. Pink-coloured tubercles are active, in this case one can rely on a sufficient nitrogen supply. Green-coloured tubercles are not active, in this case one should supply nitrogen fertiliser. At a too-low pH no tubercles are developed. Nitrogen supply by the tubercles also fails when roots are damaged by insects. Nitrogen should be given when the nitrogen production of the plant fails for any reason.

The amount to be given depends strongly on the gravity of the situation, development of the plants and the expected nitrogen production by the plant. For this reason one often waits to give nitrogen till the plants are approximately 20 cm tall. The quantity to give can be 60 kg N/ha. When needed a top dressing of 40 kg N/ha can be given one month later and another 40 kg/ha another month later. Often a top dressing is given at beginning of flowering with 400 kg 12 - 10 - 18/ha or with 300 kg 22% N and 7% Mg. Nitrogen deficiency can be recognised by the pale leaf colour and slow growth rate of the plant.

Phosphate
Phosphate is important at emergence. It stimulates the development of the root system and the tubercles. The minimum application, even at high phosphate -levels, should be 35 kg/ha. At low phosphate -levels the application can go up to 120 - 140 kg P_2O_5/ha. On sandy soils 75 kg P_2O_5 /ha is given as an average.

Phosphate deficiency can be recognised by the slow growth rate of the plant. The plants have thin stems and the leaves have a dull blue-green colour. The lower leaves wilt and the borders of the leaves show dark-brown necrotic spots.

Potassium
Snow and snap peas are chloride sensitive. It is therefore advisable to use single fertilisers. The average potassium need varies depending the soil analysis 150 - 250 K_2O/ha. Potassium deficiency of young plants can be recognised by the dull yellow-green colour of the leaves, older leaves get grey-yellowish borders.

The veins stay green and the plants have short internodes and the pods stay small and have few seeds. The first leaves die offearly. Potassium deficiency increases the risk of botrytis.

Magnesium
Deficiency of magnesium can easily occur especially in light soils. The uptake of magnesium is dependent on the temperature. As an average 60 kg MgO/ha is sufficient but in cases where the magnesium -level of the soil is good or low and the potassium-level is high to very high it is advised to increase the MgO application with 50 and 100 kg MgO/ha respectively.

A magnesium application on sandy-loam and clay soils with a pH-KCl >7 does not make sense as, due to the high pH, the magnesium will be blocked. As soon as deficiency signs are present one can spray with 60 - 80 kg magnesium sulphate in 600 litres of water/ha.

Snow pea
Delightfully sugary sweet

Magnesium deficiency can be recognised by yellowing of the leaves while the veins are still green.

Manganese
Manganese deficiency can occur in light clay soils with high calcium -levels and sandy-loam and sandy soils which have been chalked heavily. The cure is to spray with 15 kg manganese sulphate in 1000 litres of water/ha When manganese deficiency can be expected it is advised to spray preventively when the crop is in full flower. Manganese deficiency can be recognise by yellowing of the leaves between the veins, flowering stops early and the plants are rather weak.

Fertilisation scheme	N	P_2O_5	K_20	MgO
Before planting		75 -150	150 - 250	60
At plant height of 20 cm	60			
At flowering	40 - 60			
Top dressing (only when needed)	40 - 80			
Total	**60 - 150**	**75 - 150**	**150 - 250**	**60**

Irrigation
Several methods are practised according to the amount of water and equipment available. Immediately after sowing most growers use sprinkler irrigation as this covers the whole bed giving a thorough soaking at seed-depth. After emergence furrow irrigation is often used. In areas where water is scarce some growers start to use drip irrigation.

During the growing and harvesting period the soil should be kept moist to provide maximum yield and quality. Curved pods and premature seed enlargement indicate insufficient water. These two symptoms are also caused by high temperatures.

Harvest
Starts approximately 65 - 70 days after sowing. Normally pods should be harvested three times a week. The less the damage done to the plants during harvest the higher the total yield will be. Average yield is 5 - 6 t/ha, high yields can reach 9 - 10 t/ha, low yields go down to 3 - 4 t/ha. After picking, the pods should be stored in a cool place (2-3 °C).

Weed control
When weeds are controlled mechanically, this must be carried out at a shallow level as many roots are in the top 30 cm of the soil. It is possible to use products like paraquat, diquat, glyphosate, etc. before sowing against annual weeds. For use of all chemicals it is advisable to contact your local agrochemical supplier.

Pests and diseases
Peas are attacked by a range of pests on the leaves, flower buds and the pods. They are also susceptible to various fungal diseases which are more likely to occur in periods of high humidity (after a good irrigation, especially when sprinkler irrigation is used). To control pest damage the crop should be checked for the presence of insects, especially bollworm, thrips and aphids which are the commonest.

A preventive spraying programme and weeding (many insects, fungal-, bacterial diseases and viruses host on weeds) will probably overcome most of the problems. The commonest fungal diseases are Powdery mildew and Ascochyta. Recent research results show that Alternaria infection probably occurs in the flower buds as well.

Keep the leaves and flowers dry and/or use a preventive spraying programme. The insecticide and fungicide spraying can be mixed but before doing this ask your agrochemical supplier for advice and read the labels carefully.

The main fungal and bacterial diseases which may cause problems are:
Pythium spp.
Fusarium spp.
Ascochyta pisi
Micosphaerella pinodes
Phoma medicaginis var. pinodella

Sclerotinia sclerotiorum
Botrytis cinerea
Peronospora pisi
Erysiphe pisi
Pseudomonas syringae f. sp.

Most common pests and nematodes are:
Thrips angusticeps
Kakothrips robusuts
Myzus persicae
Acyrthosiphon pisum
Sitonia lineatus
Contarinia pisi
Laspeyresia nigricana
Heterodera goettingiana
Heterodera trifolii f. sp.
Meloidogyne hapla
Pratylenchus spp.
Rotylenchus spp.
Trichodorus spp.

The most important viruses are:
PLRV (leaf roll virus)
PEMV (Pea enation mosaic virus)

Sweet corn
Supersweet

Growing sweet corn

Introduction

Sweet corn is a warm season crop and is planted throughout South Africa for fresh markets as well as processing usage. The climatic difference in the seasons make it possible to produce cobs for the fresh produce marketing year round.

The main production areas are:

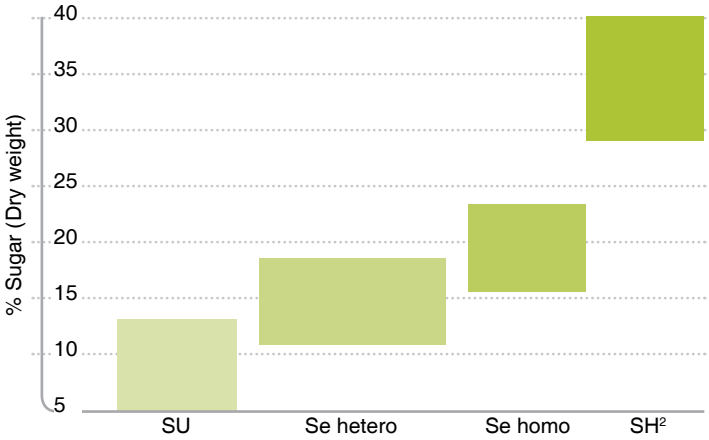
- Soutpansberg / Musina - mainly winter production
- Hoedspruit - year round with peak in winter
- Brits, Eastern Free State, Marble Hall / Groblersdal - mainly summer KZN - mainly summer, with winter possible in some Pongola districts S & W Cape - summer to early winter
- W Coast - late summer and winter

The flavour and quality of this crop make it an ideal pull into the retailer's shops and therefore an important vegetable crop. On the other hand sweet corn is highly perishable and growers must ensure that adequate market opportunities exists to handle the crop immediately after harvesting.

Genetics

There have been many developments in recent years with newer varieties of corn that have im- proved sweetness over standard varieties. The sweetness in corn results from the accumulation of sucrose in the kernels, which could be lost rapidly in warm temperatures. Varieties available on the markets worldwide now have more sugar and retain the sweetness longer than before. This added to the disease resistances and tolerances make sweet corn a very important fresh vegetable crop although huge areas are planted for processing needs - frozen, canned, whole cob frozen, etc.

- SU Sugar or Ordinary sweet corn - The oldest sweet corn known with the only SU-gene that makes it different from normal field corn (maize). Range of total sugar is 5 to 9%. The sugar to starch conversion is quick and limits the use of these types for fresh market retailing. It is however a favourite in home gardens and is easy to grow.



- SH² or Super sweet Types - The gene also referred to as Shrunken Types was found in 1970 by the University of Illinois and resulted in much sweeter sweet corn - almost twice as sweet and losing the sugars much slower than the SU-types. As the name implies the seeds are shrunk and germination is more difficult especially under cool soil or adverse conditions. The seed coat of these kernel types is fairly thick making it tougher or crunchier. Furthermore the kernels do not accumulate water-soluble polysaccharides or "liquid starch" giving them a more watery characteristic. When these types cross-pollinate with other corn it loses sugar content therefore isolation of 100 metres should be kept between types. Range of total sugar is 15 to 35%.
- SE Extra Sweet or Sugary Extender Types - Again identified by the above university in 1980. This type of corn is somewhere between the SU & SH2 types. It is sweeter than ordinary sweet corn, the seed coat is tender and the kernels accumulate liquid starch. Germination is better under adverse conditions - cooler season plantings and isolation are not required. Range of total sugar is 15 to 35%.
- White kernel and bi-colour hybrids are also becoming more common although some consumer resistance exists against them. The main reasons probably the association of white corn with green mealies - a typical South African delicacy.

Sweet corn
Supersweet

Pollination
Sweet corn is a wind-pollinated crop and pollination by other types (maize or popcorn) can reduce the quality and the marketability of the crop. Corn pollinates when the tassels shed pollen to the emerging silks. Corn varieties that do not tassel at the same time will therefore not cross-pollinate. Varying the planting dates and the growing days is an easy tool to manage this potential threat.

Soil requirements
Performs well in a wide variety of soil types provided they are well drained. Good seedbed preparation is required to succeed and planting should always be done in moist soils to assist with easier germination and establishment.

Sandy soils warm up quickly and could be used for early season and late season plantings but water management is important as the water holding capacity is less favourable compared to loamy soil types. The critical factor however as with most crops in South Africa is not the soil type but the water management.

Planting
Quick germination and emergence requires soils that are warm. Ideally sowing should start when the soil temperatures exceeds 20°C, with the optimal sowing temperatures between 25°C and 30°C. Avoid planting in soil below 15°C and make sure the seeds germinate in the next 24-hour period. Avoid high temperatures 25°C+ just after sowing. Irrigate before sowing so that seeds are deposited into a moisture rich environment and the water imbibition (absorption) can start immediately. Too much damage occurs when seeds are sown into too warm / cold soil - exposed to soil organisms and then drowned in water afterwards.

A continuous supply of product is what the retailer and market requires and therefore sequential plantings are suggested. Early season plantings will be slower to emerge and later-in the season it will be much quicker. The use of different varieties with different maturity days will assist in managing the needs. It should also be noted that yields are normally lower in late season and out of season plantings and disease and pest more. This makes for challenging decisions in cropping and locality. Plant population also plays a role in the success of a crop and the general rule is to aim for a final population of 55 000 plants/ha in summer and somewhere between 35 000 - 45 000 plants/ha in the cooler seasons of production. Sweet corn should never be over planted to fill in missing plants - they will always be late.

Fertilization
A soil analysis should always be done before the season and the use of soil mapping with satellite technology could be advantageous in the longer run. A moderate acid soil with ph 5,5 - 6 is required for optimal growth. All applications of fertilizer should have been concluded by tassel forming stage. It is also important to remember that fertilizer takes as a general rule 14 - 21 days to have an effect on the plantings. Foliage sprays could be added if short-term needs exist. The microelement needs should also be addressed in a balanced programme from leaders in the field.

