Rockmelon and honeydew information kit

Reprint – information current in 1997

REPRINT INFORMATION – PLEASE READ!

For updated information please call 13 25 23 or visit the website www.deedi.qld.gov.au

This publication has been reprinted as a digital book without any changes to the content published in 1997. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research:

- Chemical recommendations—check with an agronomist or Infopest www.infopest.qld.gov.au
- Financial information—costs and returns listed in this publication are out of date. Please contact an adviser or industry body to assist with identifying more current figures.
- Varieties—new varieties are likely to be available and some older varieties may no longer be recommended. Check with an agronomist, call the Business Information Centre on 13 25 23, visit our website www.deedi.qld.gov.au or contact the industry body.
- Contacts—many of the contact details may have changed and there could be several new contacts available. The industry organisation may be able to assist you to find the information or services you require.
- Organisation names—most government agencies referred to in this publication have had name changes. Contact the Business Information Centre on 13 25 23 or the industry organisation to find out the current name and contact details for these agencies.
- Additional information—many other sources of information are now available for each crop. Contact an agronomist, Business Information Centre on 13 25 23 or the industry organisation for other suggested reading.

Even with these limitations we believe this information kit provides important and valuable information for intending and existing growers.

This publication was last revised in 1997. The information is not current and the accuracy of the information cannot be guaranteed by the State of Queensland.

This information has been made available to assist users to identify issues involved in the production of rockmelon and honeydew. This information is not to be used or relied upon by users for any purpose which may expose the user or any other person to loss or damage. Users should conduct their own inquiries and rely on their own independent professional advice.

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained in this publication.

Queensland Government

Key ISSUES

This section contains more detailed information on some of the important decision making areas and information needs for rockmelons and honeydews. The information supplements our growing and marketing recipe in Section 3 and should be used in conjunction with it. The information provided on each issue is not designed to be a complete coverage of the issue but instead the key points that need to be known and understood. Where additional information may be useful, we refer you to other parts of the kit. Symbols on the left of the page will help you make these links.

Economics of production

One way of assessing the economics of melon production is by calculating the gross margin for the crop. A gross margin is the difference between the gross income and the variable or operating costs. The variable or operating costs include the growing, harvesting and marketing costs. The calculation does not consider fixed or overhead costs such as rates, capital, interest, electricity, insurance and living costs. These fixed or overhead costs must be taken into account in calculating a whole farm budget.

The following gross margin is for rockmelons grown in north Queensland using container grown seedlings, trickle irrigation and plastic mulch.

Assumptions

The calculations assume rockmelons are being grown on plastic mulch and trickle irrigation with good management. All machinery operations include costs for fuel, oil, repairs and maintenance (F.O.R.M.). No allowance is made for owner operator labour.

Gross margin for transplanted rockmelons in north Queensland

GROSS INCOME	Yield (trays/ha)	$/tray	$/ha
	1800	13	23 400

PREHARVEST COSTS	Operations	$/operation	$/tray	$/ha
Machinery costs (F.O.R.M.)				
Ripping	1	$47.47	$0.03	$47.47
Discing	2	$38.82	$0.04	$77.64
Rotary hoe	1	$16.67	$0.01	$16.67
Bed & mulch	1	$22.23	$0.01	$22.23
Planting	1	$44.47	$0.02	$44.47
Tape laying	1	$11.12	$0.01	$11.12
Interrow herbicide	1	$11.12	$0.01	$11.12
Spray application	12	$7.78	$0.05	$93.36
Mulch removal	1	$16.37	$0.01	$16.37
Container grown seedlings	**13 300**	**$0.11**	**$0.81**	**$1 463.00**

Fertiliser		**/ha**	**$/unit**		**$/tray**	**$/ha**
Pre-plant	CK88	300 kg	$0.52		$0.09	$156.00
Trickle	Potassium nitrate	20 kg	$0.94		$0.01	$18.80
	Calcium nitrate	20 kg	$0.69		$0.01	$13.80
	Magnesium sulphate	2 kg	$0.70		$0.00	$1.40
Foliar	Sodium molybdate	2 kg	$34.45		$0.04	$68.90
		Applications	**/ha**	**$/unit**		
Herbicide	Sprayseed	1	3.5 L	$10.21	$0.02	$35.74
Insecticide	Endosulfan	7	2.1 L	$8.77	$0.07	$128.92
	Pirimor	5	1 kg	$42.47	$0.12	$212.35
Fungicide	Ridomil MZ	3	2.5 kg	$33.96	$0.14	$254.70
	Mancozeb	9	2 kg	$7.45	$0.07	$134.10
	Morestan	6	0.4 kg	$75.13	$0.10	$180.31
	Bayfidan	2	0.4 L	$140.99	$0.06	$112.79
	Nimrod	2	0.6 L	$29.96	$0.02	$35.95
	Calixin	2	0.4 L	$81.89	$0.04	$65.51
IF REQUIRED						
Fumigant	Vapam	1	790 L	$1.96		
Nematicide	Nemacur	1	24 L	$39.5		
Water charges		1.5 ML/ha	$36/ML		$0.03	$54.00
Labour cost		37 hours	$11.41/hr		$0.23	$422.17
Irrigation	Trickle tape	6600 m	$0.14/m		$0.51	$924.00
	Layflat (4", 4 year life)	50 m	$4.5/m		$0.13	$225.00
	Plastic mulch	6600 m	$0.09/m		$0.33	$594.00
Hire of hives		4 weeks	2.5 hives	$9/hive/wk	$0.05	$90.00
		$/ha				
Bug checking		$50.00			$0.03	$50.00
TOTAL PREHARVEST COSTS					**$3.10**	**$5 581.89**

POSTHARVEST COSTS

		trays/hr	**$/hr**	**$/tray**	**$/ha**
Harvest & pack					
	Picking	20	$9.48	$0.47	$853.20
	Packing	20	$9.48	$0.47	$853.20
	Precooling			$0.31	$560.00
	Trays			$2.31	$4 158.00
	Machinery costs			$0.27	$480.00
	Cartage on farm			$0.13	$240.00
TOTAL POSTHARVEST COSTS				**$3.97**	**$7 144.40**

MARKETING COSTS

		$/pallet	**pallets/ha**	**$/tray**	**$/ha**
Road freight (Cooled)	Brisbane	$111.00	32.14	$1.98	$3 567.86
(Pallet = 56 trays)	Sydney	$181.00	0	$0.00	$0.00
	Melbourne	$212.00	0	$0.00	$0.00
Commission		12.5%		$1.63	$2 925.00
Levies ($0.20/package)				$0.20	$360.00
TOTAL MARKETING COSTS				**$3.81**	**$6 852.86**

Summary table

	$/tray	$/ha
TOTAL PREHARVEST COSTS	$3.10	$5 582
TOTAL POSTHARVEST COSTS	$3.97	$7 144
TOTAL MARKETING COSTS	$3.81	$6 853
TOTAL VARIABLE COSTS	$10.88	$19 579
GROSS MARGIN	**$2.12**	**$3 821**

Income, costs and gross margin/ha at several prices per tray

$/tray	Gross income	Variable costs	Gross margin
$11	$19 800	$19 129	$671
$12	$21 600	$19 354	$2 246
$13	$23 400	$19 579	$3 821
$14	$25 200	$19 804	$5 396
$15	$27 000	$20 029	$6 971

Gross margin at different yields and prices

	Trays per hectare		
$/tray	1500	1800	2100
$11	– $585	$671	$1 926
$12	$728	$2 246	$3 764
$13	$2 040	$3 821	$5 601
$14	$3 353	$5 396	$7 439
$15	$4 665	$6 971	$9 276

Break even price $10.57

Last update: June 1996

Container grown transplants

Container grown transplants reduce the amount of time the crop is in the field, so reduce the risk of losses and competition from weeds. They are however more expensive to grow than planting seed.

Introduction

Plants are started in trays which consist of a large number of cells. Seeds are planted in a seedling mix in the individual cells. Two plants may be grown in each cell, so the extra root development makes it easier to pull them out. Transplant seedlings into the field once they will pull cleanly out of the tray, that is when the roots have fully penetrated the mix. This is usually when the second or third true leaf has just emerged.

Comparison of transplants with direct seeding

Advantages of container grown seedlings

- Seedlings are raised in a sheltered environment and planted out when conditions are more favourable, giving them a head start over seed planted in the soil.
- Less water is required in establishment.
- Better weed control is possible.
- Seed costs are lower.
- More time is available for land preparation.
- No losses in the field from mice eating seed or from cutworm or wireworm attack.
- Plants mature earlier and fruit maturity is more concentrated.

Disadvantages of container grown seedlings

- It costs more to plant using seedlings than direct seeding.
- Sunburn will cause losses if seedlings get too tall, or are not hardened off properly.

Growing container grown seedlings

Seedlings are best grown by nurseries who have the right equipment and expertise to grow plants well. Poorly grown plants have a lower yield potential than well-grown, sturdy plants. However some growers prefer to grow their seedlings.

To grow healthy seedlings, it is essential to use an open, well-drained, sterile potting mix with sufficient nutrients to give the seedlings a good start. Many different mixes have been used successfully, one mix is shown in Table 1.

Table 1. *A mix used for growing container grown seedlings*

Ingredient	Quantity
Peat	20 L
Vermiculite	20 L
Fine milled superphosphate	100 g
Dolomite	100 g
5:6:5 (N:P:K) fertiliser	30 g
Blood and bone	30 g
Iron sulphate	7 g
Trace elements	7 g

Mix ingredients thoroughly, add about 5 litres of water and mix again. This dampens the peat so that water penetrates more easily into the filled trays. Mix ingredients for up to three minutes. Over-mixing will damage the vermiculite and reduce the aeration and water holding ability of the mix.

Ridomil 50G can be included in the mix at the rate of 2.5 grams per 10 litres of mix to control damping-off (*Pythium* spp.).

A wide range of trays is used but the inverted pyramid Speedling type trays seem to give the best results. The larger the cell, the more space is available for plants and shorter, sturdier plants result. The 64 cell Speedling tray and 90 cell plastic trays are commonly used for rockmelons and honeydews.

To assist uniform and rapid germination, the planted trays are often placed in a warm room on pallets. Great care must be taken to ensure the seedling starts to emerge from the tip of the seed only, before the trays are taken out and placed on racks, either outdoors or in the plant house.

Apply nutrients with a high nitrogen content (for example Aquasol or Thrive), as a foliar spray when plants are about one week old. Spray once or twice weekly until plants are hardened off. Potassium nitrate can also be applied at 2 g/L.

