

Brassica I.P.M.

Version 1, 2000

Integrated Pest Management for vegetable brassicas

IPM brings together a wide range of pest management methods to prevent pests from reaching damaging levels in crops, while reducing reliance on any single method.

Past over-reliance on using key insecticides in vegetable brassicas has led to the development of insecticide resistance to a level that has produced control failures for the key pest, diamondback moth.

An IPM programme to control pests of vegetable brassicas has been developed by Crop and Food Research. The key factors in implementing a vegetable brassica IPM programme are:

- Regular crop scouting and the use of threshold levels.
- Consideration of the pests present and of beneficial insects present.
- Reference to action thresholds for the crop stage.
- Consideration of non-insecticidal controls (e.g. natural enemies, cultural controls).
- The use of selective insecticides (when available) in preference to broad spectrum insecticides.

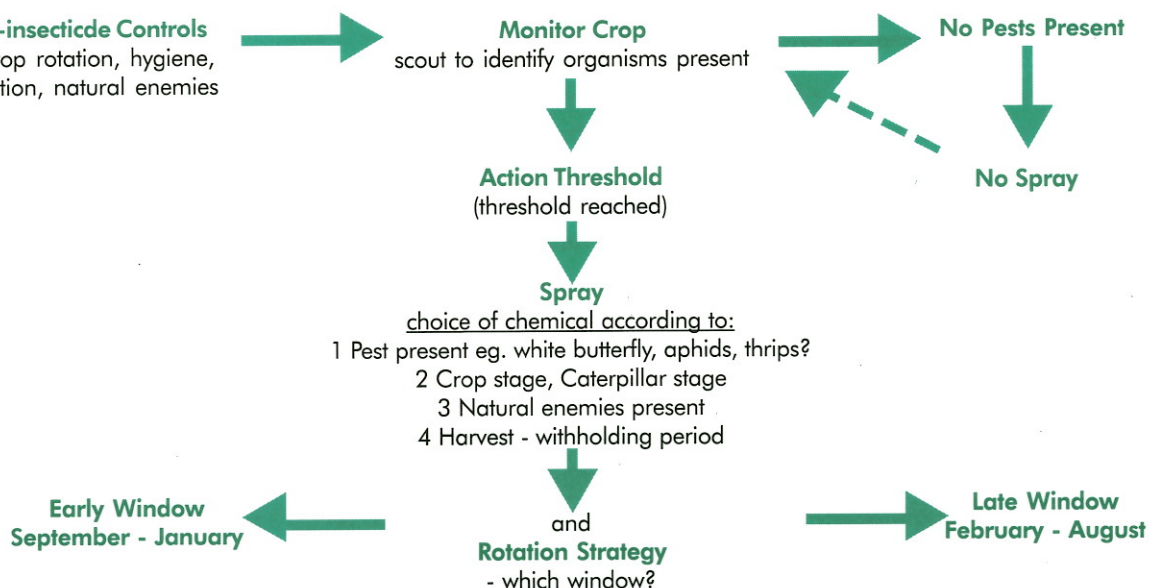
Crop scouting

Regular crop scouting of vegetable brassica crops can determine the level of infestation by pests and indicate whether insecticide applications are required. Using this technique, three or four insecticide applications can be saved, reducing the selection pressure that favours resistant pests. The spray application is therefore targeted at critical periods of high insect activity.

Action thresholds

An action threshold is the level of pest infestation at which control will give an economic return. Minor insect pest infestations can be tolerated without economic damage and applying insecticides only when they are necessary can significantly reduce insecticide use. In vegetable brassicas, appropriate action thresholds for insect pests have been established, tested commercially and shown to achieve significant savings on insecticide applications.

Non-insecticide Controls
eg. crop rotation, hygiene,
cultivation, natural enemies



Crop Type	Lepidoptera	Aphids
Cabbage	15% infested plants (15/100 plants)	10% infested with colonies
Broccoli & Cauliflower	10% infested plants from seedling to 6-8 true leaf 20% infested plants from 6-8 true leaf to curd initiation 10% infested plants from curd initiation to curd development (5% for cauliflower under development)	10% infested with colonies
If plants are within 3% of these thresholds, check again in 3 to 6 days		

An aphid colony is an adult aphid plus more than one nymph. Isolated adults are not considered a colony.