	N	
Target	150-250kg/ha	
Application	Heavy	Sandy
Pre-plant %	50	40
+2-3 weeks%	25	30
+4-5 weeks%	25	30

	P	
Target	120-130kg/ha	
Application	Heavy	Sandy
Pre-plant %	100	100
+2-3 weeks%		
+4-5 weeks%		

	K	
Target	25-55kg/ha	
Application	Heavy	Sandy
Pre-plant %	25	30
+2-3 weeks%	45	30
+4-5 weeks%	30	40

Sweet corn
Supersweet

Irrigation
Sweet corn in general has a limited root system and water management is critical for the successful cropping and marketing. Critical times are when the plants are young and need to grow rapidly, from first tassel to harvest time. Yields are influenced the most by water deficiencies. Ensure that moisture remains adequate within the first month after sowing - this is when yield potential is determined and in the ear fill stage.

Harvesting
Harvesting date is determined by the tempo of pollen "absorbed" by the silks. A general rule of thumb is to start harvest at approximately 20 days after 50% silk. The silk starts browning completely then and the colour and appearance can also be used as reference. If harvested too early, kernel contents are thin, watery and bland. If harvested late, the contents are doughy and much of the sugar has been converted to starch. The moisture content for SU should be 70 - 74% and the SH2 between 75 and 79%.

Other methods include measuring the soluble solids. With field temperatures around 16°C an ear can remain in prime condition for about 5 days; With field temperatures at 29°C it goes down to 1 to 2 days. If picked ears are not packed and cooled soon after harvest they must be stored in a cooler or if possible hydro cooled. High temperatures after harvest and before packing / marketing.

Diseases
Typical diseases that may occur in South Africa are:
Seed rot and Damping Off- *Phytium sp., Rhizotonia sp.* and *Diplodia maydis*
Smut - Fungus - *Ustilago maydis*
*Rus*t - Brown rust - *Puccinia sorghii*
Leaf Blight - NCLB-
Stewart's Wilt / Bacterial Wilt - Bacteria - *Xanthomonas stewartii*

Pests
The biggest threat from pest comes from:
European Corn Borer
Rootworms & cutworms
For best results use your local crop protection specialist and use-registered products.

Sweet pepper
Bursting with flavour

Growing peppers

Soil

Peppers are deep rooted and therefore require a well-aerated soil with good drainage. To encourage good rooting, the soil should be ploughed to a depth of 30 - 40 cm. Inorganic fertilisers and organic material should be carefully spread and incorporated into the soil to a depth of 25 cm. With drip irrigation a plastic mulch can be used. The aim of this plastic covering is to restrict soil evaporation. By doing this it also prevents a concentration of salts at surface level.

Growth and development

Peppers have a slow (about 25% less than tomatoes) growth rate and due to this they rarely forgive cultivation mistakes. The slow growth rate is due to a slow production of leaf area and although the productivity per unit area is comparable to that of tomatoes the leaf mass is just smaller. This slow growth rate makes peppers very sensitive to stress and it makes them very slow to re- cover from stress. Successful and, ongoing pepper production lies in keeping a steady, regular growth rate through the life cycle.

The pepper plant grows upright with a single stem of 8 - 10 leaves. The shoot then terminates in a flower and two side shoots are formed. After 1 - 2 leaves the side shoot terminates in a flower and again side shoots are formed. This pattern is repeated for about five nodes, always splitting into two after the formation of a terminal flower.

Peppers are like most fruit-bearing crops: the first fruits to set take all the energy from the plant, inhibiting further growth, flowering and fruit set. Once the first fruits are harvested the extra energy is channeled into new growth, flowers and fruits. In peppers, due to the slow growth rate, this phenomenon is much more marked and the balance between vegetative growth and generative growth (flower development and fruit set) is easily disturbed.

When the crop load and leaf canopy are not manipulated to maintain the best balance then peppers will grow in flushes and become much more prone to diseases. Pepper flowers are induced six weeks before the buds appear. This long time lag has severe implications under stress conditions. The most common stress is a crop overload for the productive capacity of the plant. A plant with no flowers present may have been suffering from stress for the entire six-week period and when stress is removed it will take another six weeks before new buds appear.

The fruits take 70 - 80 days before they can be harvested as mature green peppers. The total gap from removal of the stress and induction of new flowers to the harvest of new fruit is 120 days. A good pruning system will help to establish a well-balanced plant and a continuous production of quality fruits.

Sowing

Germination is very sensitive to temperature and moisture. The optimum day temperature is 24 - 28 °C while the optimum night temperature is 20 - 21 °C. The absolute minimum for pepper seed to germinate is 13 °C. Temperatures outside the optimum range will be slow and protracted. Preparing a good seed-bed for raising the pepper seedlings is of extreme importance.

Sowing in a seedbed

The seed can be broadcast in a seedbed. The seedbed must be non-saline and well drained. Throughout the germination period the seedbed must be kept well-moistured and have an optimal temperature of 25 °C. Please ensure that the seedbed has been sterilised (about one month before sowing) by means of a chemical treatment or steaming as the disease Phytophtora capsici can be brought into the soil when the young plants are transplanted. Do not sow too densely, approximately 200 plants/m2 is optimal.

In temperate climates, transplanting from the seedbed can take place approximately 60 days after sowing. In more (sub)tropical climates this period will be shorter. Ensure that the roots are not damaged and that the plants are hardened off.

Raising in pots

Pepper seed can be sown mechanically or by hand in pots, pressed peat blocks or trays containing a specially-prepared growing medium mixture. If the raising period

is prolonged an NPK-fertiliser can be dissolved in the irrigation water. The pots or trays should be placed at a raised level above the soil surface to prevent root establishment. Otherwise the roots will be damaged at lifting, resulting in growth stagnation. When using trays do not use a model smaller than 200; a 128 is better. The bigger the surface area of the cell, the thicker and more sturdy the stem of the seedling.

Do not over-water the medium after sowing, it should be saturated only for 50% of its depth. Pepper seed needs a good deal of oxygen so over-watering will inhibit germination. After emergence water to 10 - 15% drainage. The drainage is important to redistribute or eliminate any excess salts. Fertigation can start once the true leaves have emerged. Use an EC of 2 - 2.5. Avoid excess watering with fertiliser solution, especially with nitrogen during low-light conditions as this promotes thin and lanky plants.

If necessary foliar feeds can be used. Once the seedlings are close to desired length they can be hardened off. Just before transplanting top up with nutrient solution.

Planting

Plants (raised from a traditional seedbed) should be watered as sparingly as possible in the begin- ning to prevent Phytophtora capsici contamination and to strengthen the root development. Plants raised in pots or trays are watered immediately after setting out.

To prevent the pots drying out, they should be covered with a thin layer of soil within a couple of hours after planting. As a general rule the plant density should be between 20 000 - 30 000 plants/ha. Plant density for vigorous-growing hybrids is 20 000 plants/ha. For less vigorous-growing hybrids, we recommend a plant distance of 30 000 plants/ha. In greenhouses and plastic tunnels the density should not exceed 20 000 - 25 000 plants/ha.

Pruning

It will be necessary to prune side shoots until the start of flowering. When grown under glass or plastic, plants are normally supported by string or stakes along a two-stems method.

Pruning is needed to achieve a good balance in growth and continuous production of quality fruits.

1. After transplanting, the seedling will grow upwards with a single stem for 4 - 6 nodes. The growing point then alters to produce a terminal flower and several side shoots develop. Remove the flower and select the two strongest side shoots. The first side shoots will produce 1 - 2 leaves and then terminate with a flower and two new side shoots. This pattern of continually splitting into two is characteristic for peppers. At each split there will be a flower, so the plant becomes very complex with many flowers and fruits, very quickly.
2. When the first side shoot flowers and split, remove the flower and select the strongest side shoot at each split and remove the others. This must be repeated again for the third level of flowers and side shoots. This allows the plant to concentrate on leaf and root growth. Provided that the plant is sufficiently vigorous at a height of 60 - 70 cm, which is usually after the third level split, then the flowers at the next split can be allowed to set fruit. If the plants seem to be weak then this step must be repeated.
3. At the next split leave the flower to set. In each split select the strongest shoot to continue as leader, leave the weaker side shoot but stop it from flowering by removing the growing point after a leaf has formed. This proves extra leaf mass, the factory of the plant. The aim is to have flowering at the top and mature fruit at the bottom of the stem. When growth slows or there is no flowering remove the bottom fruit to relieve the load on the plant. When growth is very strong one can even leave an immature fruit on a weaker, second, side shoot to regulate the vigour.

Fruit setting

Low temperatures influence the fruit setting. Below 12 °C natural fruit setting is very difficult and if fruits form they are often deformed. Hormone treatment is not possible with peppers. The sowing period should therefore be planned so that fruit setting will take place either before or after a cold period. High temperatures can also cause damage. Temperatures over 35 °C will result in growth reduction while continuous high temperatures can cause flower abscission. Low temperatures during flower development will alter the shape of the final fruit. Fruits will become broader and shorter while often the

blossom end is malformed. The more fruit have set, the smaller the average fruit will become. Too many fruits on a plant can cause flower and fruit abortion as result of lack of energy.

Water

The quality of the water depends upon the pH and the salt concentration. A high pH can be reduced (neutralised) by the addition of acidic fertilisers. Where fresh water with low conductivity is available, the high salt concentrations in the soil should not become a problem. When using drip irrigation the salt concentration around the roots must be washed out from time to time.

However, in order to achieve an optimal result the amount of water and the salts dissolved in it must be given in the correct dosage and frequency. Drip irrigation is preferable to furrow irrigation and perforated pipes. A sprinkler system cannot be recommended for a pepper crop. The amount of water to be given will depend on factors such as temperature, relative humidity, wind, leaf surface, length of day and the salt concentration of the soil. As a general rule 0.5 litres of water/plant given daily by drip irrigation could be sufficient. For a culture in the warm season the amount and frequency of watering will have to be very well planned. When either the water or the soil are saline, the frequency of watering will have to be in- creased while the amount given per application must be decreased. This will result in a constant dilution of the salts present in the soil.

Fertilisers

The amount of fertilisers needed depends on the availability of the elements in the soil. Adjust your applications according to the results of your recent soil analysis. As a general rule we apply: Magnesium and Boron should also be applied regularly after the harvesting begins, to prevent deficiencies.

Nutrient in kg/ha	N	P	K	Ration: N:P:K
Before planting	50 - 80	100 - 150	150 - 200	1:2:3
After planting				
Every week	25	25	25	1:1:1
After first week harvest, weekly	25	25	35	1:1:1.5

Diseases

Fungal diseases:

- *Phytophthora capsici*
  Brown-black colouring of the basal stem with rotting on the roots. Phytophtora is usually a soil-borne disease although water can be the source as well. Control by using tolerant hybrids and avoid watering close to the stem. Drenching with suit- able fungicides dissolved in the water can give some form of control.
- *Botrytis cinerea*
  Favoured by high humidity, a brown-grey mould can develop on the stem. Pruning wounds are the most common point of entry, after which water-soaked lesions appear developing into a mould. Control by providing good air movement through the crop by removing the lower foliage, by working hygienically and by using appropriate fungicides.
- *Leveillula taurica*
  First symptoms are small light-green specks on the upper surface of the leaf, later turning into yellow spots. Later on white mildew develops on the lower surface and eventually also on the upper surface of the leaf. The fungus develops well under warm, humid conditions, although germination of the spores is not dependent on such conditions. Control by preventive spraying.
- *Sclerotinia*
  This condition occurs on the stems, appearing as light necrotic spots with a hollowing of the pith. Black Sclerotia can be observed inside the stem. Further symptoms are wilting of the plant. Control measures are similar to those for botrytis but it is very important that the affected plants be removed and burnt as the sclerotia are very virulent.
- *Rhizoctonia*
  The basal stem is sunken and brown-black in colour. Retarded growth may result if disease is unchecked. Control by fungicides and keeping the base of the plant dry.