These foliar applications will supply most trace elements. When seedlings are to be planted into a soil known to be low in a particular element (for example molybdenum, zinc or boron), apply special foliar sprays before transplanting. Figure 1 shows a sedling at the three leaf stage ready for planting.

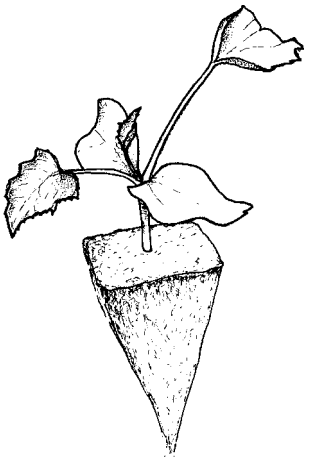


Figure 1. *A melon seedling ready for planting at the third leaf stage*

Things to remember

- Sterilise trays before re-use.
- Do not over-compact mix in trays.
- Keep potting mix moist. Use low output sprinklers which give an even cover of all trays. Cells on the outside of trays tend to dry out faster. Water until trays start to drip.
- Drain water out of pipes before watering. This water may be hot and scald plants.
- Keep trays level to prevent low spots being over watered and high spots left dry.
- Put trays on wire-based, raised benches to allow air pruning of roots. Air pruning prevents root growth out of the bottom of trays because air dries roots out if they come out of the mix.
- Maintain a regular spray program as conditions are ideal for disease development.
- Protect plants from wind and heavy rain.
- Warm conditions in winter, for example a plastic growing house, will result in better plants, grown in a shorter time. In cold areas, heating will allow more accurate scheduling of seeding and planting.

Varieties

The quality of melon that you produce depends mainly on the variety you plant. Some varieties perform better than others in some districts; some have resistance to some diseases; some rockmelons are fully netted while others have sutures.

Seed companies regularly release new varieties. A variety that performed well in one district or on another farm in your area will not necessarily perform well on your farm. We suggest that you try small areas of new varieties on your farm before making large plantings. The variety descriptions below have been supplied by the seed companies.

Rockmelons

Variety descriptions

Note: Sutures are the veins or lines joining the stem and flower ends of many rockmelons.

Dubloon. A slightly oval, fully netted, non-sutured, mid season variety. Fruit has orange flesh and a small cavity. Grows a vigorous vine.

Eastern Star. Early mid-season variety. Large, oval, well netted melon, with medium to coarse textured, slightly open pattern. Pronounced but generally netted sutures. Large stem attachment. Very good quality melon with firm, crisp orange flesh and a medium cavity. Yields well. Grows a vigorous vine.

Eldorado. Early season variety. Very large, round to oval fruit, slightly flattened ends. Moderate netting with medium textured, even, slightly open pattern. Pronounced smooth skinned sutures that tend to turn brown. Stem end depression can result in rejects. Fair quality, reasonable appearance, wide size range but reliable high yields.

Flinders. Round, fully netted, medium sized fruit with bright orange flesh.

Hammersley. Oval, sutured with a good net and orange flesh. Performs best in cool season conditions.

Hiline. A mid to late season melon for inland areas. Oval, fully netted melon with bright orange flesh.

Hot Shot. Mid-season variety. Very large, oval, heavily netted fruit with medium textured closely woven pattern. Faint suture lines are well netted. Tendency for a narrow band of skin around stem end to stay green and sparsely netted. Can be more subject to ground rots than other varieties. Good quality, attractive, melon with large variation in size. Deep orange flesh with a small cavity. Grows a vigorous vine.

Ivanhoe. Round non-sutured, fully netted fruit. Similar to Malibu but smaller. Good quality and attractive.

Malibu. Round to oval, slightly flattened ends, slight to moderate lightly netted sutures. Heavily netted with medium textured, even, slightly open pattern. Good quality, fairly even sized attractive fruit. Grows a vigorous vine. Best suited to summer production in warmer areas.

Mission. Round fully netted melon with deep orange flesh. Requires heat to achieve size.

Morocco. A non-sutured, fully netted melon for early and late plantings.

Otway. Oval, fully netted melon with orange flesh. Suited to dry inland districts.

Pablo. Early maturing, sutured, well netted fruit.

Picnic. Mid-season fully netted, non-sutured, slightly oval fruit. Grows a strong vine.

Sahara. Large, round non-sutured melon with ropy netting.

Stirling. Round to oval, fully netted melon with bright orange flesh. Will develop size in cool conditions.

Planting times

Table 2 shows the varieties and planting and harvesting times for the main production districts. Harvesting is 10 to 16 weeks after planting, depending on variety, temperature, and whether seed or transplants are used.

Table 2. *Rockmelon varieties and main planting and harvesting times for main production districts*

District	Variety	Planting time	Harvest time
Bowen – Burdekin	Dubloon, Eastern Star, Eldorado, Flinders, Hammersley, Hot Shot, Ivanhoe, Malibu, Mission, Mondo, Morocco, Oakley, Otway, Pablo, Picnic, Premiere, Sahara, Stirling	February to April	Mid March to mid October
Rockhampton – Emerald	Eldorado, Eastern Star, Malibu	June to July	Late September to October
Bundaberg	Eldorado, Eastern Star, Hot Shot, Malibu Eldorado, Eastern Star, Hot Shot,	Mid July to September	Late October to mid December
Gayndah – Mundubbera	Malibu Dubloon, Eastern Star, Hiline,	August to September	November to December
Chinchilla – St. George	Malibu, Hot Shot, Mission	September to January	December to April

Table 3 shows a suggested planting schedule for the Bowen – Burdekin district.

Table 3. *Suggested rockmelon variety and sowing schedule for Bowen – Burdekin*

Honeydew melons

Variety descriptions

Casper. An early maturing, large, green fleshed melon with smooth white skin and small seed cavity. Best suited to cool harvesting conditions or early spring.

Dewcrisp. Mid-season, medium to large, regular oval shape. Smooth white skin, with green, crisp, sweet flesh. Grows a strong vine.

Dewsweet. Medium to large, oval shape with a smooth regular surface. Creamy-green skin, with green, crisp, sweet flesh.

Dewette. Round, smooth, white-skinned melon with bright green flesh. Suited to warm weather.

Full Moon. An early maturing, large, round to oval melon with smooth white skin and sweet, green flesh.

Glacier. Early maturing, round, medium to large, white-skinned melon with crisp, green flesh.

Honeybabe. Mid-season, early maturing, round, small to medium with a smooth surface. Creamy-green skin, with green, crisp, sweet flesh. Grows a vigorous vine.

Honeymoon. Almost round, fairly smooth surface, regular shaped melon. Creamy-green skin, with bright green, crisp, sweet flesh.

Limelight. Early maturing, round, medium sized melon with off-white skin, light to mid-green flesh and a small cavity.

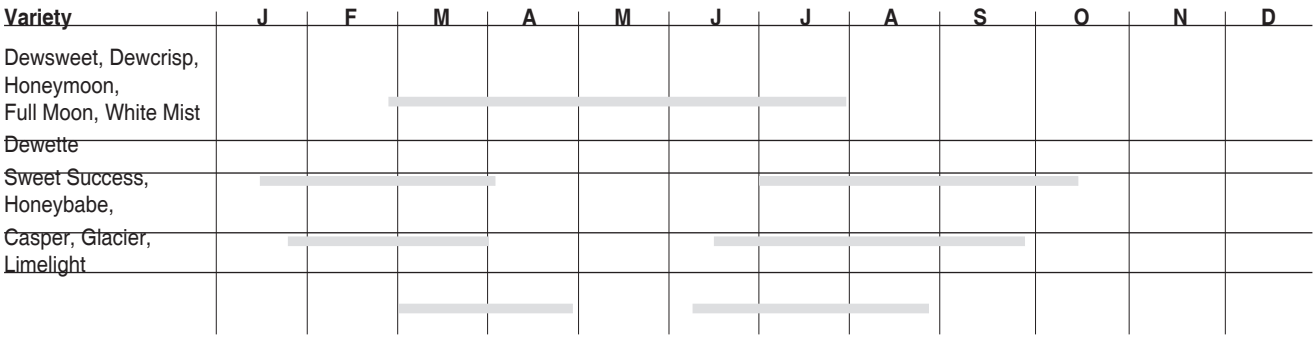
Sweet Success. Early and late season, medium sized, round melon with creamy-green skin and green, crisp, sweet flesh.

White Mist. Early maturing, round to oval melon with frosty white skin and medium green flesh.

Planting times

Table 4 shows a suggested planting schedule for the Bowen – Burdekin district. Harvesting is 10 to 16 weeks after planting, depending on variety, temperature, and whether planted as seed or transplants.

Table 4. *Suggested honeydew variety and sowing schedule Bowen – Burdekin*



Honeydew melons in other districts are planted at a similar time to rockmelons.

Pollination

Adequate pollination is very important for the production of a good yield of well shaped melons. If there are not enough bees in your crop you will need to introduce hives. It is very important that you protect bees from toxic chemicals.

About melon flowers

Rockmelon and honeydews enerally produce separate male and female flowers on each vine. Only female flowers produce fruit(Figure 2).

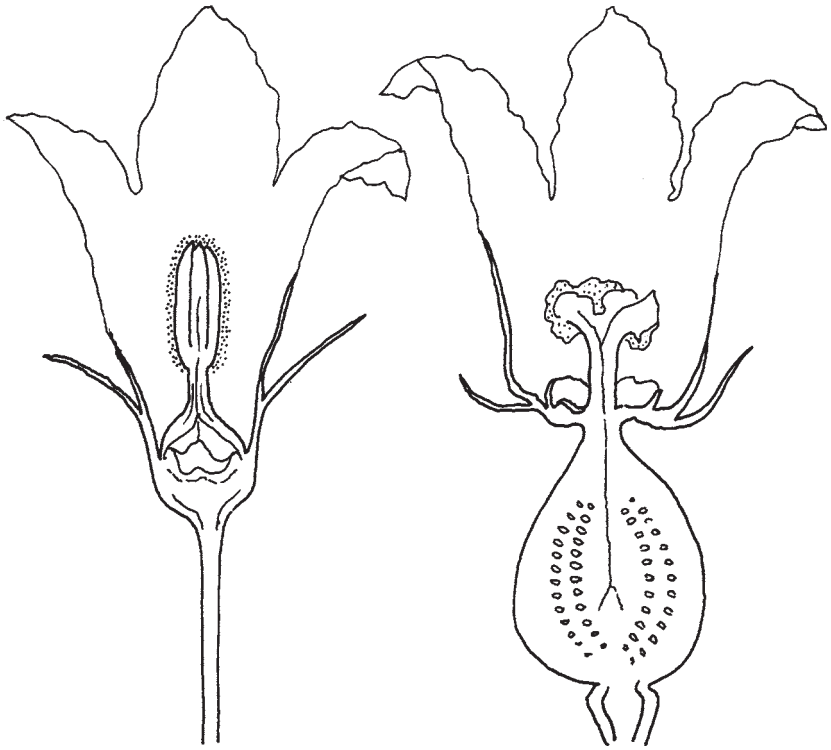


Figure 2. *Typical male (left) and female (right) cucurbit flowers*

Flowers are open for one day only. They open early in the morning and close by mid afternoon (earlier in high temperatures). Pollination is usually accomplished by midday. The first and last flowers on the plant are usually male, and there are often 10 male flowers to each fruit producing flower. High temperatures and long days result in a higher proportion of male to female flowers.