Insecticide rotation strategy

As part of the IPM programme for brassicas, an insecticide rotation strategy has been developed to limit the development of further insecticide resistance. When a decision to apply an insecticide has been made, the insecticide rotation strategy for diamondback moth (see below) should be consulted.

Insecticide rotation strategy with two windows and minor rotations based on current knowledge in New Zealand.

September - end January		February - August
Bts ¹	Btk	Bta & Bta+k
spinosad		synthetic pyrethroids ²
OPs: e.g., acephate, diazinon, malathion, methamidophos		
Endosulfan		
Aphicides:		pirimicarb

¹ apply all Bts to young larvae on small plants.

² consider applying with piperonyl butoxide (PBO) where resistance is confirmed, but not as a routine programme or resistance will develop to PBO.

The strategy requires the use of only chemicals from certain groups at specific times of the year (called windows) on a district basis.

The future introduction of new insecticides with different ways of working will allow greater flexibility within the strategy. These new products will be incorporated into the insecticide rotation strategy when they become fully registered. The insecticide rotation strategy was designed to fit within the brassica IPM programme. This factsheet is version 1 July 2000.

For more information call

Environment Waikato
Franklin District Council
Crop & Food Research
Dr Nadine Berry
ext 7091
(09) 815 4200,
(025) 208 3077

ARC Enviroline
Agriculture New Zealand

0800 80 60 40
09 237 1267



Peter Aarts amongst a broccoli crop

"... since being involved in the IPM programme I have learnt a lot about beneficials and their role."

PETER AARTS
Sundale Farms Ltd

Other Reading:

Integrated Pest Management for Brassicas Manual, Crop and Food Research Manual No.11 (Available for circulation in December 2000).

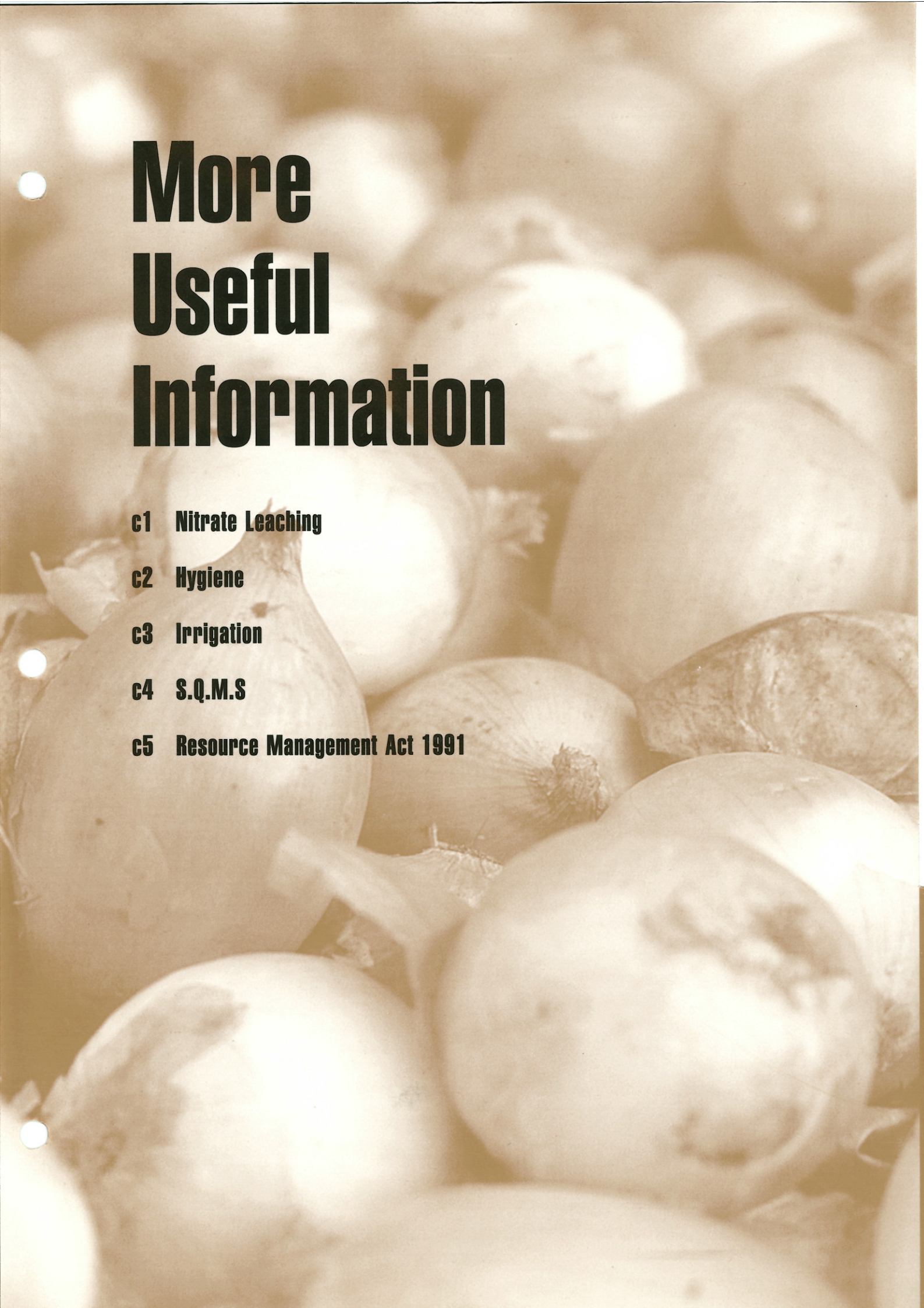
Diamondback moth resistance up-date, *Commercial Grower*, December 1999.