Physiological diseases

- Blossom-end rot
  Dark-brown, sunken, well-defined spots on the fruit base (blossom-end). Usually caused by a calcium deficiency in the fruit when the plant is incapable of

sufficient calcium intake. Moisture stress, excessive soil salinity, root damage and low pH are common causes.

- Stip
  Small, brown, sunken spots on the ripe fruits. Possible cause could be an imbalance of potassium and calcium in the fruit. Use tolerant hybrids.
- Sun scald
  White, shiny blotches on the shoulder and sides of the green fruit. Prevent exposure to direct sunlight by shading sufficiently.

Viral diseases

Viral diseases are very difficult to identify without serological tests. Symptoms can be as divergent as yellowing, mosaic pattern on leaf or fruit, vein colouring, leaf rolling, stunting, etc. In nearly all cases production will suffer. The virus is transmitted by vectors which can be insects such as thrips, white fly and aphids or by mechanical transmission. Best-known viral diseases are:
Tobacco mosaic virus (MV)
Potato virus Y (PVY)
Tobacco etch virus (TEV)
Pepper mottle virus (PeMoV)
Cucumber mosaic virus (CMV)
Control by working very hygienically, preventing vector insects and using tolerant hybrids as much as possible.

Pests

- Various insects like aphids, white fly, caterpillars, spider mites, etc.
- Nematodes (*Meloîdogyne* spp.)
  Nematodes are microscopic roundworms in the soil which cause galls on the roots. Symptoms in the plant are stunting, wilting and discolouration. When the plant is up- rooted irregular swellings and galls are seen on the roots. Control by soil disinfection and use of soil nematicides.

Explanation of terms used:

- Resistant
  The ability of the plant to interfere with the development of a certain disease or certain pathotypes of that disease. ‘Resistance’ is a relative concept.
- Tolerant
  The ability of the plant to endure a certain disease or harmful environmental factor with little adverse effect on its growth and production.
- Susceptible
  The disability of the plant to hinder or control.

Squash
Reap the rewards

Growing squash

Introduction

Squashes are members of the cucurbit family, which also includes watermelon, sweet melon and pumpkin. The most important squashes in South Africa are baby marrow (also known as courgettes), butternut and gem squash. All squashes are frost sensitive and cannot be produced under low temperature conditions without artificial heating.

Baby marrows are produced for both export and local markets. Export specifications generally require smaller, darker fruit than local markets. In the case of scallops (Patty Pans) smaller fruit is also required by the export market. Even color is important for all markets, especially so for export. Experience in South Africa has shown that the darker the color of a marrow variety, the lower the potential yield tends to be. Some of the more recently bred dark-skinned varieties do give better yields. Yellowskinned varieties of baby marrow are not popular in South Africa due to the ease with which they can be marked during harvesting and packing. Crook-necked varieties are also rarely seen here, though they are popular in the United States.

Butternuts are produced mainly for local consumption, though there is some potential for export to Europe. Spain is currently the biggest user. Butternuts are being increasingly used by processors and in prepared food for supermarkets. Blocks and chips are becoming popular and soup is another significant market for the raw product. Gem squash is presently only used locally.

Soil Requirements

Squashes will grow well in a range of soils, but will give best results with low salt content, high levels of organic matter and a slightly acidic pH. Drainage should be good, as water logging of the root system for any length of time will retard development. A sandy-loam type soil is ideal, but other types fulfilling the above criteria are also used successfully.

Planting

Most sowing is done directly into the soil. Seedlings are sometimes used early in the season to reduce the risk of frost damage and to come into production earlier than direct-sown plantings. Plant spacing in baby marrows is generally around 1m x 0.6m to give a population of 16,000 plants per hectare. The exact spacing will depend largely on the irrigation system in place and on each individual situation. for butternuts and gem squash, populations are lower and stands of 8 -12,000 plants per hectare are the most common. Where these are grown without irrigation a maximum of 5000 plants per hectare should be sown. Spacing and population have a significant effect on fruit size of butternut. A higher population gives a larger number of smaller fruits while a wider spacing results in fewer fruit per hectare but average fruit size is larger. Spacing will therefore depend on the market to be supplied. For export, maximum fruit size is 1kg, while processors prefer larger fruit, which gives less waste.

Irrigation

Butternut and gem squash can be grown without irrigation, but both perform better where supplementary water is given. For acceptable results with baby marrows irrigation is needed. Overhead, furrow, drip and micro-irrigation are all used in South Africa. Water must not be saline, as this will retard plant growth. The amount of water to be applied will depend on soil type, temperature, growth stage and rainfall.

Effective fertilizer applications are only possible where a recent soil analysis is available. As a basic programme for baby marrows 600 Kg / ha of 2.3.4 at pre-plant is widely used. Any microelements or other nutrients are given according to analysis. If heavy rainfall occurs during the growing period, topdressing with a Nitrogen source will boost the plant. for butternuts and gem squash, the following basic programme has given good results:
Pre-plant - 275 Kg / ha 2.3.2 fertilizer, 6 weeks after plant - 50 Kg / ha LAN & 4L Solubor + Multifeed foliar sprays. It must be stressed that these are guidelines only and that any effective fertilizer programme can only be formulated with the aid of a recent soil analysis.

Poor Pollination leads to poor or irregular fruit development. Normal fruit development requires effective pollination and bees are the most effective agents of this. Squash flowers are not very attractive to bees and natural populations should be supplemented with 2 or 3 hives per hectare. Hives should only be placed in the

field at the onset of flowering. If they are in place earlier, the bees may establish foraging patterns in other, more attractive plants. They will then ignore the squash when they start to flower. Bees are most active from sunrise until early afternoon. Insecticides should therefore be applied later in the day, taking care not to spray or allow drift near to the hives.

The ideal temperature for marrow production lies between 25°C and 32°C. The efficiency of pollination drops as temperatures rise above 30°C. Extremes of temperature affect the ratio of male to female flowers. More male flowers are produced in such cases and yield is reduced through lower numbers of fruit. The first female flowers on a plant often open before the first male flowers. This leads to poor pollination due to lack of available pollen. In the past pollinators were interplant with the main crop to overcome this. With the newer hybrids the problem is less marked and the practice no longer widely used. Temperatures over 38°C can cause flower drop and abortion.

Butternut and gem squash are generally harvested once or twice when fruit are mature. Baby marrows are harvested continually. During peak production one fruit per plant per day is usually picked. Peak production normally lasts about 3 - 4 weeks. In cooler conditions, harvest interval will double. The yield achieved will depend on a number of factors, the level of virus infection is particularly important. A good yield is in the region of 10 tons per hectare for baby marrows. It is important to handle baby marrow fruit carefully as they are easily marked and this reduces quality and hence margin. If practically possible, harvest should be in the early part of the day in summer to prevent the fruit being picked with high levels of field heat. Cooling of the harvested fruit will give a better life.

The most important pests are aphids and pumpkin flies, the most important disease virus is powdery mildew. These two are described together as aphids are the most important vectors of viral diseases. Virus diseases are difficult to control and there are no cost-effective chemical treatments available against the virus itself. Control therefore targets the vector rather than the virus. Baby marrows are generally more severely affected than butternut and gem squash types. Incidence and severity of disease vary depending on complex interactions between pathogen, hot weather and environment. Symptoms also vary: leaf mottling and malformation, silvering of foliage and malformed fruit is the most common. 32 viruses are considered of importance in cucurbits and the situation in South Africa has never been fully clarified with regard to which viruses are present and of importance.

It is not known with certainty how many different viruses are present and in which regions. No effective overall resistance is available presently, though resistance to some viruses is. Control of virus diseases is therefore reliant on vector control and reduction of infection reservoirs. Crops planted when vector populations are low show the lowest level of infection. This is usually following a cold winter. Sanitation of infected plants will slow the spread through a planting. Aphids are the most important vectors in South Africa, though thrips, whitefly, nematodes and fungi are also capable of transmitting some types of virus.

Seed transmission is also possible for some types of virus. All S&G seed productions are regularly inspected during growth for visible signs of infection. All seed lots are also subjected to serological tests before packaging. The probability of seed transmission is minimal.

Powdery mildew
This fungal disease is evident as white spots on the lower leaf surface. These spots expand and coalesce until both upper and lower surfaces are covered. Where the disease is known to be a problem a preventative programme can be followed, otherwise treatment should be applied at the first signs of disease. Instructions on product labels must be strictly adhered to and any programme should be discussed with a competent agro-chemical consultant.

Pumpkin Flies
These pests are small, brown flies with yellow bands or spots on the body. Young fruit are stung and eggs laid inside. These wounds cause distortion of the fruit and a white maggot later develops in the fruit. Treatments can be sprayed or used as a bait.

Growing tomatoes

Soil Preparation

When preparing the soil, plough to a depth of 30-40 cm to ensure good drainage and air-content and to encourage strong rooting. Organic and inorganic fertilizers should be carefully spread and be worked into the soil to a depth of 25 cm. Whether furrows need to be made at this stage will depend on the irrigation method used.

If drip-irrigation is used one can cover the main irrigation line with plastic mulch. This is a length of plastic foil placed over the irrigation tubing. The young plants are planted out through the plas- tic foil. Make sure beforehand that the drips are conveniently placed so that the young plants will benefit from it. The aim of this plastic coverage is to restrict evaporation from the soil. By doing this it also pre- vents salts concentrating at surface level as a result of the evaporation.

For both furrow-irrigation and drip-irrigation the row distance can be 100 cm and the distance between the plants in the row 40-50 cm. In general use a plant density of 20,000-22,000 plant/ha.

Water

The quality of the water depends upon the pH and the salt-concentration. A high pH can be re- duced (neutralised) by the addition of acidifying fertilizers. The tomato can be grouped under the salt-tolerant plants. However, the salt sensitivity varies with the variety. It is difficult to give precise maximum E.C. figures (Electro-Conductivity). Nevertheless high salt-concentrations should be prevented as this results in reduced vegetative growth because of the diminished capacity of the root system for nutrient uptake. In this case fertilizer applications will only increase the problem. The osmotic pressure in the soil will then be raised even further.

Where sweet water is available, then the high salt-concentration in the soil need not form a prob- lem. Using drip-irrigation the salt-concentration around the roots can be washed out. However, in order to achieve an optimal result, the amount of water and the fertilizers dissolved in it must be given in the correct dosage and frequency. Drip-irrigation is preferable to furrow-irrigation and perforated pipes. A sprinkler system cannot be recommended.

The amount of water to be given will depend on such factors as temperature, relative humidity, wind, leaf surface, day-length and salt-concentration of the soil. As a general rule 1-2 litres water per plant per day through a drip-irrigation system is sufficient. A culture in the warm season needs to be very well organized in respect of the amount and frequency of watering.

When either the water or the soil is saline, the frequency of watering will have to be increased while the amount given per application must be decreased. This is to effect a constant dilution of the salts present in the soil.
The first watering should be given with a limited amount of water to encourage setting of the first tomato-cluster.

Fertilizers

The fertilizer programme must be based upon soil analysis results and the appearance of the to- mato plants. Stock fertilizers per 1000 m^2 Manure: 2,500 kg dried cattle or sheep manure Super phosphate should be given before planting. The rate depends on the pH value of the soil and the water. The solubility of phosphates becomes increasingly difficult at higher pH values. Therefore it is useful to have a small surplus of phosphorus present in the soil at all times. The stock fertilizers must be thoroughly spread and incorporated into the soil. Extra fertilizers via drip-irrigation Completely soluble fertilizers are used in a mixture of N: P: K in a ratio of 1: 1.2:2. The combination of ammonium phosphate and potassium nitrate is an example.