Unpollinated flowers will not set fruit. Good fruit set and development needs 500 to 1000 live pollen grains to be deposited on the stigma of the female flower, which means each flower must receive up to 15 bee visits, with a minimum of 12 bee visits required.

Poor pollination can cause fruit to set then yellow and fall off. Flat-sided fruit are usually the result of poor pollination. Fruit with less than 400 seeds do not usually reach commercial size and are often misshapen and slow maturing. Complete pollination, therefore, is important in melon size.

In windy, dry conditions pollen rapidly dries out and dies. Fruit set is usually poor while those conditions prevail. Pollination early in the morning is essential.

Bees

Where there are no beehives close to the crop, hives must be brought into the area. Overseas trials suggest that at least two hives per hectare are necessary for pollination of melon crops. In cold, windy or wet conditions, up to four hives per hectare may be required. Hives should be double-deck hives with six or more frames of brood. If growing more than 13 ha, place four to eight hives every 300 metres around the edge of the crop. Place hives so bees have to fly over the crop to get to other food sources. Introduce the hives when 10% of the crop is in flower, to ensure a good crown set and so the bees are not distracted by other flowering plants (for example eucalyptus). Destroy flowering weeds.

Spray insecticide and fungicide late in the afternoon after bees have returned to the hive. Do not place hives in the crop where they may be sprayed with chemicals. Use sprays with a low toxicity to bees if possible.

more info
Chemicals and bees
Problem solver handy guide

Chemicals are divided into four classes depending on their toxicity. The *Problem solver handy guide* shows the toxicity to bees of most of the chemicals registered for use on melons. Fungicides generally have a low toxicity to bees, however pyrazophos, used for powdery mildew control, is highly toxic.

Some chemicals have a short residual toxicity. They can be applied in the evening after the bees have left the field and will not affect bees the next morning. Night applications of insecticides, up to 4 a.m., can halve bee kills and reduce chemical toxicity by one class. Other chemicals have a longer residual effect. If they must be used bees should be removed from the crop for at least 24 hours. Contact the beekeeper one or two days before spraying.

more info
Where to get this book
Section 6 page 15

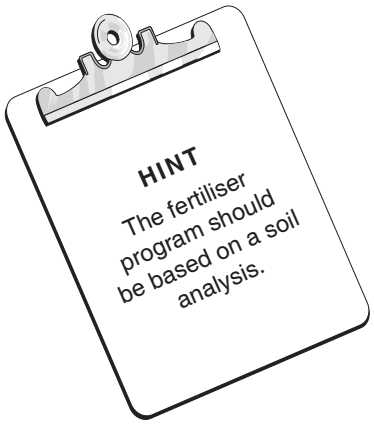
Beekeepers often lease hives for pollination. Draw up a contract which clearly outlines conditions on both the beekeeper and the grower.

The book—*The bee book, beekeeping in the warmer areas of Australia*— is a good reference on bees.

Nutrition

Adequate nutrition is important for producing high yields and good quality fruit. The most critical nutrient in melon growing is nitrogen. Insufficient nitrogen will result in poorly grown plants and low yields. If excess nitrogen is available to the plants, fruit quality will be poor, with soft melons that tend to crack.

Fertilisers



Fertilisers are commonly sold as mixtures of nitrogen (N), phosphorus (P) and potassium (K). The percentage of each element in the mix is expressed as a ratio of N:P:K. For example a fertiliser with an N:P:K ratio of 14:15:13 contains 14% nitrogen, 15% phosphorus and 13% potassium, so 100 kg of this mix would contain 14 kg of nitrogen, 15 kg of phosphorus and 13 kg of potassium.

Rockmelons and honeydews are very sensitive to nutritional imbalances. Careful management of water and nutrients, particularly nitrogen, are essential if high yielding crops of high quality fruit are to be produced.

Fertilisers should be applied before planting (pre-plant) and as side dressings as the crop grows. The pre-plant fertiliser should contain the total phosphorus requirement, 50 to 100% of the nitrogen and 50 to 100% of the potassium requirement. For medium to heavy soils the total fertiliser requirement may be applied before planting. For lighter soils prone to leaching apply the remaining nitrogen and potassium as a side dressing if required. Table 5 indicates the approximate additional N:P:K requirements of a crop of melons.

Table 5. *Approximate additional N:P:K requirements in kg/ha*

Nutrient	Minimum (Fertile soil)	Average	Maximum (Poor soil)
Nitrogen (N)	30 kg	60–70 kg	100 kg
Phosphorus (P)	20 kg	60–70 kg	90 kg
Potassium (K)	30 kg	50–60 kg	100 kg

Magnesium

Magnesium can be deficient, particularly in high rainfall areas and where soils are fairly acid. Apply dolomite or spray with magnesium sulphate ($MgSO_4$) as recommended by the soil analysis. Applications can also be made through the trickle irrigation at 15 kilograms per hectare.

Trace elements

A complete soil analysis taken six to eight weeks before planting will indicate which trace elements are deficient. These trace elements can either be applied to the soil before planting (preferred) or as foliar applications once the plants are established. Soil applications will often last for a few years, whereas foliar applications only benefit the plants to which they are applied.

Boron

Boron deficiency is more likely in sandy neutral to alkaline soils, particularly if they have recently been heavily limed or are low in nitrogen. Most vine crops are very sensitive to high boron applications.

If boron is low spray 2 to 3 kg/ha of Solubor onto the soil during final land preparation. Alternatively a foliar spray of Solubor at 200 g/100 L can be applied shortly after planting out at the fourth to fifth true leaf stage (Figure 3).

Solubor is NOT compatible with zinc sulphate heptahydrate and they should not be mixed.

Molybdenum

Apply as sodium molybdate (60 g/100 L) or another molybdenum source at the four leaf stage (Figure 11) and again three weeks after transplanting.

Zinc

Zinc deficiency is common in many Queensland soils. The best way to correct zinc deficiency is to spray either zinc sulphate heptahydrate on the soil at 30 kg/ha, or zinc sulphate monohydrate at 20 kg/ha, three weeks before planting and work it in.

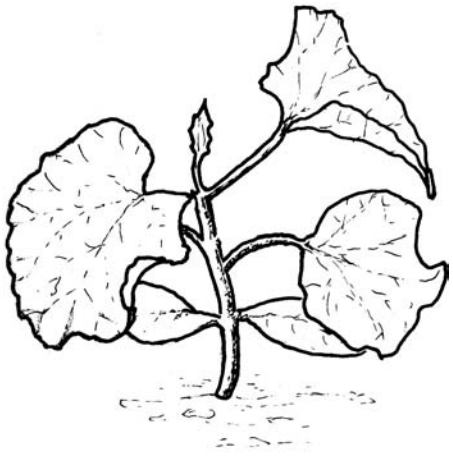


Figure 3. *The fourth true leaf stage. Note the two seed leaves plus four true leaves*

Foliar fertilisers

Foliar fertilisers have soluble nutrients which are sprayed onto the crop and absorbed through the leaves. These may be as simple as urea or potassium nitrate dissolved in water, or a 'shotgun' mixture of many major and trace elements. Many of the 'shotgun' mixtures contain mostly nitrogen with insufficient amounts of other elements to correct deficiencies. They are also expensive. Foliar fertilisers have a place when plants are under stress from waterlogging, disease or nematodes affecting the roots. Foliar fertilisers help the plants survive until new roots develop and can again support the plant.

Do-it-yourself sap testing

Sap analysis procedures are somewhat complex so we recommend you use sap testing consultants or a sap testing laboratory. Where these services are unavailable, the following guidelines may be useful. Make sure your meter has been calibrated and check it regularly.

Essential equipment required

- garlic press
- small plastic capped tube
- 1 mL plastic pipettes
- a number of 20 mL calibrated capped jars or tubes
- 500 mL wash bottle
- plastic measuring cylinder
- Merckoquant test strips for nitrate, phosphorus, potassium and calcium.

Optional equipment

- Nitrachek meter for more accurate reading of the nitrate test strips

or preferably

- Merck RQflex meter for accurate reading of the nitrate, phosphorus, potassium, calcium (and manganese if required) test strips.

Procedure

1. Collect a random sample of 30 leaf petioles (leaf stalks) from different plants. Remember to sample by mid morning and to keep each variety as a separate sample.
2. Cut the petioles into small segments about 2 mm long.
3. Using the garlic press, squeeze sap into the plastic capped tube.
4. Mix the sap thoroughly.
5. Pipette 1 mL of the mixed sap into the 20 mL calibrated jar.

Nitrate and calcium tests

6. Dilute the sap to 20 mL with distilled water and mix thoroughly.
7. Briefly immerse each strip.
8. Read the concentration.
9. Multiply by 20 to get the concentration in the undiluted sap.

Potassium and phosphorus test

10. Pipette 1 mL of the mixed sap from step 4 above into another 20 mL calibrated jar.
11. Using the measuring cylinder, add 4 mL of distilled water.
12. Mix thoroughly.
13. Briefly immerse each strip.
14. Read the concentration.
15. Multiply by 5 to get the concentration in the undiluted sap.

Optimum sap levels for rockmelons

Table 6 shows the optimum sap levels for a rockmelon crop grown in southern Queensland. Sap nutrient levels for north Queensland should be a little lower than the south Queensland levels.

These levels can be affected by over or under watering and stressful conditions. Diagnose the cause of the low levels, then apply a suitable nutrient if necessary.