Developing an action threshold for lepidopterous pests of cabbage, by N.G. Beck and P.J. Cameron, 1990. *Proceedings of the 43rd New Zealand Weed and Pest Control Conference*: 31-34.

Scouting for lepidopterous pests in commercial cabbage fields, by N.G. Beck, T.J.B. Herman and P.J. Cameron, 1992. *Proceedings of the 45th New Zealand Plant Protection Conference*: 31-34.

What is Integrated Pest Management (IPM)?, *Crop and Food Broadsheet* No. 2, February 1996.

FSP Newsletter No. 12, March 1999.

The background of the entire page is a close-up, sepia-toned photograph of several onions. The onions are piled together, with some in sharp focus and others blurred in the background, creating a sense of depth. The lighting is warm, highlighting the textures of the onion skins.

More Useful Information

c1 Nitrate Leaching

c2 Hygiene

c3 Irrigation

c4 S.Q.M.S

c5 Resource Management Act 1991

Nitrate Leaching

Background

The Franklin Sustainability Project has looked into nitrate leaching over a period of three years on a number of sites, and with a range of crops. There are several reasons why we have done this. Firstly, nitrate leaching represents wasted fertiliser that has a direct cost to the grower for no pay back. Secondly, nitrate leaching can contaminate ground water which may affect human health and the environment.

Elevated nitrate (NO_3) levels in drinking water can cause a condition called methaemoglobin, which reduces the ability of our blood to carry oxygen. Young infants ('blue baby' syndrome), pregnant women and people with certain specific enzyme deficiencies are more susceptible than older children and adults. The World Health Organisation (WHO) guideline level for nitrate expressed as an MAV (Maximum Acceptable Value) is 50mg/l of NO_3 .

Nitrate Levels in the Pukekohe Area

Both Auckland Regional Council and Environment Waikato sampling in the Franklin district indicates an upward trend in nitrate levels of the two main aquifers. Hickey Springs and Patumahoe Springs fed by these aquifers are a source of town water supply. Environment Waikato reports that three of the 13 sites monitored in Pukekohe exceed the MAV Guideline. Because all town water supply is mixed with several different sources and regularly tested it does not exceed the MAV when it reaches households. However, if the trend of increasing nitrate levels is allowed to continue, it will become more difficult and expensive to maintain the MAV.

Environmental effects include pollution of streams and waterways, excessive growth of weeds and algae and disruption to the aquatic life cycle.

The serious nature of this problem means it is important that everyone does all that they can to minimise and/or reduce the amount of nitrate leached.

What Causes Nitrate Leaching?

One of the contributing factors to the elevated nitrate levels in the Franklin District is the high nitrogenous fertiliser use by commercial vegetable growers. Winter vegetable crops are a major contributor to nitrate leaching. This is because winter crops usually receive high rates of nitrogen to compensate for low plant growth and poor nutrient uptake over winter. The normally high rainfall over this period compounds the problem.