		N	P	K
Mono-ammonium phosphate	900 kg	62	414	
Potassium nitrate	1800 kg	234		828
	2700 kg	396	414	828 (units/ha)

Depending on the plant maturity up to 1 g of this fertilizer-mixture per litre water can be added to the irrigation water. When the plant growth requires it one can add ammonium nitrate to the water. However, limit it to 200 mg or less pure N per plant per application.
Pure nitrate fertilizers are not recommended as these

could cause fruit cracking. Generally speak- ing the whole culture will need approx. 400 units N to produce a yield of 10 kg tomatoes per m' or 100,000 kg per ha. in total. This means that + 400 kg pure N, + 480 kg $P_2 0_5$ and + 800 kg $K_2 0$ will be needed per ha.

The amount of available nutrient present in the soil must be subtracted from the above figures to give the exact amount of fertilizers needed. It is of course equally possible to use a compound fertilizer, providing it is completely soluble, has a low salt-content and has a ratio approaching 1: 1.2:2. When the E.C. of the water is higher, re- duce the ratio to 1: 1.2: 1.5.

Here too an N: P: K ratio of 1 :1.2:2 is desirable. Half of the phosphate and potassium requirement can be given as stock fertilizer. With furrow-irrigation the same amount of units N, P and K is given as with drip-irrigation. How- ever, it is important to supply as frequently as possible (e.g. weekly) using small amounts. Take care not to use too much irrigation water in order to avoid leaching out of the fertilizer. Potassium is an important element for the tomato plant; it has a good influence on the flower set- ting and the rooting of the plant. Also it has a strong influence on the fruit quality.

Phosphorus has an important influence on root- development. This is why there should always be a stock of phosphorus in the soil. It also influences flower- induction, the flowering itself and fruit development. Last but not least it plays its part in producing fruits of good end-quality. On poorer soils regular additions of micro- nutrients (trace elements) to the water will be necessary.

Sowing
The preparation of the seedbed and the sowing itself are both extremely important and affect the whole course of the total production.

Traditional method
Sowing is done in a well-prepared and preferably disinfected seedbed. The seedlings remain in the seedbed until planted out. Sow thinly, so that the seedlings will be able to grow undisturbed. For optimal root development use a light soil mixture and keep it thoroughly moist. The ideal soil temperature is 23-25°C. It is very important to avoid any growth disturbance in the seedbed stage.

Raising in pots
An alternative method is to sow more densely in a seedbed or propagating trays and transplant into pots after 8-12 days. Peat pots, paper pots and plastic pots can be used, preferably using a peaty mixture. Here too, the ideal soil temperature is 23-25°C. In a prolonged raising period it is advisable to administer a fertilizer application of ammonium phosphate and potassium nitrate, both as a 1 9 per litre water solution.

Direct sowing
Specially developed drilling machines are used for sowing in trays. The seedbed or raising area should be kept insect-free using fine white netting. White Fly particu- larly can cause considerable damage as the carrier of Yellow Leaf Curl Virus and Golden Mosaic Virus. In the last two methods the pots are placed on plastic foil to prevent root establishment in the soil. In which case roots are damaged at lifting resulting in growth stagnation.

Pruning
It will be necessary to take away the side-shoots regularly in order to encourage good ventilation and fruit setting. If this is postponed too long, larger wounds are made and, particularly in moist weather, diseases such as Botrytis, Pseudomonas and Phytophtora can attack plants. Leaves must only be removed after the lower leaves turn yellow and dry out. It is not advisable to remove leaves above the first cluster, as foliage is necessary for assimilation.

Setting
The critical night-temperature for good fruit setting is 1 D-12°C. When conditions are too humid, the greenhouses must be ventilated, otherwise the pollen cannot be released and poor fruit setting will result. Pollen release can be encouraged by:

- Truss trilling using a mechanical vibrator. Once a week will be sufficient to set the fruits.
- Using an atomizer (mist spray). This method is quicker but less efficient than the vibrator. The atomizer is used once a week, without liquid, to

shake the flowers.
- Tapping with a stick. The wire-supports are tapped so that plants are shaken. This is the least efficient method.

If the night temperature drops below 1 DOC then natural setting is impossible and hormones have to be used. The hormones are sprayed onto the flowers using a fine hand-atomizer. A weekly treat- ment is necessary. It is important to measure the concentration accurately as over-dosage results in malformed and hollow fruits.

Diseases that occur on leaves, stems roots and fruit.
Common fungal diseases include *Phythophthora, Altenaria, Fusarium* and *Botrytis*. Follow latest recommendations for the control of these diseases.

Bacterial diseases include -Spot, -Speck, -Canker and -Wilt. These can be difficult to control un- der wet conditions and this soil borne wilt can be a major problem.

Virus diseases include Tobacco Mosaic Virus (TMV), Tomato Mosaic Virus (ToMV), Tomato Spotted Wilt Virus (TSWV) and more recently in the North of RSA Tomato Yellow Leaf Curl Virus (TYLCV). TMV and ToMV are transmitted by physical contact from people who smoke tobacco and who do not wash their hands before working with the plants. TSWV is transmitted by Thrips and the control of these insects is therefore important. White Fly transmits TYLCV and this insect would need to be controlled.

Greenhouse tomatoes, some cultural aspects
Genetics
In order to understand the cultural aspects of tomato growing better it is interesting to know a little more about the plant. The tomato belongs to the family of the Solanaceous and the genus Lycoperslcan. The flowers are composed, as most Lycopersicon species, of five segments: five sepals and five petals.

The anthers, which contain the pollen, are united in the form of a narrow-necked tube within which lies the style and the pollen receptive stigma. Normally the style is shorter than the anther tube so that the stigma is enclosed within the tube. This arrangement ensures self-pollination since the pollen is shed from inside the anther tube.

The F1 hybrid method has become firmly established for tomato breeding in the last fifty years. Crossing pure lines bred for the purpose creates new F1 hybrids. This job has to be done manually by emasculating the female line and then by pollinating the female line wilh the pollen of the male line.

The breeder's skill lies In judging just which parents should be crossed in order to produce a good hybrid, though trials will always be carried out to confirm or disprove his hopes. The fruit produced on F1 hybrid plants is set as a result of natural self-pollination. It means that we cannot multiply F1 hybrids and that It become segregated In the F2. The fact that a variety is a F1 hybrid does not necessarily mean that it is a good variety, either horticuitu rally or biologically. The method does however provide a very convenient and flexible way of getting acceptable compromises of characters, which are difficult to combine and also allow the simultaneous exploitation of several disease resistances in one variety.

Morphology
The root
Tomatoes usually have a well-defined taproot but (here is also an abundance of lateral roots. The root system may however be modified as a result of cultural operations e.g. root damage during transplanting. This can be of great value when the roots are damaged for any reason. A layer of soil or peatmoss at the stem base will encourage forming new secondary roots.

The plant
We can distinguish indeterminate and determinate varieties. The indeterminate varieties have a sympodial development, which means that there is always a lateral bud available to continue vegetative growth. The others have to be removed. Determinate varieties will develop one or more trusses and will stop forming a new growing point. Most commercial determinate varieties stop after four to six trusses. The number of leaves, which appear before the first truss, varies and is initiated according

to the environmental conditions prevailing during the first weeks of growth. Most of the commercial varieties produce a minimum of seven leaves before the first truss: thereafter there are usually three leaves between trusses on the indeterminate varieties and two on the determinate.

Environmental responses

Light

Light is the energy for plant growth. The accumulation of plant mass is the result of the process of photosynthesis which takes place only when the light intensity reaches a certain level. As well as the intensity, the duration of the radiation influence the level of the photosynthetic activ- ity. What matters most is the total light energy received by the plant. The essential feature of the process is the chemical fixation of the energy by the conversion of carbon dioxide from the air and water from the soil into carbohydrates such as sugar and starch. We could imagine that when the light intensity is high the plant will fully enjoy these conditions and have a good stock of energy in order to make nice trusses. On the contrary the short dull days are unfavorable for growth and development.

Light is not the only factor influencing development of plant, flowers, trusses and fruits. Other im- portant factors are temperature, fertilizer and water.
Breakdown of carbohydrates, produced by photosynthesis during the day, is the energy source for the respiration of the plant. Respiration continues during the night. The longer the night the greater the depletion of carbo- hydrates in favor of the respiration. One can imagine that under conditions with low light and dull days very little energy is left over for the formation of flowers. Temperature influences the quantity of energy needed for respiration.

Temperature

The temperature during the first weeks of seedling growth determines the number of leaves before the first truss appears.

- The leaf number being increased above the usual seven when temperature increases
- the respiration increases and more energy is spent on vegetative growth.

High night temperatures develop tall and thin plants with the first cluster situated higher than with low temperatures. High respiration causes more intensive depletion of carbohydrates with the ef- fect of strong vegetative growth.

Effect on cluster size

Most commercial varieties will develop either as a single, unbranched truss or as a truss with two or more branches. Truss branching and the number of flowers is influenced by the temperature at truss development. Truss development has taken place approximately three weeks before we can observe the truss. At lower temperatures trusses will become more branched than at high temperatures but there is also some interaction of light. It is obvious that here too the process of respiration, the breakdown of carbohydrates, plays a major role.

In practice both growers and plant nurseries play with temperatures to obtain the type of plant they prefer. Low temperatures to get an early truss with many flowers on the first truss or higher temperatures to develop a more vigorous plant with the first truss coming out later.

Even when the flowers are developed “truss abortion” can occur totally or partly. Development of trusses and flowerbuds depend on the availability and distribution of carbohydrates (energy) in the plant. An insufficient level of carbohydrates at the stage of truss development will result in either weak, not fully developed flowers or even truss abortion. As mentioned before temperature is a key factor to this as at higher temperatures the developing leaves take a larger share of the avail- able energy which goes at the expense of truss and flower development.

Growing greenhouse tomatoes

During periods with high night temperatures:
The most difficult period for plant raising is during the period when night temperatures are high. During this period measurements have to be taken to reduce the vegetative growth. It is better in this situation to sow on a seedbed and transplant than sowing direct in pots. At transplanting the plants will get a little shock, as some roots will break-off during the transplant process. The

small plants should be planted deep, till the cotyledons. Another possibility is to sow in trays with a small root volume. Make sure roots are air¬pruned this will help to slow-down the vegetative growth.
Watering should take place a few times with a soluble fertilizer with relative high amount of potas- sium and phosphorus. Maximum EC of water with fertilizer should be 1.
Important:

- Avoid transplanting of too old and tall plants.
- Keep plants after transplanting as dryas possible in order to avoid too much vegetative growth. When irrigating, add phosphorus to stimulate root development.

Often during these periods there are large differences between day and night temperatures. In these conditions the accumulation of energy in the plant during the day is low and also the de- pletion of energy during the night, by respiration, is low due to the low temperatures, unless we heat the nursery.

The result is a very slow development of a plant with less leaves till the first truss and trusses with more flowers than when producing plants during periods with high night temperatures.

In the greenhouse one should try to control the balance between vegetative and generative growth as much as possible by controlling irrigation and fertilization (fertigation) and climate control. Recommended plant density is 2,5 plants/m-. Plants have to be trimmed on one or two stems by removing the side shoots in an early stage.

- Decrease the relative humidity, which helps to avoid fungal and bacterial diseases
- Help pollination, as pollen is not released well from the anthers at a relative humidity above 70%.

At temperatures above 12°C and relative humidity below 70% natural fruit set will take place. Fruit set can be improved by:

- Tapping the wires on which plants are trellised
- Using electric vibrators
- Bumble bees

At temperatures below 12°C one can use hormones to make the fruit grow out. By using hormones under these conditions one will obtain:

- Better fruit set
- More earliness
- Bigger fruit size

Disadvantages are:

- Less firm and hollow fruits
- Less keeping quality
- High percentage of deformed fruits and hollow fruits when high concentration of hor- mones is used

When using hormones:

- Make sure the soil is sufficiently humid and there are enough nutrients available for the plants. Shortage of either water or nutrients will increase the chance of getting deformed fruits.
- Always start with an application of the lowest dose. Increase the dose when weather con- ditions are becoming worse and decrease the dose when weather conditions improve.