Table 6. *Optimum sap levels in southern Queensland*

	Optimum sap nutrient level in parts per million (ppm)			
Nutrient	**Plant growth**	**Fruit set**	**Fruit fill**	**Harvest**
	until fruit reach 10 mm	**10 mm to 25 mm**	**25 mm to fully netted**	**from 1 week before & during harvest**
Nitrate	4000–6000	3000–4000	2500–3500	500–1500
Phosphate	70–150	100–250	80–250	60–200
Potassium	4000–5000	4000–5000	4000–5000	4000–5000
Calcium	200–500	300–500	300–600	500–800
Magnesium	250–500	300–500	300–500	300–500
Zinc	2–5	2–5	2–5	2–5
Copper	1–5	1.5–5	1.5–5	1.5–5
Manganese	1–7	1.5–7	1.5–7	1.5–7
Iron	1–7	1–7	1–7	1–7
Boron	2.5–20	2.5–20	2.5–20	2.5–20

Source: John Hall, Crop Tech Research

Irrigation and water management

Irrigation management is one of the keys to producing a high yielding, good quality melon crop. An efficient irrigation system and schedule is essential to ensure that the correct quantity of water is applied when the plants need it.

Water management to produce quality melons

The number one quality control method is accurate irrigation scheduling. Inaccurate irrigation is the major cause of poor nutrition. Monitoring both gives you the best chance to achieve maximum profits.

Because most growers tend to overwater in the early stages of the crop, leaching of fertiliser, in particular nitrogen, from the root zone is common and fertiliser is often wasted. Table 7 shows the symptoms of poor water management at different growth stages.

Irrigation must No. 1—a good irrigation system

The first essential requirement of efficient irrigation is a water supply and irrigation system capable of delivering the required amounts of water when needed. Consult an irrigation equipment supplier or designer in your area and get them to develop an irrigation plan.

Irrigation methods

Trickle irrigation is the best and most common method of irrigation used in melons, but furrow and overhead irrigation are sometimes used.

Table 7. *The symptoms of poor water management*

Growth stage	Not enough water	Too much water
Early growth to budding	· Poor growth · Poor uptake of nitrogen and calcium · Small vine	· Leaching base fertiliser · Root diseases, e.g. *Pythium, Rhizoctonia* · Lush growth · Poor flowering · Shallow root system
Flowering to early fruit set Late fruit set to fruit fill	· Small vines · Low calcium and nitrogen uptake · Falling flowers and dropping of small fruit · Termination of vine	· Excessive vegetative growth, low flower set · Poor uptake of calcium, phosphate and zinc · Poor crown set · Shallow root development
Maturity to harvest	· Small fruit size · Dropping small fruit · Small vine · Sunburn	· Poor fruit set · Excessive vine growth · Poor flesh structure caused by low calcium balance · Poor keeping quality
	· Small fruit · Early maturity of young melons · Sunburn · Low yields	· Stem end break down prone to ground rots · Low sugars · Slow to mature · Soft fruit

Trickle irrigation

Trickle irrigation is the most easily controlled method of irrigation. The equipment is expensive, but has a long life. If trickle tubing is to be re-used it should be treated with chlorine to reduce the risk of blockages. Soluble fertiliser mixtures and some pesticides can be applied easily through the irrigation system. Use a trickle tube with outlets no more than 20 cm apart. Table 8 shows the advantages and disadvantages of trickle irrigation.

Table 8. *Advantages and disadvantages of trickle irrigation*

Advantages	Disadvantages
Does not wet plants and wash off sprays	Requires a greater intensity of management
Easy to regulate applications	Requires regular maintenance during the growing period
Can apply small amounts often, (daily if necessary) in the critical period	High initial cost
Only wets the root area	Can block up if good filters are not used
Can grow crop on plastic mulch	Not suitable for steeply undulating country due to variable output
Can apply nutrients through the system	Susceptible to damage by crickets
Not affected by wind	Must take precautions to filter water and/or treat it for iron bacteria
Uses less water than other systems	
Can use poorer quality water than over-head systems	
Cheaper pumping costs because it re-quires low pressure	

Furrow irrigation

Furrow irrigation requires an even, gentle slope and a soil type which allows water to spread laterally, without penetrating too deep into the soil. Table 9 shows the advantages and disadvantages of furrow irrigation.

Table 9. *Advantages and disadvantages of furrow irrigation*

Advantages	Disadvantages
Cheap to set up and operate	High water use
Does not wash spray off plants	Can cause heavy losses from fruit rots
Not affected by wind	Often have wet row ends and waterlogging
Can use poorer quality than for overhead irrigation	Cannot apply fertilisers with irrigation
	Can result in erosion if slope is too steep
	Cannot use plastic mulch

Overhead irrigation

Overhead irrigation includes travelling irrigators or sprinkler systems. Overhead irrigation is suitable for any soil type and undulating country. Table 10 shows the advantages and disadvantages of overhead irrigation.

Table 10. *Advantages and disadvantages of overhead irrigation*

Advantages	Disadvantages
Easier than furrow irrigation to regulate water application	Washes spray off plants
	Expensive to set up
Can be used in most situations	Affected by wind
Can be used to reduce losses from frost	Wets interrow and headland areas, promoting weed growth
	Difficult to apply regular, small amounts
	High pumping costs because it requires high pressure, particularly for travelling irrigators
	Cannot use plastic mulch
	High water use
	Must use high quality water
	Cannot apply fertilisers with irrigation

Irrigation must No. 2—a monitoring system

The second essential requirement of efficient irrigation is a system to tell you when and how much water your crops needs. This is known as a monitoring or scheduling system. The importance of monitoring is confirmed by research which shows that water use can be considerably reduced with monitoring, without affecting yield and bulb quality. It also makes sure you are applying enough water at the critical times.

Irrigation consultants
Section 6 Page 7

A range of equipment and techniques is available for monitoring soil moisture and scheduling irrigation. The most common are the soil-based systems using tensiometers, neutron soil moisture probes, or newly developed soil capacitance systems such as the Enviroscan. The other technique sometimes used is a climate-based system that uses estimates of evapotranspiration. The tensiometer or capacitance systems are preferred and recommended. A brief comparison of the main systems is shown in Table 11.

As soil moisture monitoring can be complex, seek expert advice first, particularly when setting up the system.

Table 11. *Comparison of the main soil moisture monitoring systems*

System	Advantages	Disadvantages
Tensiometers	· Relatively cheap · Easy to install · Can be read by growers · Continuous monitoring	· Labour intensive to collect and record data · Require regular maintenance · Can be inaccurate in extremely wet or dry soil
Capacitance probe e.g. Enviroscan	· Continuous monitoring · Accurate at all depths and for all soils · Enables rapid reading and recording of results	· Expensive · Need skill in interpreting data
Neutron probe	· Portable, can be moved around sites	· Not suitable for continuous monitoring · Equipment is expensive and radioactive. Use a consultant who owns the equipment. · Less accurate in the top 10 cm of soil · Less accurate in sandy soil because of low sampling frequency
Evaporation pan	· No in-field measurement needed as system uses weather data to predict irrigation need	· Inaccurate as system ignores soil variability

Getting the best from your irrigation

To get the best from your irrigation system use a scheduling device, such as tensiometers, to help you make decisions about when to irrigate and how much water to apply. Remember that pesticide applications, irrigation systems, labour, the availability of water, and disease risk, all influence your decision to irrigate.

A strategy for irrigating rockmelons and honeydews

Establishment. Ensure adequate moisture near the surface for a good strike rate of the seed, and for the plant to begin to access the basal fertiliser application.

Flowering. After successful establishment let the soil dry out slightly from the surface to encourage the development of a good volume of roots to access a larger volume of soil nutrients and moisture. As the plant goes into the reproductive stage, flower set is enhanced by a lack of abundant moisture.

Fruit filling. Once fruit have set, maintain soil moisture near the full point (field capacity) to facilitate fruit sizing and filling. Fruit sizing and filling is a physiological response from the plant to maximise cell elongation when soil moisture is easily accessible.

Harvest. As harvest approaches allow soil moisture to decline to the refill point. This drying process helps in the development of sugars and other products in the fruit, improves final quality (sweetness and firmness), and reduces breakdown of the flesh. This results ultimately in a more marketable product.

Tables 12 and 13 show the suggested shallow tensiometer readings for the different stages of plant growth.

Table 12. *Suggested shallow tensiometer readings from planting to early fruit set*

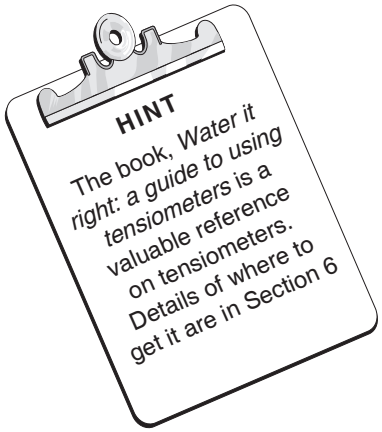
Soil type	Tensiometer reading	
	Planting to flowering	Flowering to early fruit set
Sandy loams	10–30	10–20
Clay soils	20–35	10–30

Table 13. *Suggested shallow tensiometer readings from early fruit development through harvest*

Soil type	Tensiometer reading	
	Early fruit development and fruit fill	One week before harvest and during harvest
Sandy loams	10–20	25–40
Clay soils	10–30	35–60

Tensiometers

A tensiometer consists of four basic parts—a hollow tube filled with water and algaecide, a ceramic tip, a water reservoir and a vacuum gauge which reads water tension on a scale of 0 to 100 centibars (kPa) (Figure 4). In wet soil, the vacuum gauge displays 0 to 5 units kPa. As the soil dries over several days, water moves from inside the instrument, through the porous ceramic tip, into the soil. The gauge reading steadily increases, to a maximum of about 90 Pa. When the soil is re-wet after rain or irrigation, water moves from the soil back into the tensiometer and gauge readings fall.



The DPI has published a useful booklet—*Water it right: a guide to using tensiometers*.

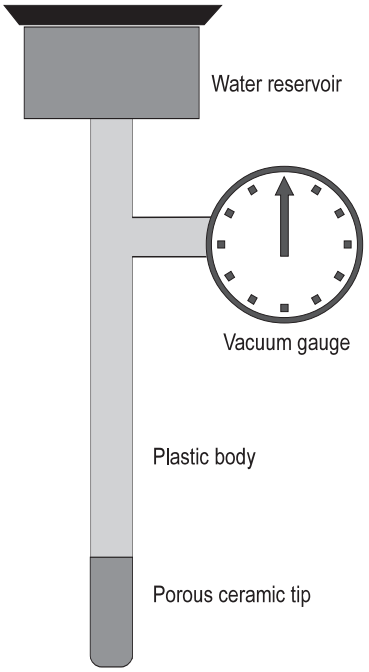


Figure 4. *Parts of a standard tensiometer*

A monitoring site consists of one shallow tensiometer installed in the major root zone, and one deep tensiometer below most of the roots (Figure 5). A crop planting should have at lease two monitoring sites. Shallow tensiometers should be placed within 10 cm of the crop row and midway between plants, though this can vary slightly. Install th shallow tensiometer with the tip 15 cm below ground (a) and the deep tensiometer 45 cm deep (b). Install tensiometers after the crop is established, disturbing the plants and surrounding soil as little as possible.