Trial Results

The FSP nitrate leaching trials were designed to document when nitrate leaching is occurring, how much is leaching and what crops are major contributors. More recently, trials have concentrated on looking at ways this nitrate leaching can be reduced while still maintaining crop quantity and quality. We found that:

- Leaching losses vary from year to year, depending on the timing and intensity of rainfall.
- Winter crops have the highest potential for nitrate leaching.
- Winter potato crops are the single biggest contributor to nitrate leaching.
- By altering the timing of nitrogen application to match the plants needs, it is possible to reduce the amount of nitrogen fertiliser and maintain yields.
- Placement of the nitrogen fertiliser is important. The use of base dressing broadcast and banding methods should match the plants' requirements.
- Deep and shallow subsoiling has little effect on the rate of nitrate leaching.
- Large amounts of nitrogen may remain in the soil after harvest. This should be retained for future crops by the use of cover crops.
- Residual nitrogen should be taken into account when calculating the nitrogen fertiliser requirements of the next crop.

Due to the number of nitrate leaching trials it is not possible to include them all here. Copies are available from FSP.

Potato Results

Potato crops planted in winter are likely to have the greatest impact on ground water nitrate levels. Through the potato trials we learnt that:

- Early planted potatoes take longer to start using nitrogen. For example, in the 1999 trial, potatoes planted in July did not begin to take up significant quantities of nitrogen until 70 days after planting. However potatoes planted in September began taking up large quantities of nitrogen after only 40 days.
- As a general rule potato plants don't take up nitrogen until at least 30 days after planting. This means the nitrogen applied at planting has a high risk of leaching - you could be pouring money down the drain!
- Potato crops take up 80 percent of their nitrogen requirement between 50 and 110 days after planting. Nitrogenous fertiliser applications should be timed to match this need, making your inputs more cost effective.
- Control plots (no nitrogenous fertiliser) showed visible signs of nitrogen deficiency soon after emergence. This indicates that some nitrogen is required at planting – but the rate that maximises yield while minimising nitrate leaching is not yet known.
- The total amount of nitrogen taken up by potatoes is usually about 300 kg nitrogen per hectare. The plant does not take up fertiliser applications in excess of this.
- Nitrogenous fertiliser applied during May appears to be most at risk from leaching over winter. The amount of nitrogen used in this month should be as low as practical.

Methods to minimise nitrate leaching

It is unrealistic to stop nitrate leaching altogether in intensively cropped areas, but it can be reduced to manageable levels by following a few simple guidelines:

- 1. Planning** Take into consideration the crop type and planting time when making decisions on fertiliser type, amount and application. Make sure you allow for soil nitrogen levels already present.
- 2. Timing** - Match plant uptake with fertiliser application. Apply several small side dressings instead of one large base application.

3. Placement - Place the fertiliser where it is easily accessible to the plant (e.g. banding). This way you can use less but still get maximum benefit.

4. Retain - After harvest use cover crops to take up and recycle left over nitrogen - this is like recycling your fertiliser dollar!

Using less fertiliser for the same yield!

By applying most of the nitrogenous fertiliser during periods of plant uptake it is possible to use less nitrogen without suffering a loss in yield. This is because some standard fertiliser rates supply nitrogen in excess of a plant's requirement, but take into account the amount that will be lost or become unavailable to the plant.

The 1999 FSP potato trial showed applying a lower rate of nitrogen (total of 330 kg N/ha) over four applications to match crop requirements, produced the same potato yield as higher rates of nitrogen (520 kg N/ha) split over two applications.

The key to using lower rates of nitrogenous fertilisers is to apply them during the period of maximum plant nitrogen uptake.

Nitrogen use tips

- Only use adequate nitrogen for the crop needs.
- Prevent surplus fertilisers washing into waterways.
- Maintain good soil structure and organic matter levels in the soil.
- Use cover crops to avoid water runoff and leaching of nitrogen between crops (see cover crops factsheet).
- Allow for any residue nitrogen and any nitrogen applied with irrigation when calculating fertiliser needs.

Other Reading:

Nitrate leaching from potato and cabbage crops – Year 3 results from the Franklin Sustainability Project. Crop & Food Research confidential report No 195. P H Williams, C S Tregurtha, JAD Anderson, D S Pollock, M Jeram & G S Francis. May 2000.