Fertigation
Production both for yield and quality are directly influenced by the fertigation. The control in sandy soils, and substrates is relatively easy as these growing media have a mini- mum retention of ions and one can quickly influence the behavior of the plants. On the other hand it requires high skills to get the maximum out of the plants. An error is easily made and a power cut of several hours can destroy the whole planting.

In heavy loamy soils with a high ionic retention and bad drainage the control of the plant is much more difficult. The stock of fertilizers and water in these type of soils prevents a quick change in the behavior of the plants by a change in fertilizing and irrigation.

EC and pH are the key factors.
EC multiplied by 0,64 expresses the concentration of ions dissolved in mg/l or p.p.m. In soil cultures the EC should be measured at least once a week in substrate cultures daily. When growing in soil EC figures can increase due to insufficient irrigation or an excess of fertilizers. On the

contrary an excess of water or a strong growth can cause a drop in EC.
The use of tensionmeters to control the water content in the soil is recommended. One tensionme- ter should be placed at the root level and the other should be placed under the root level to check that enough watering is done and prevent over-watering.

EC levels in soil			
Sandy soils	- no manure	- start crop	2,5 - 3
Sandy soils	- manure	- start crop	2 - 2,5
Heavy soils	- no manure	- start crop	2 - 2,5

Recommended EC levels different growing stages
Seedling stage: 2,5
Growing till first truss has completely set: 1,8
1 st to 5th truss 1,6 - 2 depending on weather conditions and plant growth
5th truss to end crop 1,8 - 2,2

EC in soil/medium should not differ more then +/- 05 with irrigation water. Adaptation by chang- ing EC irrigation water by not more then 0,2 at the time Management of EC in the soil/medium is essential for successful crop.

When growing in a medium the best is to use a pH neutral medium. In case the growing medium is not pH neutral this may have consequences for the availability of minerals to the plant. In the worst situation minerals can be blocked completely. Both in soil and growing medium it is best to keep the pH between 5,5 and 6,2. When pH is chang- ing it is very important to make sure the availability of some micro-nutrients are sufficiently avail- able (Fe, Bo, Mn, Zn, Mo, Co). When pH is getting high (> 6,8) Ca can be blocked which in combination with high EC may cause Blossom End Rot.

Nutrient ratios

Ratio	N	P_2O_5	K_2O
Planting till 4th truss	1	1-1,5	1,2-1,5
Beginning harvest - end crop	1	0,5-1	1,5-2

Ratio K: Ca should not exceed 10: 6, too much potash makes uptake of Ca difficult. We know two major physiological problems, which are strongly linked to growing fertigation, blotch ripening and blossom, end rot.

Symptoms are flattened, blotchy, brownish-grey areas that develop on green fruits.

As the fruits mature these blotchy areas remain grey or turn yellow resulting in uneven ripening. When the fruit is cut, dark brown vascular tissue can be seen in the fruit walls This phenomenon is caused by:
- Genetic sensitivity
- KIN relation too low (< 2)
- Lack of light
- Strong temperature fluctuations
- Low EC

At blossom end fruit starts rotting, sunken brown / black area plant has a shortage of Ca and takes the Ca from the fruits to achieve right levels of Ca in the vegetative part of the plant.
- Genetic sensitivity
- Ca deficiency
- Ratio K: Ca (> 10: 6)
- Ca blocked due to high pH
- Ca blocked by high EC (disturbs transport of Ca in the plant)

Damping Off results in loss of young seedlings due to a complex of fungi. The growing medium can be treated before sowing the seed or can be applied before or after germination.

Using correct spray programs can control regular treatment for leaf diseases like Phytophthora, Altenaria, Furarium, Botrytis, Stemphyllium and Bacterial Spot and Speck. Fusarium Crow Rot can be difficult to control with chemicals. Use tolerant varieties. People who smoke tobacco and who do not wash their hands before working with the plants physically transmit Tobacco Mosaic Virus and Tomato Mosaic Virus.

Tomato Spotted Wilt Virus (Kromnek) is transmitted by Thrips and can be difficult to control. Use tolerant varieties. White Fly transmits Tomato Yellow Leaf Curl Virus and the best control measure is to use tolerant varieties.

Processing tomato

Soil preparation

Ploughing, winter scuffling, harrowing to get a good soil mincing, preparation of seed beds (150 cm), ploughing out/tillage after transplanting.

Sowing/Transplanting

- Direct sowing F1 types: 60.000-100.000 seeds per ha. Distance between rows 150 cm.
- Direct sowing standard (O.P.) types: 100.000-200.000 seeds per ha. Distance between rows 150 cm.
- Transplanting 26.000-30.000 plants per ha. 150 cm; in-row distance 22-25 cm.

Fertilizers

As a rule one has to fertilize the crop taking into consideration the crop's uptake ability. In sandy-loam and light clay soils one can follow the scheme below. In pure sandy soils the amount of fertiliser should be divided over the crop's growing period.

Nitrogen

80-120 N/ha. 60% of which before planting in Anhydrous Ammonia form; the remaining 40% as covering in nitric form. It is very important to check the amount of Nitrogen as too much will cause a delay and loss of concentration in ripening of the fruits.

Phosphorus

120-180 $P_2 0_5$ /ha before planting.

Potassium

180-300 K_2O/ha. 80% of which before planting and the remaining 20% as covering. Calcium, Magnesium and Sulphur are also very important.

Irrigation

Irrigation needs particular attention. The irrigation should be shut down when 30 to 40% of the fruits are ripe. With shutting down it is meant that the irrigation should maximally be decreased but the crop should not completely die due to lack of water.

Harvesting Methods

Manual harvesting

Mechanical harvesting (Italian machinery: Sandei-FMC; Guaresi; Gallignani)

Sundried tomatoes

Sun dried tomatoes are, as the word says, dried in the sun. Generally this is only done in regions and periods where and when a high number of sun hours can be expected. Also relative hummidity in these areas is very low. The lower the better. Important for drying tomatoes is that there is sufficient wind to accelerate the drying process. Tomatoes are placed in a single layer on frames with an iron or plastic wiring system (like a net with rather big holes).

Air can reach the fruits from all sides. Generally fruit size used is approx 100 grs. but bigger and smaller is also possible. Important is the % brix, the higher the better. After harvest fruits should be washed and when required by the market graded. Damaged fruits can be used in separate grading.

Fruits should after washing and grading be cut in length (when you keep the two halves attached on the down side this will save labour when putting them on the tables to dry). Cutting edge of the fruit should be on top when the nets are put on. Put salt on the open fruits to help the dehydrating process and to conserve them.

In Italy (most important producer for sundried tomatoes in Europe) the drying process takes
4 days under optimal conditions.

Dried fruits are washed in water of 70^{0}C with a little vinegar to remove salt and dirt. After washing fruits are dried for 7 hours in a hot air oven at 40^{0}C.

After this, one can make a final preparation with olive oil, herbs etc. or just market them as they are.

Watermelon

Refreshing and sweet

Growing watermelons

Introduction

Watermelons are mainly grown flat outdoors. To supply an early market the use of low plastic tunnels can advance the culture by creating a suitable microclimate and raising the soil temperature.

Soil

Well-drained soils with good aeration and moisture retention are preferred. A timely addition of organic material, well decomposed, can help in obtaining the right soil structure. A slightly acid to neutral pH (6.5 - 7.0) in the soil, provides best growing conditions. Work the soil deeply to create optimal conditions for root development.

Fertilisers

Before planting apply approx. SO t/ha of organic material e.g. farmyard manure. When (according to a recent soil-analysis) the soil has a good balance of available nutrients watermelons need approx.:

- before planting	60 kg/ha N	130 kg/ha P_20_5	200 kg/ha K_20
- after planting	100 kg/ha N	0 kg/ha P_20_5	150 kg/ha K_20
total	160 kg/ha N	130 kg/ha P_20_5	350 kg/ha K_20

If, during the culture, it becomes apparent that one of the elements is deficient, apply a top dressing. Also if necessary apply approx. 40 kg/ha MgO.

Sowing

Next to direct sowing, consideration should be given to the use of transplants. Sowing can be done in pressed peat blocks or in tray cells. Size of block should be 5 x 5 cm. Water the planting medium thoroughly and allow to drain for 4-6 hours before sowing. After sowing the optimal air temperature should be at least 25 °C, although outdoors this is difficult to regulate. Transplanting can take place 3 - 4 weeks later when the young plant has 3 - 4 true leaves. Harden-off the plants before planting. This can be done by lowering the greenhousetemperature, reducing irrigation, or moving the plants outside to increase their exposure to field conditions. When sown directly make sure that the soil temperature is at least 20 °C.

Plant spacing

Plant spacing in the field will vary depending upon location, cultural practices and production equipment used. Rows are 2.0 - 2.5 m apart with 1.0 - 1.2 plants per running meter (5OOO pl/ha). Placing windbreaks to protect the crop proves beneficial. Fruit-setting is improved byplacing bee hives in the field (3 - 4 beehives per ha).

Irrigation

Irrigate as necessary by means of a sprinkler, a drip or a furrow system. After transplanting irrigate immediately to allow the young plants to develop their roots. It is advisable not to irrigate from the time of sowing or planting until the first fruit setting. This will stimulate the roots to penetrate deeply into the moisture level of the soil. Irrigate well after fruit setting and during further develop- ment. Avoid irrigation immediately before harvesting, as this will affect the quality of the fruits.

Harest

Harvest the watermelons just before they reach maturity. They will ripen sufficiently during trans- port. To maintain a good quality watermelon, harvest early in the morning to avoid the field heat. If watermelons are stored under controlled temperature conditions, do not let the temperature drop below 10 °C to avoid chilling injury.

Crop Protection

Programmes

Crop Programme

Brassica Vegatable Group

BRASSICA VEGETABLE GROUP

Stage:	Pre-Germination	Nursery	Transplanting	Rossette	Head	Harvest	RATE	PHI
Days:	-10	1-12	13	14-40	41-50	50+	ALWAYS REFER TO LABEL	DAYS
Fungicides								
White Blister (Albugo candida)			Amistar Amistar Opti Bravo 720 Ridomil Gold Flo				500-1000ml/ha 3.125L/ha 2L/ha 2L/ha	14 7 14 14
Alternaria leaf spot (Alternaria spp)			Amistar Bravo 720 Amistar Top Switch				500-1000ml/ha 1.3L/ha 800-1000ml/ha 800-950g/ha	14 14 3 7
Anthracnose (Colletotrichum higginsianum			Amistar Top				800-1000ml/ha	3
Black spot (Alternaria spp.)			Amistar				500-1000ml/ha	14
Basal stem rot (Phytopthora spp.)		Ridomil Gold 480SL					1.2-2.3L/ha	7
Cercospora leaf spot (Cercospora spp.)			Amistar Top Amistar Switch***				800-1000ml/ha 500-1000ml/ha 800-950g/ha	3 14 7
Damping-off(Pythium spp.)		Ridomil Gold 480SL					0.29-0.58L/ha	7
Powdery Mildew (Erysiphe polygoni)			Amistar Top Switch				800-1000ml/ha 700-840g/ha	3 7
Pin rot (Alternaria spp.)			Amistar				500-1000ml/ha	14
Downy Mildew (Peronospora parasitica)			Revus Bravo 720 Ridomil Gold 480SL Amistar				550ml/ha 1.3L/ha 0.14-0.29L/ha 500-1000ml/ha	1 14 7 14
Ring Spot (Mycosphaerella brassicicola)			Topaz 200EW* Bravo 720				12.5ml/100L water 1.8-3.5L/ha	7 14
Insecticides								
Diamond back moth			Ampligo Karate Zeon 10CS Proclaim Selecron 500EC*** Voliam Targo Sorba				100-200ml/ha 50-70ml/100L water 250-336g/ha 1L/ha 500ml/ha 60-80ml/100L water	3 3 7 10*/7 3 7
African Bollworm			Ampligo Voliam Targo Karate Zeon 10CS Proclaim				100-200ml/ha 500ml/ha 4ml/100L water 250-336g/ha	3 3 3 7
Armyworm			Ampligo Voliam Targo Sorba Karate Zeon 10CS Proclaim				100-200ml/ha 500ml/ha 500-1000ml/ha 50-70ml/100L water 250-336g/ha	3 3 7 3 7
False armyworm			Sorba				500ml-1000ml/ha	7
Cabbage semi-looper			Selecron 500EC*** Voliam Targo Ampligo Karate Zeon 10CS				1L/ha 500ml/ha 100-200ml/ha 35-60ml/100L water	10*/7 3 3 3
Leafminer			Patron 75WP				190g/ha	7
Greater Cabbage Moth			Ampligo Voliam Targo Selecron 500EC				100-200ml/ha 500ml/ha 1L/ha	3 3 10*/7
Cutworm			Ampligo Karate Zeon 10CS				100-200ml/ha 35ml/ha	3 3
Aphids			Actara	Aphox Chess Selecron 500EC+ Karate Zeon 10CS			0.0083ml/plant 250g/ha 20-60g/100L water 0.75L/ha 50-70ml/100L water	50 7 7 10*/7 3
Whitefly			+ Ampligo + Chess + Karate Zeon 10CS				100-200ml/ha 20-60g/100L water 50-70ml/100L water	3 7 3
Thrips			Ampligo + Karate Zeon 10CS				100-200ml/ha 50-70ml/100L water	3 3
Stink bugs			Ampligo				100-200ml/ha	3
Bagrada bug			Ampligo				100-200ml/ha	3
Herbicides								
Select annual/perrenial grasses	Fusilade Forte*						1.67-3.33L/ha	40
Annual grasses and broad leaf weeds	Gramoxone Preeglone						1.25-5L/ha 1.25-2.5L/ha	N/A N/A
Seed Treatments								
Damping off /seedling blight	Apron XL Celest						20-40ml/100kg seec 5-10ml/100kg seec	N/A N/A
Seeds								
Cauliflower Broccoli Brussels Sprouts Cabbage								