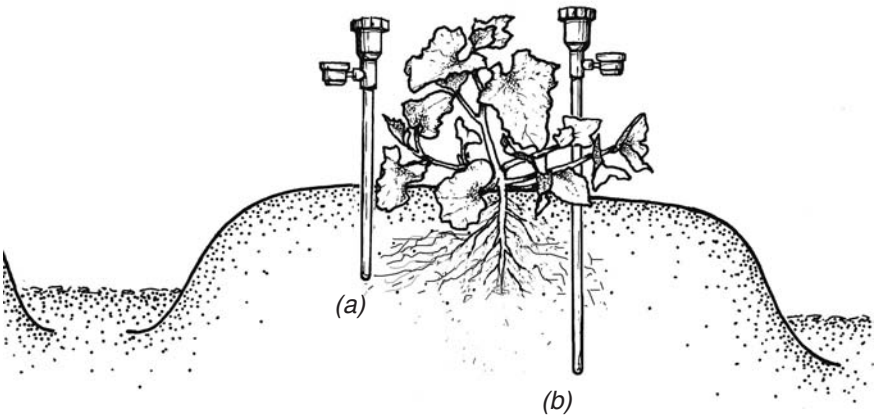


Figure 5. *Tensiometers in place, (a) in root zone and (b) below main roots*

The shallow tensiometer indicates when to water. The deep tensiometer indicates when the right amount of water has been applied. If deep tensiometer readings fall to less than 10 kPa within two days after irrigation, there is more water than the root zone can hold. Constant values after irrigation indicate the root zone is saturated. If readings continue to rise immediately after irrigation not enough water has been added to the root zone.

Installation

Assemble tensiometers and fill with good quality water to which algaecide has been added. Leave them to stand in a bucket of water at least overnight, but preferably for one to two days. The water does not need to be pre-boiled. Tensiometers are more reliable if an appropriate vacuum pump is used to remove any air. Top up the tensiometers with more water if necessary. They are now ready to install.

Carry the tensiometers to the installation site with the tips either in water or wrapped in wet rags. Provided the ground is moist and well cultivated, the shallow tensiometer can be pushed 15 cm into the soil. Don't push too hard. The tips are strong but can crack under excessive pressure. Only experience teaches how hard is too hard. At $30 per tip, this can be an expensive lesson. If you reach a hard soil layer, either take the tensiometer out and try somewhere else, or use the deep tensiometer procedure.

To install the deep tensiometer, dig a hole 45 cm deep, keeping the excavated soil nearby in a pile. We have found a 50 mm (2 inch) auger the best tool. Put the tensiometer in the hole, over to one side.

The next step is critical. Good contact between the ceramic tip and the surrounding soil is most important. Take the most crumbly, moist soil from the dirt pile and pack it around the tip at the base of the hole. A piece of 10 to 15 millimetre diameter dowel is useful for packing. Don't over-compact the soil into plasticine, but remove any large air gaps. Continue replacing soil until the hole is filled. It doesn't matter which soil you use once you have packed the first 5 cm above the tip. Friable topsoil from a few metres away can be used to create a slight mound around the tensiometer. This minimises water draining down beside the tensiometer, causing false readings.

Covers made from silver/blue insulation foil placed over the tensiometers minimise temperature fluctuations and algal growth. The gauge can be left exposed for easier reading.

The tensiometers are now ready to operate. Use the vacuum pump to again remove air bubbles. Tensiometers may take a few irrigation cycles to settle down, so don't take too much notice of the readings for the first few days. During this period, air gaps may appear in the tensiometer. Simply refill with algaecide-treated water. Within a week of installation, readings should rise and fall with irrigation and rainfall.

Clearly mark tensiometer locations, otherwise they may be damaged by tractors, harvesters, rotary hoes and other machinery.

Reading

Read tensiometers at the same time early in the morning, preferably before 8.00 a.m. because at that time there is little movement of water in the soil or plants and they are almost in equilibrium. Errors caused by heating of the gauge or water column are also avoided. Read at least twice a week, but preferably every one to two days. Lightly tap the gauge before reading.

Troubleshooting tensiometer problems

No water in the tensiometer; gauge reads 0

There is either a crack in the ceramic tip or a faulty seal. Fill the tensiometer with water and apply suction with a vacuum pump. A stream of large bubbles will indicate the problem area; usually a cracked tip or a missing o-ring.

Air entering over several days; gauge registering more than 5

There is either a hairline crack in the tip, or a substantial air gap in the soil around the tip. Remove the tensiometer. If there are no obvi-

ous tip cracks, then re-install the tensiometer. If the problem persists, replace the tip.

No change in readings over several days

The gauge may be faulty or blocked. Check that the gauge is working.

- Apply suction to the tensiometer with a vacuum pump.

Or

- Remove the gauge, rinse with clean water and suck it. If the needle does not move there is a problem with the gauge.

Tensiometer readings increase beyond 80 then fall to 0, accompanied by air in the tensiometer

The soil has become too dry for the tensiometer to operate. After irrigation, refill the tensiometer and treat as if it had just been installed. If this happens frequently, consider whether you are under-irrigating. If you are happy with your irrigation, try installing the shallow tensiometer slightly deeper. This problem should never occur with the deep tensiometer.

Getting started with tensiometers

A good grower starter pack would include two 30 cm and two 60 cm tensiometers, a suitable vacuum pump, algaecide and a one-metre long 50 mm diameter auger. The total cost should be less than $600. The best tensiometers have replaceable tips, gauges and reservoirs.

Tensiometers should be installed at two monitoring sites in a crop. Continue usual irrigation practices and get a feel for how tensiometers operate. Once you are comfortable with using them, make slight changes to your irrigation and observe what happens. For example, if the reading of the deep tensiometer always fall after irrigation, reduce the amount of water you apply.

Tensiometers are easiest to use in overhead irrigated vegetables. Flood, furrow and drip irrigation systems are more complex because positioning of the tensiometer is more critical.

The Enviroscan capacitance probe

This is a continuous moisture monitoring device based on capacitance sensors. The sensors are mounted on probes which have slots every 10 cm to accommodate the snap-in sensors. These probes are then placed within vertical PVC access tubes installed in the soil after the crop is established. The probes and tubes are left in place until the end of the season. Sensors are positioned on the probes to provide readings at specific depths.

Measurements from the sensors are relayed at regular intervals via acable to a data logger where it is recorded. The data from the logger is downloaded to a computer every day or every few days and is available for viewing or printing within minutes. Figure 6 shows the main components of an Enviroscan probe.

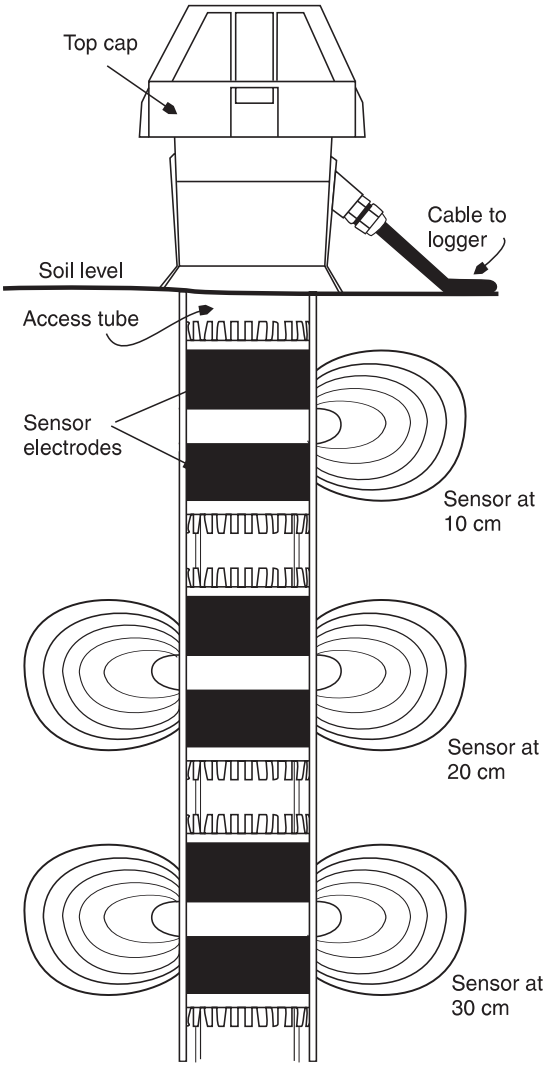


Figure 6. *Diagrammatic representation of an Enviroscan probe*

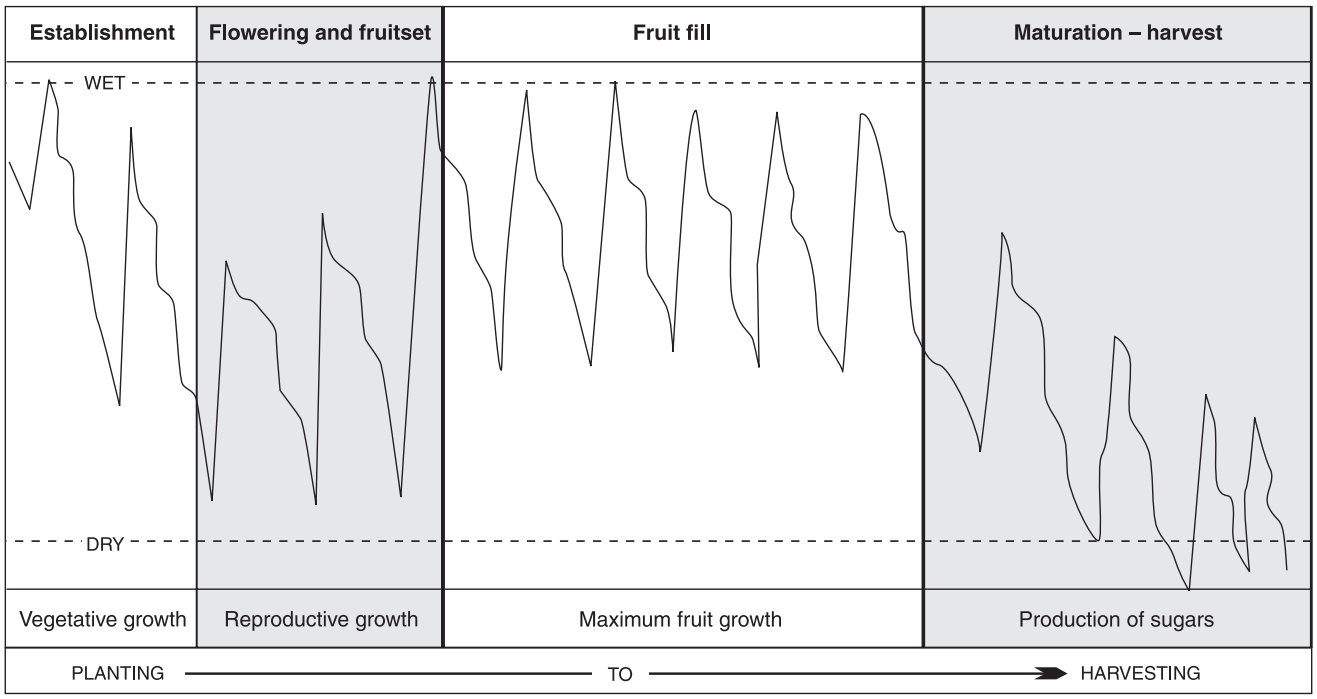
After downloading, the computer analyses the data and provides an accurate and dynamic understanding of the crop's daily water requirements and the effectiveness of irrigation and rainfall.