Interaction of nitrate leaching and subsoiling. Crop & Food Research confidential report No 155. P H Williams, C W Ross, C S Tregurtha, JAD Anderson, D S Pollock, J Dando, M Jeram & G S Francis. April 2000.

Nitrate in Franklin Groundwater – proceedings of a forum held at Auckland Regional Council, 1 December 1999. Edited by R Scoble. Auckland Regional Council Working Report No 78, January 2000.

FSP newsletter no 4, 10 & 17.

For more information call

Environment Waikato
Franklin District Council

0800 800 401
09 237 1300

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0800 80 60 40
09 237 1267

Crop Hygiene

Preventing the spread of pests and diseases

Good control of pests and diseases is based on preventing the problem - in conjunction with other good integrated management practices and chemical controls.



Self set onions harbouring pests

Good hygiene practices as part of an overall integrated control programme include:

- Reducing potential sources of pests and diseases.
- Controlling or eliminating out-of-crop sources.
- Preventing spread of soil borne pests and diseases.
- Use of resistant or tolerant varieties.
- Crop rotations with non-susceptible crops.
- Maintaining good soil health with cover crops and good organic matter levels.

Most pests and diseases which commonly affect vegetable crops are:

- Introduced on seed or plants.
- Spread from other crops as windblown or flying activity.
- Spread from selfset (volunteer) plants in fallow or waste areas.
- Come from alternative hosts such as weeds.
- Are spread with infected soil.
- Are present in the soil from previous crops.

Good practices to prevent or reduce these risks, and specific crops that these apply to are:

- 1. Only use clean seed or plants to establish crops.** With seed, look for reliable sources or disease indexed seed. Use suitable seed treatments and keep seed in clean uncontaminated bins (potatoes) before planting.

Most vegetables raised from seed can have seed-borne diseases. Potatoes can have powdery scab or Potato Cyst Nematode and these can easily contaminate bins from previously harvested crops before the bins are used for seed.

With seedlings from cell plants, use clean plants not already infected with diseases or pests. Keep cell plants healthy until planting by holding away from established crops or infection risk areas and not placing trays on infected soil on headlands or on dirty yard areas.

With open ground bed plants, avoid producing these on areas already infested with diseases such as "Clubroot" for brassica vegetables.

- 2. When crops have been harvested, cultivate the remains (residual trash) into the soil soon after harvest to reduce carry-over of pests and diseases.** Leaving cut over or harvested crop remains in the field allows pests and diseases to buildup, especially since control practices such as spraying are unlikely to be continued.

Brassica crop remains in summer are a source of pests such as Diamond Back Moth and White Butterfly. Squash vines left after harvest are a source of buildup of Rofls diseases (*Sclerotium rolfsii*).

3. Destroy selfsets (volunteers) in non-crop areas, in fallow areas or in dump areas.

Potatoes regrowing are a source of blight, Potato Tuber Moth and Aphids. Left growing in fields they will allow Potato Cyst Nematode and powdery scab to persist.

Selfset onions are a source of thrips in newly sown onions. Carry over onions found in other vegetable crops, in fallow areas or in dumps can allow insecticide resistant populations to persist from one season to the next.

4. Prevent spread of soil-borne diseases from infected areas on equipment.

When leaving known infected areas, clean down equipment with high pressure water hosing to remove the soil from the equipment. Sterilising the equipment with steam cleaners is not essential for most situations. The prime purpose is to remove the soil which carries the diseases or pests.

The main soil borne diseases which are carried around in soil and need special attention are:

- White rot on onions
- Potato Cyst Nematode on potatoes
- Clubroot on brassicas.

These diseases and pests are spread with soil, even when the host crop is not present in the infected field. For example, white rot in onions is spread by equipment in other crops, such as field bins, when harvesting potatoes, squash, pumpkins or carrots, with sprayers in brassicas, lettuce or any other crop.

5. Prevent soil wash from spreading or introducing soil borne pests and diseases.

Soil washed from field to field, or from overflowing drains is known to be a source of new disease infections. See sections on managing contour drains and co-ordinating drainage systems to prevent runoff water, which may bring new diseases, pests or weeds such as oxalis onto farms.