This program is recommended for the BRASSICA VEGETABLE GROUP and is therefore registered for use on the following crops (unless otherwise specified):

Broccoli; cauliflower; cabbage; mustard greens, Chinese broccoli (gai lon); raab broccoli (rapini); Brussels sprouts; Chinese cabbage (bok choy); Chinese cabbage (napa); Chinese mustard cabbage (gai choy); cavalo broccolo; collards; kale; kohlrabi; mizuna; mustard spinach; rape greens

Exceptions
* Brussels Sprouts only
** Cabbage only
*** Cabbage, Cauliflower & Brussels sprouts only
\+ Supression only
PHI - PRE-HARVEST INTERVAL

CARROT / ROOT VEGETABLES

Stage:	Pre-Germination	Germination	Leaves and Shoots	Roots	Harvest	RATE	PHI
Days:	-10	0-14	21-25	26-75	75+	ALWAYS REFER TO LABEL	DAYS
Fungicides							
Powdery mildew (Erysiphe spp. & L. taurica)			Amistar Top**			880-1000ml/ha	7
			Amistar^			650-1000ml/ha	1
			Switch			800-950g/ha	7
Southern blight (Sclerotium rolfsii)			Amistar Top**			880-1000ml/ha	7
	Amistar^					4-8ml/100m row	1
			Amistar**			500-1000ml/ha	1
Alternaria leaf spot (Alternaria alternata)			Amistar^			500-1000ml/ha	1
Grey Mould (Botrytis cinerea)			Bravo 720***			1.8-2.3L/ha	7
Leaf Blight (Alternaria dauci)			Amistar Top**			500ml/ha	7
			Amistar**			500-1000ml/ha	1
			Amistar Opti**			2.8L/ha	1
			Bravo 720**			1.8L/ha	7
			Score**			300-500ml/ha	7
			Switch			800-950g/ha	7
Leaf Blight (Cercospora carotae)			Score**			300-500ml/ha	7
			Amistar**			500-1000ml/ha	1
			Amistar Top**			880-1000ml/ha	7
			Amistar Opti**			2.8L/ha	1
			Bravo 720**			1.3-1.8L/ha	7
			Bravo 720**			1.3-1.8L/ha	7
Cercospora Leaf Spot (Cercospora pastinaceae			Amistar^			650-1000ml/ha	1
Rust (U. betae & P. helianthi)			Amistar^			500-1000ml/ha	1
White Rust (Albugo tragoponis			Amistar^			500-1000ml/ha	1
Root Rot (Pythium spp. And Phytopthora spp.)	Ridomil Gold 480SL					1.2-2.3L/ha	14
	Amistar^					4-8ml/100m row	1
Root Rot (Rhizoctonia solani)	Amistar^					4-8ml/100m row	1
	Amistar**					4-8ml/100m row	1
Insecticides							
Aphids			Aphox*			0.5-1.0kg/ha	2
Cutworm	Karate Zeon 10CS					35ml/ha	50
Herbicides							
Anuual grasses and broadleaf weeds	Gramoxone					1.25-5L/ha	N/A
	Preeglone					1.25-2.5L/ha	N/A
Post Em. Annual & perrenial grasses	Fusilade Forte					1.67-3.33L/ha	40
Seed Treatments							
Seedling Diseases (Rhiz, Fusarium)	Celest					5-10ml/100kg	N/A
	Celest XL#					100-200ml/100kg seec	N/A
	Celest XL White#					100-200ml/100kg seec	N/A
Damping Off	Apron XL#					100-200ml/100kg seec	28
	Apron XL					5.3ml/15L water	28
Seeds							
Varieties	Dordogne Champion						

This program is recommended for the BRASSICA VEGETABLE GROUP and is therefore registered for use on the following crops (unless otherwise specified

Carrot, potato, radish, and sugar beet Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; beet, garden; beet, sugar; burdock, edible; canna, edible; carrot; cassava, bitter and sweet; celeriac; chayote (root); chervil, turnip-rooted; chicory; chufa; dasheen (taro); ginger; ginseng; horseradish; leren; parsley, turnip-rooted; parsnip; potato; radish; radish, oriental; rutabaga; salsify; salsify, black; salsify, Spanish; skirret; sweet potato; tanier; turmeric; turnip; yam bean; yam, true.

Exceptions:
*** Radishes only
** Carrots only
* Beetroot, radish and turnips
^ for leaf production and consumption onl
# Carrots and beetroot only
+ Supression only
PHI - PRE-HARVEST INTERVAL

Crop Programme

Cucurbit Vegetable Group

CUCURBIT VEGETABLE GROUP

Stage:	Pre-Germination	Germination	Transplant	Growth	Side Shoots	Flowering	Fruit Development	Ripening	RATE	PHI
Days:	-10	0-20	21-25	26-40	41-60	61-70	70-100	100+	ALWAYS REFER TO LABEL	DAYS
Fungicides										
Powdery mildew (Sphaerotheca fuliginea & Erysiphe cichoracearum)				Amistar Amistar Opti Amistar Top Thiovit Jet***		Amistar			400-500ml/ha 2.0lL/ha 625ml/ha 380g/100L water	3 3 3 N/A
				Topaz 200EW Switch					22.5-112.5ml/100L water 800-650g/ha	7 1
Downy mildew (Pseudoperonospora spp.)				Amistar Opti Amistar Top Bravo 720 + Revus		Amistar			2.0lL/ha 400-500ml/ha 750-1000ml/ha 1-2L/ha 550ml/ha	3 3 3 3 1
Phytophthora blight			+ Revus						550ml/ha	1
Anthracnose (Colletotrichum spp.)				Amistar Opti Amistar Amistar Top Bravo 720					2.0lL/ha 400-500ml/ha 750-1000ml/ha 1-2L/ha	3 3 3 3
Alternaria leaf blight (Alternaria spp.)				Amistar Top Bravo 720 Amistar Opti Switch		Amistar			750-1000ml/ha 400-500ml/ha 1.6-2.5L/ha 3.7L/ha 800-650g/ha	3 3 3 3 1
Alternaria leaf spot (Alternaria alternata)				Switch Bravo 720					800-650g/ha 1.8-2.6L/ha	1 3
Cercospora leaf spot (Cercospora citrullina)				Amistar Top Bravo 720 Amistar Opti		Amistar			750-1000ml/ha 400-500ml/ha 1.6-2.5L/ha 3.7L/ha	3 3 3 3
Damping Off (Pythium spp.)			Ridomil Gold 480SL						1.3-2.1L/ha	5
Gummy stem blight (Didymella bryoniae)				Amistar Opti Bravo 720					3.7L/ha 1.6-2.5L/ha	3 3
Belly rot (Rhizoctonia solani)			Amistar Top Amistar Bravo 720 Amistar Opti						750-1000ml/ha 400-500ml/ha 1.6-2.5L/ha 3.7L/ha	3 3 3 3
Root rot (Pythium spp.)			Ridomil Gold 480SL						0.29-0.47L/ha	5
Scab (Cladosporium cucumerinum			Bravo 720						1.8-2.6L/ha	3
Septoria leaf blight (Septoria cucurbitacearum				Amistar Top					750-1000ml/ha	3
Post Harvest Treatment (melons)								Tecto**	80ml/25L wax	N/A
Insecticides										
Aphids		Actara		Aphox Karate Zeon 10CS Chess					0.033ml/plant 100-200g/100L water 50-70ml/ha 40-60g/100L water	3 2 1 3
Thrips				Karate Zeon 10CS* + Ampligo*					70ml/ha 100-200ml/ha	1 1
Whitefly				+ Karate Zeon 10CS + Ampligo + Chess					70ml/ha 100-200ml/ha 40-60g/100L water	1 1 3
Looper				Karate Zeon 10CS					50-70ml/ha	1
Leafminer				Agrimec Gold Patron 75WP Karate Zeon 10CS Ampligo					130-260ml/ha 190g/ha 70ml/ha 100-200ml/ha	7 1 1 1
Cutworm	Karate Zeon 10CS		Ampligo						35ml/ha 100-200ml/ha	1 1
African Bollworm				Ampligo					100-200ml/ha	1
Pumpkin fly				Ampligo					100-200ml/ha	1
Stink bug				Ampligo					100-200ml/ha	1
Semi-looper				Ampligo					100-200ml/ha	1
Armyworm				Karate Zeon 10CS Ampligo					50-70ml/ha 100-200ml/ha	1 1
Spider mites				Agrimec Gold					130-260ml/ha	7
Herbicides										
Annual grasses and broadleaf weeds	Gramoxone Preeglone								1.25-5L/ha 1.25-2.5L/ha	N/A N/A
Seed Treatments										
Damping Off	Apron XL Celest								20-40ml/100g seed 5-10ml/100kg seed	28 N/A
Insecticide seed treatment	Cruiser Cruiser White								2.5-75ml/kg seed 1.5-43.7ml/kg seed	N/A N/A
Seeds										
Cucumber Melon Squash Watermelon - seeded Watermelon - seedless yellow Watermelon - seedless Watermelon - baby Watermelon - pollinator										

This program is recommended for the CUCURBIT VEGETABLE GROUP and is therefore registered for use on the following crops (unless otherwise specified

Cucumber, muskmelon, summer squash Chayote (fruit); Chinese waxgourd (Chinese preserving melon); citron melon; cucumber, gherkin; edible gourd (includes hyotan, cucuzza, hechima, Chinese okra); Momordica spp (includes balsam apple, balsam pear, bittermelon, Chinese cucumber); muskmelon (includes cantaloupe, pumpkin; squash, summer; squash, winter (includes buttermut squash, calabaza, hubbard squash, acorn squash, spaghetti squash); watermelon

Exceptions:

* excludes Fromdimetia
** Musk melons only
*** Do not use on Musk melon or cucumbers
Caution when using BRAVO 720 on watermelo
+ Suppression only
PHI - PRE-HARVEST INTERVAL