Access to this information removes the guesswork from irrigation decisions. It provides a basis for further manipulation of the crop for flower set, fruit filling and fruit quality.

For melons, two probes are recommended for a block of plants but the number of sites depends on the variability in soil and varieties. The probes should have sensors at 10, 20, 30 and 50 cm.

The current cost of a logger, solar panel, 100 m of cable, two one-metre probes, 10 sensors and software is about $8000. Equipment can also be hired from some consultants.

The interpretation of the data requires skill. We recommend you use consultants to set up the system and provide at least the initial advice. Figure 7 is a diagrammatic representation of the water use of a melon crop recorded by an Enviroscan. The high points occur after irrigation or rainfall.



Source: John Hall, Crop Tech

Figure 7. *A diagrammatic representation of irrigation and water use of a melon crop as recorded by the Enviroscan*

Maintenance of a trickle irrigation system

Before developing your irrigation system, have the water tested to make sure that it is suitable for your crop and to check if it contains soluble iron. Iron bacteria in the water can turn the soluble ferrous iron into insoluble ferric iron that precipitates out of solution as a red sludge. This sludge will block the trickle outlets. Iron levels above 1 mg/L ppm can cause problems. Chlorinating your water will kill the bacteria and prevent precipitation.

Filters

The outlets of trickle irrigation tape are very small, so a good filtration system is essential. There are three main types of filters—sand filters, mesh and screen filters, and multi-media filters. The type of filter you need will depend on the quality of your water. Talk to a reputable irrigation specialist before deciding the type of filter you need.

Filters should be cleaned regularly. This can be done manually or automated. Flush out pipes regularly; the dirtier the water the more often you need to do it. Fit flushing valves to the ends of your trickle tubing so that the system is automatically flushed at each irrigation.

Chlorination

Chlorination is an effective way of cleaning and keeping trickle tape clean by oxidising and destroying organic matter and micro-organisms. The quantity of chlorine required to oxidise these organisms is referred to as the 'chlorine demand' of the water. The chlorine left after oxidisation is the 'residual chlorine', which can be measured at the end of the irrigation system using a swimming pool test kit. You should aim to have 1 mg/L (ppm) chlorine at the end of your system so that you know that you have used enough chlorine. The amount of chlorine required will depend on the quality of your water.

Chlorine is corrosive and toxic, so read the label carefully and handle it with care. It is available as liquid sodium hypochlorite, usually about 10 to 12.5% chlorine, or granular calcium hypochlorite, usually about 65 to 70% chlorine.

Chlorination can be done continuously, using 1 mg/L residual chlorine; on a regular basis at about 10 mg/L; or as a slug dose using 500 to 1000 mg/L. Test the water at the end of the system to ensure there is about 1 mg/L residual chlorine.

When using chlorine regularly it is injected during the last 20 to 30 minutes of an irrigation.

The slug dose is only used if the trickle outlets are badly blocked, or before used tape is to be re-used. Chlorine at this concentration may damage plants. It is left in the system for 24 hours, then flushed out. First flush water out of the main lines, then the submains and finally through the open the ends of the trickle tubing. If the mains and submains are not flushed first, all the sediment cleaned from them will go into the trickle lines.

Chlorine can be injected into the irrigation water on either the suction or the discharge side of the pump, but before the filter. The filter must be resistant to corrosion by chlorine. Make sure the pump runs long enough after you stop injecting chlorine to ensure that no chlorine is left in the pump or any other metal part of the system.

Calculating how much chlorine to inject

To do this you need to know the following things.

1. The chlorine concentration of your chlorine product.
2. The flow rate of your pump in litres per minute.
3. How long the water takes to reach the furthest point of your system.

Table 14 shows the amount of two chlorine products required to make two different concentrations of chlorine.

Table 14. *Chlorine product required for two concentrations of chlorine*

Concentration required	12.5% chlorine product		65% chlorine product	
	rate per 100 L	rate per 500 L	rate per 100 L	rate per 500 L
10 mg/L	8 mL	40 mL	1.5 g	7.5 g
500 mg/L	400 mL	2 L	75 g	375 g

If your pumping rate is 500 L per minute, you will need to add each minute the amount required for 500 L, for as long as it takes the water to reach the furthest point of your system. You can use a swimming pool test kit to determine when the chlorine has reached this point.

Pest and disease management

Managing pests and diseases is probably the most difficult aspect of melon growing. This is because serious pests and diseases will most likely be a problem at some stage in the life of the crop. These problems have the potential to reduce fruit yield and quality. Here are some things you need to know.

The problems with the traditional approach

The traditional approach to pest control is to apply routine calendar sprays of chemicals. This approach has a number of problems.

- It wastes money if there are no pests in the crop.
- Even when pests are present, plants can tolerate small numbers of pests without significantly affecting yield and quality. In these cases, the cost of spraying is much greater than the benefit gained by controlling the pest.
- It is costly, with many sprays being applied each season.
- It relies heavily on new chemicals being developed to replace those for which insects develop resistance. This contradicts the modern reality where fewer new chemicals are being discovered and developed.
- It exposes the farm family and farm employees to a range of toxic chemicals.
- It increases the amount of chemical residue in both the fruit and the environment.
- It induces some problems such as spider mites.

A new approach: Integrated Pest Management

The modern approach to crop protection is to manage the pests so that they do not cause economic damage. By pests, we mean the whole range of insects, mites, fungi, bacteria, viruses and nematodes. Heavy spraying to destroy all pests is neither efficient nor desirable. Unsuit-

able pesticides may even create pest problems by killing the parasites and predators of other insects.

Integrated Pest Management (IPM) is the preferred approach to crop protection because it uses preventative measures and biological control in conjunction with appropriate use of pesticides. Integrated Pest Management involves the following techniques.

- Inspecting the crop regularly for pests and their symptoms.
- Introducing parasites and predators, if they are available.
- Spraying only when the pest level becomes economically damaging.
- Avoiding pesticides which may kill parasites and predators.
- Spraying at the stage in the pest life cycle when it is most susceptible.
- Spraying the affected plants or parts of the plant only, not the whole crop.
- Destroying old crop residues that are a reservoir of pests.
- Applying a high standard of hygiene in the field and in the packing shed.

Farm hygiene

Good farm hygiene includes crop rotation, cover cropping and good land preparation.

Farm hygiene also includes:

- control of weed and volunteer (self set) plants around the farm;
- removal and destruction of reject fruit;
- ploughing in crops as soon as harvesting is completed.

Poor farm hygiene will result in greater losses from pests and diseases.

Monitoring for pests

- We recommend you use a competent pest consultant to do the monitoring for you. If you wish to do it yourself, we suggest that you get some training from a pest consultant. The main requirements for monitoring are:
- good eyesight and a hand lens, magnifying glass or small microscope;
- time each week to inspect the crop;
- a good knowledge of pests and beneficial insects and mites.

more info
Pest consultants
Section 6 page 6

Predators

For some pests—for example two-spotted mites—predators are available which feed on the pests. This removes the cost of chemical applications and avoids the risk of pests developing resistance to the chemical controls. When predators are used, avoid using chemicals which are

more info
Suppliers
Section 6 page 6

toxic to them. The suppliers of the predators will also provide a list of chemicals which will not affect the predators. Handle predatory mites very carefully and follow the supplier's instructions.

Diseases

more info
Section 5 *Problem solver*

The most serious diseases of cucurbits are powdery mildew, downy mildew and mosaic virus.

The key to controlling these diseases is good farm hygiene.

- Destroy crop residue as soon as harvesting is completed.
- Plant new crops upwind of older crops.
- Keep as much distance as possible between plantings.
- Ensure transplants are free of disease before planting.

Powdery mildew

Powdery mildew is serious in susceptible melon varieties but it can be controlled by fungicides. It can quickly develop resistance to systemic fungicides. Resistant strains of powdery mildew have been found in many areas of Queensland.

The symptoms of powdery mildew are small, more or less circular, white powdery patches on leaves, runners and leaf stalks. These are usually first seen on the undersides of leaves but eventually cover both surfaces. Affected leaves shrivel and die, which may lead to sunburn of exposed fruit, premature ripening and poor netting.

The white mildew consists of large numbers of spores which are spread by wind. Unlike downy mildew, powdery mildew flourishes in comparatively dry weather because free water on the leaf surface inhibits germination of spores. Dews provide enough moisture for infection. Late crops are generally most severely affected. Chemicals used to control powdery mildew are either protectants or systemics.

Use the strategy below for control of powdery mildew at this stage. Table 15 shows the five groups of fungicides for control of powdery mildew.

Table 15. *The fungicide groups for control of powdery mildew*

Group C (DMI)	Group E (morpholine)	Group F (phosphoro-thiolate)	Group H (hydroxy-pyrimidine)	Group X (unspecified)
		systemics		
protectant				
Bayfidan Rubigan Shavit	Calixin	Afugan	Milcurb Nimrod	Morestan

Use the following strategy to reduce the risk of developing powdery mildew resistance to systemic fungicides.

1. Ensure spray application equipment is well maintained and properly set up to give good spray coverage.

2. Spray with Morestan at seven to 10 day intervals from planting until early fruit set.
3. After fruit set alternate or tank mix Morestan and a registered systemic fungicide at seven to 10 day intervals. Use a systemic fungicide from at least two of the C, E, F and H groups in rotation.