6. Rotate crops to reduce the buildup of diseases.

Long-term rotations are difficult for most growers with the limited range of crops grown on local farms. However any rotation pattern when combined with good use of cover crops and preservation of soil organic matter will reduce the buildup and carry-over of pests and diseases.

Rotations that can generally be attained are:

Potatoes - no more than two crops in every four or preferably five years (PCN control).

Onions - no more than two or three crops in every five or six years. (Minimise whiterot buildup, and reduce risk of Fusarium, and Pinkroot).

Pumpkins/Squash - one crop every three years (Reduce Fusarium and storage rots).

Lettuce - one crop every 18 - 24 months (Reduce Bigvein, Pythium diseases).

Brassicas - one crop every two - three years (Clubroot).

For all these crops a combination of general hygiene and rotation is part of the overall crop health management programme.

For more information call

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Irrigation

Improvements in irrigation efficiency can improve bottom line profit results and protect the environment at the same time.

The average cost of irrigating an outdoor vegetable crop in 1999 was \$178/ha/pass (Barber, 2000). There may also be the added costs of inefficient irrigation such as nutrient leaching and reduced crop yields and quality, so getting the irrigation efficiency right is important for your business.

Efficient use of irrigation is based on;

1. How much is applied at each application,
2. How often irrigation is done, by crop requirements or by the weather,
3. System performance, particularly uniformity of application.

Accurate soil moisture monitoring is crucial in determining when to irrigate. A range of monitoring devices were trialed over the three year project. All gave a much more accurate picture of what was happening in the root zone than visual observations. The type of soil monitoring device chosen by an operator will depend on required accuracy and price. Data from the FSP irrigation trials was collected using the EnviroSCAN continuous soil moisture monitor equipment.

1. Amount of water to apply at each irrigation

The quantity of water applied per pass depends on both the crop being grown and the soil type. The crop type determines the active root depth

and hence the volume of soil that should be wetted with each irrigation. The soil type determines the amount of water that can be held in the soil to the effective root depth.

Crop type	active root depth
Onion	30cm
Potato	over 50cm
Lettuce	30cm
Cabbage	over 50cm

Site specific monitoring is required to determine exactly how much water should be applied to wet the necessary volume of soil without causing loss to drainage below the active root zone.

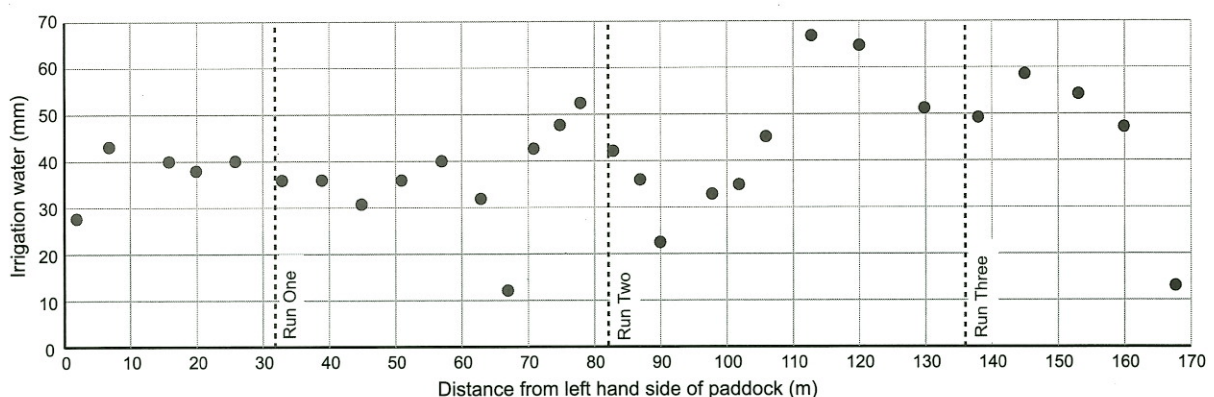
2. Frequency of application

A soil's moisture content should be monitored and a "trigger" irrigation or soil moisture point set. The trigger point is just before the onset of plant stress (see graph). The speed at which a crop will reach this trigger point is dependent on many factors including:

- weather conditions
- crop type
- crop stage
- soil type
- disease presence.

The only way to know how all of these factors determine when to irrigate is by monitoring the soil moisture content.

Little and often is the key to irrigation efficiency.