Crop Programme

Leafy Vegetables Group

LEAFY VEGETABLES GROUP (EXC BRASSICAS)

Stage:	Pre-Germination	Nursery	Transplanting	Rosette	Head	Harvest	RATE	PHI
Days:	-10	1-13	14-40	41-50	51-59	50+	ALWAYS REFER TO LABEL	DAYS
Fungicides								
Downy Mildew (Bremia lactucae)			Revus				550ml/ha	1
			Ridomil Gold 480SL*				0.15-0.29L/ha	7
			Amistar				800-1000ml/ha	1
Alternaria leaf spot (Alternaria spp.)			Amistar				500ml/ha	1
			Switch				800-950g/ha	3
Anthracnose (Colletotrichum dematium			Amistar				500ml/ha	1
Basal stalk rot (R. solani)			Bravo 720**				1.8-2.6L/ha	7
			Amistar Opti**				2.8-4.0L/ha	7
Damping off (Pythium spp		Ridomil Gold 480SL					1.2-2.3L/ha	7
Early blight (Cercospora apii)			Bravo 720**				1.2L/ha	7
			Amistar Opti**				2.8-4.0L/ha	7
Cercospora leaf spot (Cercospora spp.			Amistar				500ml/ha	1
Septoria leaf spot (Septoria lactucae)			Switch				800-950g/ha	3
Septoria leaf spot (Septoria petroselini)			Bravo 720**				1.8L/ha	7
			Amistar				500ml/ha	1
Grey mould (Botrytis cinerea)			Switch				800-950g/ha	3
Pink rot (Sclerotinia sclerotiorium			+ Bravo 720**				2.6L/ha	7
Rhizoctonia seedling blight (R. solani)	Amistar						4-8ml/100m row	1
Late blight (Septoria apicola)			Amistar Opti**				2.8-4.0L/ha	7
Sclerotinia rot			+ Switch				800-950g/ha	3
Powdery mildew (Erysiphe cichoracearum)			+ Switch				800-950g/ha	3
			Amistar				800-1000ml/ha	1
Insecticides								
African Bollworm			Proclaim				150-336g/ha	7
			Ampligo*				200ml/ha	1
Armyworm			Proclaim				150-336g/ha	7
			Ampligo*				200ml/ha	1
			Karate Zeon 10CS*				50-70ml/ha	1
Semi-looper			Ampligo*				200ml/ha	1
Looper			Karate Zeon 10CS*				35-60ml/ha	1
Leaf hopper			+ Karate Zeon 10CS*				50-70ml/ha	1
Leaf miner			Agrimec Golc				130-260ml/ha	7
			Patron 75WP				190g/ha	7
			Ampligo*				200ml/ha	1
Stink bug			Ampligo*				200ml/ha	1
Cutworm		Ampligo*					200ml/ha	1
		Karate Zeon 10CS					35ml/ha	1
Diamond back moth			Karate Zeon 10CS*				50-70ml/ha	1
			Ampligo*				200ml/ha	1
Aphids			Aphox***				50-200g/100L water	2
			Chess				40-60g/100L water	7
Whitefly			+ Ampligo*				200ml/ha	1
			+ Chess**				40-60g/100L water	7
			+ Karate Zeon 10CS**				50-70ml/ha	1
Thrips			Ampligo*				200ml/ha	1
Spider mites			Agrimec Golc				130-260ml/ha	7
Herbicides								
Annual grasses and broadleaf weeds	Gramoxone						1.25-5L/ha	N/A
	Preeglone						1.25-2.5L/ha	N/A
Seed Treatments								
Seedling diseases	Celest						5-10ml/100kg seec	
	Celest XL						100-200ml/100kg seec	
	Celest XL White						100-200ml/100kg seec	
	Apron XL						20-40ml/100kg seec	28
Seeds								
Lettuce								

This program is recommended for the LEAFY VEGETABLE GROUP (EXCLUDING THE BRASSICAS) and is therefore registered for use on the following crops (unless otherwise specified):

Celery, head lettuce, leaf lettuce, and spinach Amaranth (Chinese spinach); arugula (roquette); cardoon; celery; celery, Chinese; celtuce; chervil; chrysanthemum, edible-leaved; chrysanthemum, garland; corn salad; cress, garden; cress, upland; dandelion; dock (sorrel); endive (escarole); fennel, Florence; lettuce, head and leaf; orach; parsley; purslane, garden; purslane, winter; radicchio (red chicory); rhubarb; spinach; spinach, New Zealand; spinach, vine; Swiss chard

Exceptions:

* Lettuce only

** Celery only

*** Endive, lettuce and spinach only

\+ Suppression only

PHI - PRE-HARVEST INTERVAL

Crop Programme

Legume Vegetables

LEGUME VEGETABLES

Stage:	Pre-Germination	Germination	Leaf Development	Side Shoots	Inflorescence Development	Flowering	Pod Development	Harvest	RATE ALWAYS REFER TO LABEL	PHI DAYS
Days	-10	1-9	10-19	21-29	51-59	60-69	71-75	79		
Fungicides										
Brown rust (U. appendiculatus)				Bravo 720 Amistar Opti Amistar		Amistar Top*			0.7-1.4L/ha 1.8-2.8ml/ha 500ml/ha 500ml/ha 250ml/ha	3 14 1 45 14
Anthracnose (C. lindemuthianum)				Amistar Opti	Score	Amistar Top* Amistar			1.8-2.8L/ha 500ml/ha 500-1000ml/ha 1.2-1.8L/Ha	14 45 1 3
Alternaria blight (Alternaria spp.)				Amistar Opti Amistar	Bravo 720*				1.8-2.8L/ha 500-1000ml/ha	14 1
Alternaria leaf spot (A. alternata)				Amistar Opti Amistar					1.8-2.8L/ha 500-1000ml/ha	14 1
Ascochyta leaf spot (A. phaseolorum)				Amistar Opti Amistar					1.8-2.8L/ha 500-1000ml/ha	14 1
Ascochyta blight (Mycosphaerella pinodes)				Amistar Opti	Bravo 720*				1.8-2.8L/ha 1.2-1.8L/Ha	14 3
Ascochyta leaf & pod spot (Ascochyta spp.)				Amistar Opti Amistar					1.8-2.8L/ha 500-1000ml/ha	14 1
Bean Rust (Phakospora spp.)				Amistar Opti Amistar					1.8-2.8L/ha 500-1000ml/ha	14 1
Cercospora leaf blotch (C. cruenta)					Bravo 720*				1.2-1.8L/Ha	3
Chocolate spot (Botrytis fabae)					Bravo 720**				1.4-2.3L/ha	3
Powdery mildew (Oidium spp.				Topaz 200EW***					300ml/ha	7
Powdery mildew (Erysiphe pisi				Topaz 200EW****					110ml/ha	7
Downy mildew (Phytopthora nicotianae					Bravo 720*				1.2-1.8L/Ha	3
Web Blight (Rhizoctonia solani)				Amistar Opti Amistar					1.8-2.8L/ha 500-1000ml/ha	14 1
White Mould (Sclerotinia sclerotiorum						Switch			800-950g/ha	7
Rhizoctonia root rot (Rhizoctonia solani	Amistar								4-8ml/100m row	1
Southern blight (Sclerotium rolfsii				Amistar					500-1000ml/ha	1
Grey Mould (B. cinerea)					Switch Bravo 720				800-950g/ha 2.6L/ha	7 3
Insecticides										
Cutworm		Karate Zeon 10CS Ampligo							35ml/ha 100-200ml/ha	1 7
Armyworm		Ampligo Proclaim Sorba							100-200ml/ha 200g/ha 500-1000ml/ha	7 14 14
False Armyworm		Sorba Ampligo Proclaim							500-1000ml/ha 100-200ml/ha 200g/ha	14 7 14
Bollworm			Ampligo		Karate Zeon 10CS				50ml/ha 100-200ml/ha	1 7
Aphids					Aphox				500g/ha	2
Leafminer				Patron 75WP	Agrimec Gold Ampligo				130-260ml/ha 100-200ml/ha 20g/100L-150g/1000L wate	7 7 3
Red spider mite					Agrimec Gold Thiovit Jet				130-260ml/ha 400g/100L wate	7 0
Semi-looper			Ampligo						100-200ml/ha	7
Pumpkin fly					Ampligo				100-200ml/ha	7
Stink bug					Ampligo				100-200ml/ha	7
Tomato moth		Ampligo							100-200ml/ha	7
Whitefly					Ampligo				100-200ml/ha	7
Thrips				Thiovit Jet Agrimec Gold Ampligo					400g/100L wate 130-260ml/ha 100-200ml/ha	0 7 7
Herbicides										
Annual/Perennial Grasses			Fusilade Forte						0.83-1.67L/ha	40
Annual Grasses (Pre)		Metagan Gold Dual Gold							0.6-1.3L/ha Label Rate	N/A N/A
Yellow nutsedge (Pre)		Metagan Gold Dual Gold							0.6-1.3L/ha Label Rate	N/A N/A
Contact broadspectrum	Gramoxone Preeglone								1.25-5L/ha 1.25-2.5L/ha	N/A N/A
Annual Broadleaf Weeds		Flex							1L/ha	14
Seed Treatments										
Damping off /seedling blight	Apron XL Celest Celest XL Celest XL White								40ml/100kg seec 5-10ml/100kg seec 100-200ml/100kg seec 100-200ml/100kg seec	28 56 56
Seeds										
Bean Varieties Peas Varieties										

This program is recommended for the LEGUME VEGETABLE GROUP and is therefore registered for use on the following crops (unless otherwise specified):

Bean (Phaseolus) (succulent & dried), pea (Pisum) (succulent & dried) and soybean Bean (Lupinus) (includes grain lupin, sweet lupin, white lupin, and white sweet lupin); bean (Phaseolus) (includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean); bean (Vigna) (includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean); broad bean (fava); chickpea (garbanzo); guar; jackbean; lablab bean; lentil; pea (Pisum) (includes dwarf pea, edible-podded pea, English pea, field pea, garden pea, green pea, snowpea, sugar snap pea); pigeon pea; soybean; soybean (immature seed); sword bea

Exceptions
* Dry Beans
** Broad Beans, Faba Bean
*** Lupins
**** Peas and Mange Tout
PHI – PRE-HARVEST INTERVAL

NOINO

Stage:	Pre-Germination	Nursery	First Leaf	Growth	Bulb Development	Swelling	Leaf Fall/Complete	Drying	RATE	PHI
Days:	-10	0-15	15-25	26-40	41-60	61-90	90-150	100+	ALWAYS REFER TO LABEL	DAYS
Fungicides										
Purple blotch (Alternaria porri)				Amistar					400ml/ha	20
				Amistar Opti					1.8-3.7L/ha	14
				Amistar Top					500-1000ml/ha	7
				Bravo					1.8-2.3L/ha	14
				Chorus					700g/ha	7
				Switch					800-950g/ha	7
Stemphylium leaf blotch/blight (Stemphylium vesicarium)				Amistar					400ml/ha	20
				Amistar Top					500-1000ml/ha	7
				Switch					800-950g/ha	7
Botrytis leaf blight (Botrytis aclada)				Amistar Top					500-1000ml/ha	7
				Amistar					400-870ml/ha	20
				Bravo					1.3-2.6L/ha	14
				Chorus					700g/ha	7
				Switch					800-950g/ha	7
Botrytis neck rot				Chorus*					700g/ha	7
				Bravo					1.3-2.6L/ha	14
				Switch*					800-950g/ha	7
Cercospora leaf spot (Cercospora spp)				Amistar Top					500-1000ml/ha	7
Damping Off (Pythium spp)		Ridomil Gold 480SL							0.6-1.2L/ha	14
Powdery mildew (Leveillula taurica)				Amistar Top					500-1000ml/ha	7
Black mould				Switch					800-950g/ha	7
Rust (Puccinia allii)					Amistar				400-870ml/ha	20
Rhizoctonia damping off (Rhizoctonia solani)		Amistar							4-8ml/100m row	20
Downy mildew (Peronospora destructor)				Amistar Opti					2.8-4.0L/ha	14
				Amistar					400-800ml/ha	20
				Bravo					2.3L/ha	14
					Revus				550ml/ha	7
Insecticides										
Aphid			Aphox***						50g/100L water	2
Cutworm	Karate Zeon 10CS								35ml/ha	3
Leafminer				Agrimec Gold**					130-260ml/ha	30
				Patron 75 WP					190g/ha	7
Thrips				Karate Zeon 10CS**					40-60ml/ha	3
				Selecron 500EC					1L/ha	14
				Agrimec Gold**					130-260ml/ha	30
Herbicides										
Select annual/perrenial grasses	Fusilade Forte								0.83-1.67L/ha	40
Annual grasses and broad leaf weeds	Gramoxone								1.25-5L/ha	N/A
	Preeglone								1.25-2.5L/ha	N/A
Seed Treatments										
Seedling Diseases (Rhiz, Fusarium)	Celest								5-10ml/100kg seec	N/A
Damping Off	Apron XL								20-40ml/100kg seec	28
Seeds										
Varieties	Banko									