NOTE:

- Do not apply Milcurb as a low volume high concentrate spray as it may scorch leaves.
- If applying Milcurb through the trickle irrigation system, spray with a protectant chemical, for example Morestan, as well.
- The manufacturers of some products recommend the addition of wetting agents. Check individual labels for details.
- Afugan is highly toxic to bees. Do not spray if bees are active.

Downy mildew

Downy mildew can quickly develop resistance to systemic fungicides. Resistant strains of downy mildew have been found in many areas of Queensland.

Downy mildew is a widespread disease of cucurbits that can cause serious leaf loss and subsequent fruit damage. It first appears as small, pale-yellow areas that enlarge and dry out to form brown angular spots, often limited by veins. In humid weather, purple downy growth may be seen on the underside of the spots. The affected leaves curl, shrivel and die. It is worse in warm, moist weather, when it is difficult to control.

Until the weather favours downy mildew use a protectant fungicide registered for its control, then use a systemic fungicide. Follow the downy mildew strategy below to prevent resistance developing to systemic fungicides. Table 16 shows the three groups of fungicides for control of downy mildew.

Table 16. *The three groups of fungicides for control of downy mildew*

Group D (phenylamide)	Group X (unspecified)	Group Y (multi-site activity)
systemics		protectants
Galben M	Acrobat MZ	chlorothalonil
Fruvit		mancozeb
Recoil		propineb
Ridomil MZ		zineb

Use the following strategy to reduce the risk of developing downy mildew resistance to systemic fungicides.

1. Ensure spray application equipment is well maintained and properly set up to give good spray coverage.
2. Spray at seven to 14 day intervals with a protectant fungicide from group Y.
3. If it is wet, apply two consecutive systemic sprays from the D or X group in Table 16, then resume applying protectant sprays.

Mosaic

Zucchini yellows mosaic virus (ZYMV) and papaya ringspot virus, cucurbit strain (PRSV-W)—formerly watermelon mosaic virus type 1 (WMV-1)—can severely affect melons. Watermelon mosaic virus type 2 causes only mild fruit distortion. Losses are greatest if crops are infected before or during the main fruit setting period.

Papaya ringspot virus, cucurbit strain and zucchini yellow mosaic virus infection can cause severe losses in all cucurbits.

Infection by papaya ringspot virus, cucurbit strain causes a prominent light and dark green mosaic pattern on leaves. Terminals of recently affected melons tend to stand more erect, with the mosaic pattern developing later. Fruit often develop wart-like lumps.

Zucchini yellow mosaic virus is also present in most cucurbit growing areas of Queensland. It affects all commercial types of cucurbits and causes severe fruit distortion. Zucchini yellow mosaic virus produces a more yellow mosaic on leaves as well as fruit distortion.

The main sources of infection are infected cucurbit crops, home garden plants and weed species such as wild gherkin. The virus is spread by many species of aphids who need only probe leaves for 30 seconds to acquire and transmit the virus. It is generally spread only to the first plant the aphid feeds on. Winged aphids may be carried several kilometres by wind.

These management practices can help reduce mosaic infection.

- Farm hygiene—plough in old cucurbit crops as soon as harvesting is completed.
- Avoid planting crops of cucurbits, particularly zucchinis, that overlap so that old infected crops and new crops are in the ground at the same time.
- Super reflective plastic mulch will deter aphids from landing on plants until they cover the mulched area. Weekly applications of a mineral oil/insecticide mix may be used in conjunction with super reflective mulch or alone. Apply to thoroughly cover the leaf surfaces.

Sudden wilt (sudden death syndrome)

Sudden wilt appears as yellowing of the crown leaves, followed by the rapid collapse of the vine and death of the runners. It usually occurs from the late fruit filling stage onwards, when the plants are under most stress. Root systems of affected plants are much smaller than healthy plants and have few fine feeder roots. Root rotting is common. Yield and fruit quality from affected fields is poor.

The following factors contribute to sudden wilt.

Root diseases. *Pythium* and *Fusarium* species, and *Macrophomina phaseolina* have all been implicated.

Poor water management. Too much or too little water can reduce the root mass and increase susceptibility to diseases.

Variety selection. Some vigorous rockmelon varieties such as Planters Jumbo, Eastern Star, Malibu and Eldorado are generally less susceptible. Most honeydews are very susceptible.

These management practices can help reduce sudden wilt.

- Maintain a good crop rotation and land preparation.
- Maintain good farm hygiene.
- Ensure good water management and laser level fields to prevent wet areas.
- Plant on beds.
- Plant less susceptible varieties.

How to calibrate a boom spray

To ensure good plant coverage by pesticides the spray equipment being used must be calibrated to accurately apply the correct amount of chemical. One method of calibrating a boom spray is described here. Before calibration, measure the output of each nozzle for a set time, for example 30 seconds, and discard any nozzle that varies more than 10% from the others.

Where to get this book
Section 6 page 15

Refer to DPI publication *Pesticide application manual* for more details.

1. Calculate the effective spray width (swath) of the boom by multiplying the number of nozzles on the boom by the nozzle spacing (in metres).

   Swath width (m) = number of nozzles x nozzle spacing (m)
2. Calculate the length of the calibration run by dividing 100 by the swath width.

   $$\text{Length of calibration run (m)} = \frac{100}{\text{swath width (m)}}$$
3. Measure and mark the calibration run out on the ground.
4. Mark the position of the tractor wheels at the refill site so that you can return to that position.
5. Fill the spray tank with water to a known mark. Spray the water over the calibration run using the gear, engine revolutions and pump pressure that you will use when spraying.
6. Return to the refill position and measure the volume of water required to refill the tank to the mark showing the initial water level.
7. The application rate is calculated by multiplying the volume of water used (L) by 100:

   Application rate (L/ha) = water volume sprayed (L) x 100

Alternatives to methyl bromide

The continued use of methyl bromide, the main soil fumigant used in melons, is under threat. Many questions are being asked about the future of methyl bromide and the alternatives that are available. Here are the main things you need to know.

The immediate problem with methyl bromide

You have probably heard about the problem with gases such as CFCs and halons attacking and breaking down the ozone layer in the atmosphere. The bromine from methyl bromide has also been shown to be a major destroyer of the ozone layer. There is a lot of concern about the destruction of the ozone layer as it will, amongst other things, increase the risk of skin cancer, particularly in countries like Australia. As a result, Australia is part of an international effort to reduce bromine emissions.

This is being implemented through Australia's involvement as one of 149 nations that are signatories to an international agreement called the *Montreal Protocol on Substances that Deplete the Ozone Layer*. Through this Protocol, it was agreed in 1995 to phase out completely the use of methyl bromide in Australia by 2010. This is being achieved by the Commonwealth Government progressively restricting import of methyl bromide to 2010. The policy is being administered by the Federal Government agency, Environment Australia.

Pros and cons of methyl bromide

These are the main advantages of methyl bromide.

- It has provided a reliable and consistently effective soil treatment in a wide range of soil types and environments.
- Its broad spectrum of activity has enabled it to be used as an effective insurance against a wide range of diseases, pests and weeds.
- Specialised equipment makes it relatively easy to apply.
- It produces what is known as 'a non-specific fumigation response'—a

plant growth response which is often beneficial but is not well understood.

- Besides its ozone depletion problem, methyl bromide has some other important problems.
- Methyl bromide may leak into groundwater. It has already been banned in The Netherlands because of this problem.
- Because of its wide spectrum of activity, methyl bromide may also kill beneficial soil organisms including mycorrhiza. Although the short term effects of this may be minimal, the long term effects on both the fertility and structure of soils are still largely unknown.
- As methyl bromide is a highly toxic and dangerous gas, it needs to be applied by experienced operators under carefully managed conditions.

Possible alternatives

The range of possible alternatives for methyl bromide are listed in Tables 17 and 18. Some are practical alternatives, some are still highly theoretical and are only included to give a complete picture.

Table 17. *Chemical alternatives to methyl bromide*

Chemical	Affective against:			Current status
	Diseases	Nematodes	Weeds	
Metham, Vapam	✓	✓	✓	Cheaper and easier to apply than methyl bromide. Effective but not as effective as methyl bromide. Requires more accurate placement or irrigation water to spread it through the soil. Limited by 2 to 3 week plant-back period. Most effective when applied under plastic sheeting.
Basamid	✓	✓	✓	Effective but very costly. Limited by 2 to 3 week plant-back period. Most effective when applied under plastic sheeting.
Chloropicrin	✓	✓		Excellent disease control but poor weed control. Limited by 6 week plant-back period. Has very objectionable odour. Sold only as a mix with methyl bromide.
Fungicides such as Ridomil, thiram, etc	✓			Effective against some specific diseases but limited by cost, potential disease resistance and rapid degradation in soil.
Nematicides such as Nemacur		✓		Effective against nematodes and some soil insects. Problems include high mammalian toxicity, potential to contaminate groundwater, and rapid degradation in soil.
Herbicides			✓	Problems include cost of application, and potential for crop damage.

Table 18. *Non-chemical alternatives to methyl bromide*

Treatment	Effective against:			Current status
	Diseases	Nematodes	Weeds	
Steam/hot water	✓	✓	✓	Effective but cost seriously limits usefulness.
Soil solarisation	✓	✓	✓	Effective in some situations but limited by cost, climate and season.
Resistant varieties	✓	✓		Little known resistance in existing varieties. Best medium to long term solution.
Cultivation			✓	Limited application for weeds only.
Crop rotation	✓	✓	✓	Effective against some problems. Limited by amount of land available.
Organic treatments	✓	✓		Beneficial in improving soil fertility. Limited by cost, reliability and lack of information.
Biofumigation	✓	✓		Beneficial in improving soil fertility. Recent trials indicate some potential.
Biological control	✓	✓	✓	Specific to certain problems. Limited practical applications to date.
Artificial soil	✓	✓	✓	Limited to hydroponic systems.
Irradiation	✓	✓		Limited by practicability and cost.
Quarantine and use of clean planting material	✓	✓		Useful only against problems transported on planting material.

Tables 17 and 18 indicate that practical alternatives are limited at this stage. There is no other registered or existing chemical that has the same attributes as methyl bromide, so there is no easy shift to another chemical. Many growers see metham or Vapam as the only current alternative but it is doubtful if this represents a long term solution. The past 20 years has seen the demise of five or more fumigants—current ones may also go the same way.

Future strategies for the grower

Here are some suggestions as to strategies that may be worth considering.