In all crops that were monitored, during their most rapid growth stages, the soil can go from field capacity to the onset of stress in approximately a week. A good example of this was in January 1999 when a 145mm storm event saturated soil for two days. Just eight days after the storm a potato crop that was being monitored reached the onset of stress. In other trials, potatoes during their tuber bulking phase have gone from field capacity to the onset of stress in 10 days. Irrespective of how quickly a crop depletes the soil water, it is essential to monitor what is happening so that the irrigation decisions are not being left to guess work.



Allan Fong

" We are guided by the soil moisture readings to know what is really happening in the field."

ALLAN FONG
Goon Fong and Co

" We try to get around in a five to seven day rotation - little and often."

ALLAN FONG
Goon Fong and Co

3. System performance

Optimising irrigator system performance is a critical aspect of irrigation efficiency. An irrigation audit can highlight poorly performing areas by investigating:

- Pump and well performance.
- Hydrant pressure variation.
- Pipe layout and sizing.
- Irrigation distribution uniformity.

Monitoring irrigation distribution is critical. This will determine;

- How much water is being applied (at a given irrigator speed).
- How the water is being distributed.

Big gun irrigator performance can be dramatically affected by wind. Replacing the gun nozzle with an extendable boom is one way of improving distribution performance.

The poorer the distribution uniformity, the greater the volume of water that must be applied over and above the target amount in order to adequately irrigate a field. Understanding the irrigator's distribution pattern and required overlap will improve uniformity and reduce the quantity of water that must be applied to ensure the field is adequately irrigated.

Test the irrigator's distribution performance. Know how much is being applied. Have the right overlap.

Other Reading:

FSP newsletters
No. 6 Jan 98
No. 7 Feb 98
No. 8 May 98

For more information call

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S.Q.M.S



Mike Beare demonstrating S.Q.M.S

Soil Quality Monitoring System

Soil Quality means fitness of the soil for sustained crop production. Soil quality is important because:

- High quality soil improves crop yields.
- Cropping can lead to a decline in soil quality.
- Restoring degraded soil can be slow and costly.

You need to monitor soil quality because it:

- Can provide an early warning of soil degradation.
- Will identify factors responsible for soil degradation.
- Means you can adjust management to reverse soil quality decline.

Test of Soil Quality

1. Soil fertility

Regular soil tests provide important information on the amount of nutrients that are potentially available to plants. This allows appropriate fertiliser choices to be made.

2. Bulk Density and Penetration Resistance

Soil compaction is an important issue as it can reduce infiltration of water and nutrients into the soil and restrict the growth of plant roots. This will have a direct effect on crop yields achieved.

- Soil bulk density is used to measure surface soil compaction.
- Penetration resistance simulates the resistance of soil to root growth.

3. Water Holding Capacity

Water holding capacity (WHC) provides a measure of a soil's capacity to store and supply water to a crop. WHC can be improved by increasing organic matter levels

and the soil's structural condition. The WHC is measured by timing the absorption of a known volume of water into the soil.

4. Soil Structural Condition and Aggregate Stability

A soil structural condition score is given to soils based on the size, shape and porosity of soil aggregates, their cohesion and root development in and around them.

Soil structure should be stable enough to withstand the degradation that may result from normal cultivation, compaction and raindrop impact.

Soil aggregate stability measures this by testing the ability of the soil to withstand rapid wetting and gentle shaking in water.

For more information on these tests and how to use them on your property, contact Mike Beare from Crop & Food Research phone (03) 3256400.

The SQMS program is still under development. Look out for further updates as they become available.

Other Reading:

FSP newsletter No 5

FSP newsletter No 10 Dec 98

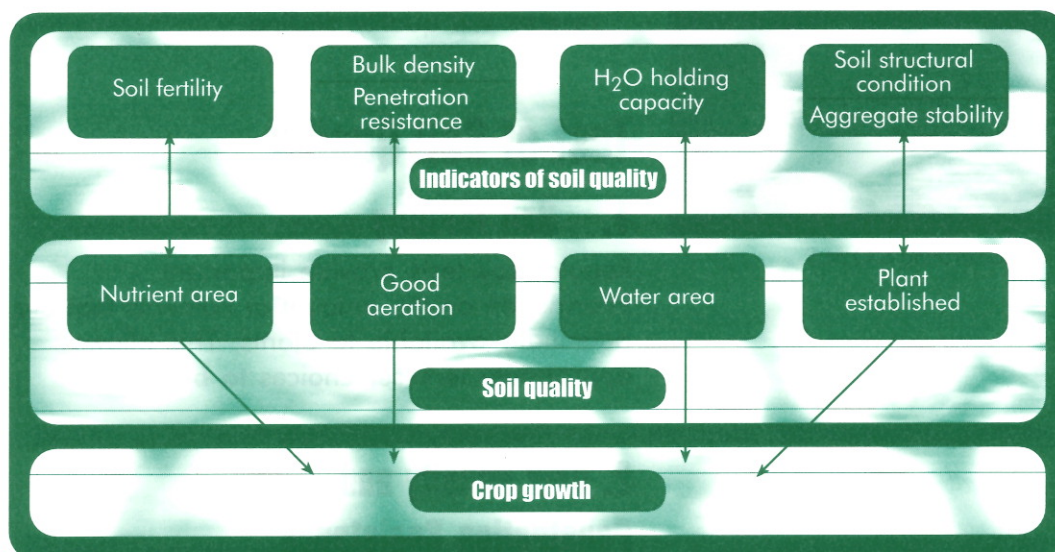


Diagram showing how soil quality monitoring works

For more information call

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Resource Management Act 1991

It's your Legal

Responsibility to Do it Right

The Resource Management Act 1991 (RMA) is New Zealand's environmental protection legislation. The Act says that we all have a responsibility for our environment and therefore every person has a duty to avoid, remedy or mitigate any adverse effects on the environment.

The Role of Councils

One of the functions of Regional and District Councils is to manage the use, development and protection of natural and physical resources, taking into account the needs of present and future generations. This means they must try to:

- Enable farmers and growers to provide for their well-being,
- Safeguard the life-supporting capacity of water, air, soil and ecosystems, and
- Avoid, remedy or mitigate the adverse effects of land-based activities on the environment.

Regional Councils are responsible for controlling the use of land to maintain and enhance the quality of water. Regional Councils also control discharges of contaminants into or onto land, air, or water, as well as the discharge of water into water. District Councils are responsible for managing the effects of use, development, or protection of land and associated natural and physical resources, and also the control of subdivision of land.

Regional and District Councils do this through the implementation of Regional Policy Statements, Regional Plans and District Plans. These documents set out the objectives of the community, and the policies to achieve them.

How do Rules Work?

A common way for Councils to implement objectives and policies is to make rules. Rules list activities for which you will need a resource consent, and set out the environmental standards that you must meet. A resource consent is effectively a permit from a Council to do something that is not otherwise permitted by the rules in a plan.

Many of the activities that you will undertake as a grower are permitted as of right as *long as you comply with the standards set out in any rules, and you do not create any adverse effects on the environment*. If you intend to undertake activities that do not comply with the standards in the rules, you will need to get a resource consent. To find out what rules your Council has that might affect you, give them a call:

Auckland Regional Council
0800 80 60 40

Environment Waikato
0800 800 402

Franklin District Council
(09) 237 1300

Offences and Enforcement

Provisions under the RMA

If you or your company do something that is not permitted, and you do not have a resource consent, Councils can take various forms of action. Enforcement 'tools' available to Councils include the following:

- **Abatement notice.** An abatement notice specifies certain things which you must or must not do by a specified time, to prevent or remedy environmental effects. Failure to do so can result in legal action. An abatement notice is issued by council enforcement officers. They can be appealed without action.
- **Enforcement Order (EO).** For more serious situations or where immediate action is required. An enforcement order must be approved by the Environment Court and then issued by an enforcement officer. You must comply with the enforcement order before you can appeal.
- **Environmental Infringement Notices (EINs).** This is a relatively new 'tool' and is very much like an instant fine.
- **Prosecution.** Sometimes, if justified, Councils will prosecute. This occurs particularly where there is continued, deliberate or repeat offending or where there are prolonged or marked effects on the environment.

Any prosecutions under the Resource Management Act 1991 are criminal proceedings, which can lead to fines or even imprisonment.

To find out more

If you require more information on the Resource Management Act, Regional Policy Statements, Regional Plans or District Plans, call your Regional or District Council.

For more information call

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0800 800 401
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