This program is recommended for the BULB VEGETABLE GROUP and is therefore registered for use on the following crops (unless otherwise specified):

bulb onion, green Chive, fresh leaves; chive, Chinese, fresh leaves; daylily, bulb; elegans hosta; fritillaria, bulb; fritillaria, leaves; garlic, bulb; garlic, great-headed, bulb; garlic, serpent, bulb; kurrat; lady's leek; leek; leek, wild; lily, bulb; onion, Beltsville bunching; onion, bulb; onion, Chinese, bulb; onion, fresh; onion, green; onion, macrostem; onion, pearl; onion, potato, bulb; onion, tree, tops; onion, Welsh, tops; shallot, bulb; shallot, fresh leaves; cultivars, varieties, and/or hybrids of these

Exceptions:

* Suppression only
** Onion only
*** Leeks and shallots only
- Amistar PHI for bulb onions is 20 days, Garlic & Shallot is 1 day and Leek is 3 day
- Amistar Opti PHI for bulb onions is 7 days, Green/bunching onions is 14 day
PHI - PRE-HARVEST INTERVAL

PEPPER / FRUITING VEG GROUP

Stage:	Pre-Germination	Nursery	Leaves and Shoots	Flowering	Fruit Development	Ripening	Harvest	RATE	PHI
Days:	-10	0-20	21-25	26-40	41-60	61-90	90-150	ALWAYS REFER TO LABEL	DAYS
Fungicides									
Powdery mildew (Leveillula taurica)				Amistar #				60ml/100L water	14
				Amistar Opti #				250ml/100L water	7
			Bravo 720					1.3-2.3L/ha	3
				Amistar Top #				250ml/100L water	7
			Topaz 200 EW #					45ml/100L water	7
Powdery mildew (Sphaerotheca spp.'				Amistar #				500-1000ml/ha	14
Anthracnose (Colletotrichum spp.)			Bravo 720					1.3-2.3L/ha	3
				Amistar #				500-1000ml/ha	14
Botrytis leaf or grey mould (Botrytis cinerea)			Bravo 720					1.3-2.3L/ha	3
Cercospora leaf spot (Cercospora spp.)			Bravo 720					1.3-2.3L/ha	3
				Amistar Top #				580-1000ml/ha	7
Damping Off (Pythium spp.'	Ridomil Gold 480 SL							1.2L/ha	7
Crown rot (Phytopthora capsici)	Ridomil Gold 480 SL			Ridomil Gold 480 SL				1.2L/ha	7
			+ Revus					550ml/ha	1
Rhizoctonia seedling rot (Rhizoctonia solani'		Amistar #						4-8ml/100m row	14
Downy mildew (Peronospora tabacina)			Revus					550ml/ha	1
Insecticides									
Whitefly		Actara						0.03ml/plant	45
			+ Chess					40-60g/100L water	1
				+ Ampligo				100-200ml/ha	5
Aphids		Actara						0.03ml/plant	45
			Chess					40-60g/100L water	1
Thrips			Sorba #					200ml/100L water	7
			Ampligo*					100-200ml/ha	5
Red spider mite				Agrimec Gold				130-260ml/ha	7
Broad mite				Agrimec Gold				130-260ml/ha	7
Leafminer				Agrimec Gold				130-260ml/ha	7
				Patron 75 WP #				190g/ha	1
				Ampligo				100-200ml/ha	5
Tomato leafminer moth (Tuta absoluta)				Ampligo				400ml/ha	5
African bollworm			Proclaim					150-336g/ha	7
				Karate Zeon 10CS				3.75ml/100L water	5
			Ampligo					100-200ml/ha	5
Armyworm			Proclaim					150-336g/ha	7
			Ampligo					100-200ml/ha	5
Semi looper				Karate Zeon 10CS				3.75ml/100L water	5
			Ampligo					100-200ml/ha	5
Diamond back moth			Ampligo					100-200ml/ha	5
Stink bugs			Ampligo					100-200ml/ha	5
Cutworm		Karate Zeon 10CS						35ml/ha	5
			Ampligo					100-200ml/ha	5
Herbicides									
Anuual grasses and broadleaf weeds	Gramoxone							1.25-5L/ha	N/A
	Preeglone							1.25-2.5L/ha	N/A
Seed Treatments									
Seedling Diseases (Rhiz, Fusarium)	Celest							5-10ml/100kg seec	
Damping Off	Apron XL							20-40ml/100kg seec	28
Seeds									
Varieties									

This program is recommended for the FRUITING VEGETABLE GROUP (EXCLUDING CUCURBITS) and is therefore registered for use on the following crops (unless otherwise specified)
Tomato, bell pepper, and one cultivar of nonbell pepper Eggplant; groundcherry (Physalis spp); pepino; pepper (includes bell pepper, chili pepper, cooking pepper, pimento, sweet pepper); tomatillo; toma

Exceptions:
* Excluding Frankliniella occidentali
** Okra and Pepino only
& Only for use on nonbell pepper; Eggplant; groundcherry (Physalis spp); pepino; pepper (includes bell pepper, chili pepper, cooking pepper, pimento, sweet pepper); tomati
# Only for use on bell/sweet/chilli pepper,paprika, pimento, piquant
+ Suppression onl
Ampligo registered for Pepper group (#) and Eggpla
PHI - PRE-HARVEST INTERVAL

SWEETCORN

Stage:	Pre-Germination	Germination	4 Leaves	9 Leaves	Stem	Heading	Flowering	Cobs	Ripening	RATE	PHI
Days:	-10	0-5	6-20	21-40	41-60	61-80	81-100	101-120	120+	ALWAYS REFER TO LABEL	DAYS
Fungicides											
Northern corn leaf blight (Exserohilum turcicum)					Score Amistar Top Artea					300ml/ha 500-750ml/ha 500-750ml/ha	14 28+ 21
Rust (Puccinia sorghi)					Artea Amistar Amistar Top					500-750ml/ha 300-500ml/ha 500-750ml/ha	21 7 28+
Grey leaf spot (Cercospora zeae-maydis & C. zeina)					Score Amistar Amistar Top					300ml/ha 400-750ml/ha 500-750ml/ha	14 7 28+
Insecticides											
African bollworm					Proclaim		Karate Zeon 10CS			50ml/ha 150-250g/ha	7 3
Armyworm				Ampligc Proclaim Sorba						200-240ml/ha 200g/ha 500-1000ml/ha	14 3 14
False Armyworm				Ampligc Proclaim Sorba						200-240ml/ha 200g/ha 500-1000ml/ha	14 3 14
Stalk Borer				Karate Zeon 10CS Ampligc						0.5ml/100m row 1.08ml/100m row	7 1
Cutworm	Karate Zeon 10CS									35ml/ha	7
Herbicides											
Annual grasses and broadleaf weeds (Pre)	Bataleur Gold Gramoxone Preeglone									Label rate 1.25-5L/ha 1-2L/ha	N/A N/A N/A
Annual grasses and nutsedge (Pre)	Dual Gold									Label rate	N/A
Seed Treatments											
Seedling Diseases (Rhizoctonia, Fusarium, Pythium, Downy Mildew)	Celest Celest XL Celest XL White Apron XL									5ml/100kg seec 100-200ml/100kg seec 100-200ml/100kg seec 30ml/100kg seec	N/A 35 35 42
Seeds											
Sweetcorn Varieties											

This program is recommended for SWEETCORN only.

* Green Peach Aphid - Myzus persicae
\+ Suppression only
PHI - PRE-HARVEST INTERVAL

TOMATO

Stage:	Pre-Germination	Nursery	Transplant	Growth	Side Shoots	Flowering	Fruiting	Ripening	RATE	PHI
Days:	-10	0-20	21-25	26-40	41-60	61-90	90-150	100+	ALWAYS REFER TO LABEL	DAYS
Fungicides										
Early blight (Alternaria solani)					Amistar Top Amistar Opti Bravo 720 Score Ridomil Gold Pepite				100ml/100L water 330ml/100L water 100-380ml/100L water 35ml/100L water 250-340g/100L water	7 7 3 7 7
Late blight (Phytopyhora infestans)				Amistar Bravo 720 Ridomil Gold Flo Ridomil Gold Pepite Revus					80-120ml/100L water 100-380ml/100L water 300-360ml/100L water 250-340g/100L water 50ml/100L water	7 3 7 7 3
Powdery mildew (Oidiopsis sicula)				Amistar Opti					1.5L/ha	7
Leaf spot (Septoria spp.)				Bravo 720 Ridomil Gold Pepite					100-380ml/100L water 250-340g/100L water	3 7
Botrytis rot (Botrytis cinerea)				Bravo 720					100-380ml/100L water	3
Bacterial speck (Pseudomonas syringae			Bion						7.5g/100L water	3
Bacterial spot (Xanthomonas campestris			Bion						7.5g/100L water	3
Insecticides										
Whitefly			Actara		Pegasus 500SC + Chess				0.03ml/plant 60ml/100L water 80g/100L water	28 4 3
Aphid						Selecron 500EC*			0.5-0.75L/ha	4
Red spider mite			Agrimec Gold		Pegasus 500SC Selecron 500EC				13ml/100L water 80ml/100L water 1.0-1.5L/ha	3 4 4
American leafminer			Agrimec Gold		Patron 75WP				13ml/100L water 20-150g/100L water	3 3
Tomato leafminer (Tuta absoluta)			Ampligo						400ml/ha	3
African bollworm				Karate Zeon 10CS Proclaim					3.75ml/100L water 200g/1000L water	2 1
American bollworm				Selecron 500EC					0.75-1.0L/ha	4
Semi looper				Karate Zeon 10CS Proclaim Selecron 500EC Sorba					3.75ml/100L water 200g/1000L water 0.75-1.0L/ha 80ml/100L water	2 1 4 3
Potato tuber moth		Sorba Selecron 500EC							80ml/100L water 0.75-1.0L/ha	3 4
Onion thrips		Selecron 500EC							0.5-0.75L/ha	4
Cutworm		Karate Zeon 10CS							35ml/ha	2
Rust mite					Thiovit Jet				400g/100L water	N/A
Erinose mite					Thiovit Jet				400g/100L water	N/A
Herbicides										
Annual grasses and broadleaf weeds	Gramoxone Preeglone								1.25-5L/ha 1.25-2.5L/ha	N/A N/A
Seed Treatments										
Seedling Diseases (Rhiz, Fusarium)	Celest								5-10ml/100kg seec	
Damping Off	Apron XL								20-40ml/100kg seec	28
Seeds										
Tomato Indeterminate										
Tomato Determinate										
Tomato Determinate - Processing										
Tomato Indeterminate - Saladette										
Tomato Speciality										

This program is recommended for TOMATOES only.

* Green Peach Aphid - Myzus persicae

\+ Suppression only

PHI - PRE-HARVEST INTERVAL

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