- In the short term while methyl bromide is being phased out, you may find that the 70:30 and 50:50 mixtures of methyl bromide and chloropicrin are as effective as methyl bromide alone. Also, you might like to experiment with reduced application rates, particularly if you are fumigating sandy soils or if you target is nematodes rather than fungal diseases. The use of less permeable plastic will also enable you to get the same result with less methyl bromide.
- Then ask: What are you really using it for? This is a necessary step as methyl bromide has been used widely as a general insurance against many problems, in some cases even when the problem didn't exist. So go back to where you were before you started to use methyl bromide and identify your main target problems. You

can then look most effectively at what alternatives there are.

- Think of your soil not as an inert medium to support the plants, but rather as a living fertile system in which soil bacteria, mycorrhiza, earthworms and other soil micro-organisms interact with nutrients and organic matter. This is important as no single approach will probably provide an effective alternative to methyl bromide. The answer will lie in choosing a combination of complementary approaches.
- There is no doubt that the alternatives to methyl bromide will require more sophisticated management of pest, disease and weed problems. You will need to better understand the problems, more accurately diagnose them, properly select appropriate control measures and integrate these into an effective and compatible program.
- Study the alternatives, talk to experts and get their advice on your problems. Then while methyl bromide is still available, experiment on your farm by comparing the alternatives with methyl bromide. Remember to leave some untreated soil for comparison.

Postharvest handling

Careful handling and postharvest treatment of melons, especially rockmelons, is critical to ensure that you can put a top quality melon into the market place.

Cooling

Place fruit in the shade as soon as possible after harvesting. Force air cool rockmelons to a pulp temperature of 4 to 5°C as soon as possible after packing to prolong shelf life. Do not cool honeydews below 5°C or fruit will be damaged. Unless forced air cooling is used cooling could take up to 36 hours.

Cooled fruit can be held in normal cool rooms. Seek specialist advice before buying a cool room as there are several important design features you need to consider.

Fungicide treatment of rockmelons

Postharvest treatment with fungicides will greatly improve keeping quality of rockmelons and reduce losses from fungal rots. This is not necessary for honeydews.

The treatment should be applied as soon as possible and within 24 hours of harvest. Ensure the fruit is dry before dipping as treatment of wet fruit is less effective. Heating the fungicide mix to 55°C increases its effectiveness to some extent, but because of the difficulty in maintaining the temperature, most growers apply the treatment at ambient (air) temperature. The mix is applied either as a one minute dip, or as a flood spray over rollers. If using a flood spray, ensure the fruit is wet for at least one minute.

The level of fungicide mix in the tank will drop with use. If topping up is required, add the required quantity at full strength. Trials indicate that this mixture can treat about 70 times its own volume of fruit, that is 100 L of mix will treat 7000 kg of fruit, or about 200 to 220 trays. If fruit is washed before treatment, up to 100 times the volume, that is

about 310 trays can be treated. Dirt and trash in the mix absorb the chemicals and reduce its effectiveness. Discard dirty fungicide in an environmentally safe manner.

Use screens to separate the wash section of the treatment equipment from the area in which the treatment is applied, so that water does not dilute the mix. Insertion rubber slit into 25 mm strips is effective. A slower brush speed and using sponge rollers to absorb the water will also reduce dilution. Alternatively, do not recycle the fungicide.

Fungicide mixture

The chemicals used are benomyl (Benlate), guazatine (Panoctine), and Monsoon, a non-ionic wetting agent, at the following rates per 100 L of water:

- benomyl 100 g
- guazatine 130 mL
- wetting agent 30 mL

The fungicide mixture must be prepared in the following way.

Mix the benomyl with a little water to form a smooth paste, then stir the paste into the full volume of water in the tank. Next pour in the wetting agent, then continue stirring while adding the guazatine.

Be sure to follow this order while mixing, as benomyl and guazatine are only compatible in the presence of the wetting agent.

Agitate the fungicide mixture constantly before and during use to prevent chemicals from settling. Mechanical agitation is best. If the fungicide mixture has sat unused in the tank for a while, scrub the sides and bottom of the tank to remove attached chemicals and thoroughly agitate to re-incorporate the chemicals into the mix.

Ensure that appropriate methods are used to dispose of used dipping solution. The dipping waste can be neutralised with activated carbon and filtration before disposal.

Ethylene ripening of honeydew melons

Use ethylene ripening only when there are problems of mixed maturity with honeydews, or when a high proportion of fruit do not mature to eating ripe stage within three to four days when held at room temperature. Most current honeydew hybrids have a concentrated maturity. Provided they are mature when harvested the melons should ripen naturally.

Marketing and quality management

Marketing and quality management is a vital step in melon production. How well you manage this, and the quality of your product, will have a big effect on whether you make a profit or loss from your melon production.

How do you sell your melons?

There are many options for marketing melons. These include:

- selling to a local merchant;
- selling to an agent or merchant at the major markets;
- selling to a packer;
- selling direct to a retailer, for example the major supermarkets or smaller retailers;
- selling overseas, either direct to buyers or through an exporter.

NOTE**. Agents** sell your produce on your behalf, then receive a commission, usually about 12.5%. **Merchants** buy the produce from you at an agreed price, then sell it for what ever price they can get.

Quality management

One of the few things that growers can be sure of is change and one of the areas undergoing rapid change in horticulture is quality management. Some of the forces driving this change are discussed below.

Customer demand

Customers (retailers, processors, exporters and so on) today are demanding more quality products and services. For example, supermarket chains in Australia check product on arrival at the warehouse and will reject product if it doesn't meet their specifications.

Consumer concerns about food safety have been heightened by recent outbreaks of food poisoning. In response to these concerns, Woolworths Australia and several food processing companies and fast food chains have requested their major suppliers to implement quality management systems to prevent food from being unsafe to eat.

Joint marketing

The shift to large buyers (supermarket chains) and increased export has seen an upsurge in joint marketing arrangements between growers, packers and distributors. The need to develop common product quality standards is stimulating group members to improve quality management.

Competitive edge

Many businesses have already made the move and are using their improved quality management systems to gain competitive edge in the market.

Inefficient operations

Reduced profitability is forcing businesses to look for efficiency gains. Improved quality management can lead to tangible cost savings through less mistakes and better ways of doing things.

Easier market access

Many markets are difficult to access because of quarantine requirements. Documented quality management systems are now being accepted by Government authorities as an alternative to inspection. Examples are the Australian Quarantine and Inspection Service (AQIS) Certification Assurance arrangement and Interstate Certification Assurance arrangements.

What is quality management?

All businesses have a quality management system in place. Some are more effective than others. All can be improved.

Quality management refers to how growers run their business to satisfy customers. It is not just about the standard of the product.
There are three basic principles of quality management.

1. Customer focus

- Build a relationship with your customers and satisfy their needs.

2. Planning, prevention and control

- Plan all operations to identify clearly how things should be done.
- Prevent problems by doing it right first time, every time.

- Control operations to ensure that they are carried out as planned.

3. Continuous improvement

- Continually look for ways to do things better.

What makes up a quality management system?

A quality management system consists of the following parts. These parts are common to all growing and packing businesses.

Product specifications

Describes the features of the product for sale so that there is no confusion for either customers or staff.

Product identification and traceability

The method used to trace product from its point of origin in the field, through the packing shed, to the customer. It also enables trace back from the customer to the product's point of origin.

Control of production processes

Planning the production process and doing it correctly.

Monitoring of products, processes and services

Checks to ensure that products meet specifications, and processes and services have been done correctly.

People (managers and staff)

Motivated and well trained managers and staff are critical to the success of a business.

Customers and suppliers

Developing relationships with customers for mutual benefit, and working with suppliers to ensure raw materials, for example carton, chemical or seed suppliers, are satisfactory.

Documentation

The documents that are used to support a quality management system. This may include manuals, records, checklists, procedures, work instructions, job descriptions, training guides.

Reviewing and improving the system

Developing a process to regularly review operations, and plan and implement improvements.

Quality management system standards

A range of standards has been developed to enable businesses to have a recognised quality management system. The standards have been

developed by international organisations, government departments or customers. To achieve accreditation, the quality management system is audited to check that it meets the requirements of the standard.

Examples of standards for quality management systems include:

- international/national standards: ISO 9002, SQF 2000;
- customer standards: Woolworths Vendor Quality Management Standard;
- government quarantine standards: AQIS Certification Assurance (CA); Interstate Certification Assurance (ICA).

ISO 9002

ISO 9002 is an international standard for quality management systems. It consists of 20 elements covering all aspects of producing products and servicing customers. Most small growers will not have the resources nor the need to progress to ISO 9002.

SQF 2000

SQF 2000 was developed by Agriculture Western Australia for small businesses in the food industry. It is recognised in Australia, but not internationally at this stage. This standard consists of six elements incorporating aspects of ISO 9002.

It includes a management tool called Hazard Analysis and Critical Control Point (HACCP). This is aimed at preventing food from being unsafe to eat. To achieve accreditation to SQF 2000, someone involved in developing the HACCP plan must have attended an approved HACCP training course.

Woolworths Vendor Quality Management Standard

Woolworths Australia have developed a Vendor Quality Management Standard aimed at food safety and quality requirements for their suppliers. It is an HACCP-based quality management standard. Woolworths initially have targeted their major direct suppliers to implement this quality management system. Woolworths recognise SQF 2000 as an alternative to their Vendor Quality Management Standard.

AQIS Certification Assurance (CA)

Certification Assurance is a scheme established by the Australian Quarantine and Inspection Service (AQIS) as an alternative to end-point inspection. It is a voluntary arrangement between AQIS and an exporting business. The CA system takes over the inspection function previously done by AQIS, which monitors the effectiveness of the CA system by a regular programme of audits.

Interstate Certification Assurance (ICA)

Interstate Certification Assurance has been developed by the state Departments of Agriculture as an alternative to inspection of product destined for states requiring treatment for fruit fly control. It consists of a series of operational procedures that must be followed by growers to meet interstate quarantine requirements. The Department of Primary Industries in Queensland audits each business at least once a year.

What is quality management going to cost?

There is no simple answer to this question.

Costs will depend on:

- size and complexity of the business;
- what level of quality management is wanted;
- how much knowledge the owner and staff have to develop and implement a system;
- whether outside help is needed.

Types of costs include:

- owner's time, this is the biggest cost;
- the staff's time involved in developing and implementing quality management;
- for large businesses, staff positions dedicated to quality management (monitoring, documentation);
- materials such as manuals, folders, posters, measuring equipment;
- training costs for owners and staff;
- consultant fees if outside help is needed;
- auditing costs if aiming for accreditation.

Quality management is an investment

There is a pay off for quality management. As one grower said: "An effective system does not cost, it pays". Like buying machinery, the time and money spent on quality management is an investment for future profitability.