INSECT PEST MANAGEMENT IN SWEET CORN

(Project VG 97036)

Milestone Number 2

"Documentation of the present pest management practices associated with the sweet corn industry in the major regions of Eastern Australia; and the identification of Best Management Options (BMO) which will contribute towards an integrated approach to pest management."

Due Date :- 30th April 1998.

1. "PEST MANAGEMENT PRACTICES ASSOCIATED with the SWEET CORN INDUSTRY in EASTERN AUSTRALIA, as at NOVEMBER 1997."

2. "BEST MANAGEMENT OPTIONS for SWEET CORN PEST MANAGEMENT in AUSTRALIA."

CONTENTS

[1] Further copies of this document can be obtained from:- Peter Deuter, QDPI, Locked Bag 7, MS 437, Gatton Research Station, Gatton, Qld. 4343. Phone (07) 5466 2222.

SUMMARY

The Australian sweet corn industry is situated in locations which have a range of quite different environments from the dry tropics of North Queensland to temperate Victoria and Tasmania. The timing of production, the level of insect pest pressure and control measures are significantly influenced by these different environments.

Summer production in the semi-tropics of SE Queensland has presented the greatest opportunities to a range of damaging insect pests because of high temperatures often accompanied by high humidity and rainfall events. The winter environment of North Queensland which usually has mild temperatures and low rainfall, results in less difficulties in managing pests in this crop. In both districts extreme difficulties, resulting in 100% crop losses at times have occurred since 1992. Summer temperatures in the NSW, Victorian and Tasmanian production districts are more moderate (generally) than those in the more northern production districts of Australia. Combined with lower rainfall probabilities during the production season, pest management has also been at less extreme levels in Southern Australia.

The pest management practices, as documented in this report, reflect the 'ease' or 'difficulty' in managing insect pests, especially heliothis, by the sweet corn industry in Eastern Australia. The choice of materials and techniques varies with the severity of the problem and the environmental and management factors influencing their effectiveness.
eg. Aerial application of pesticides is the standard for much of the industry in Queensland and NSW, especially where large areas are planted at each sowing date and fields are not adjacent to residential areas. Ground rigs are used in more intensive farming areas and where smaller fields exist often in close proximity to residential areas.

The market destination of the product also has an influence over the level of pest control required by the industry in these locations.

All production districts have varying degrees of difficulty in controlling pests, especially heliothis. These difficulties first arose in Southern Queensland in 1992, and have been progressively felt in all districts as insecticide resistance has increased, coupled with other factors such as temperature, intensity of crop monitoring and effectiveness of spray coverage.

The cultivars chosen by growers in the various regions are those which perform best in the respective environment and meet the market specification. Pest management considerations are taken into account after these conditions are satisfied. eg. In SE Queensland, the H5 cultivar (which is Maize Dwarf Mosaic Virus resistant) is grown during the mid-season production window, as temperate cultivars more closely meet the market specification for early plantings, and MDMV is not a problem until mid-summer.

INTRODUCTION

1. To clearly define the starting point of this project [1]**, **pest management practices** used in the sweet corn industry in Eastern Australia have been identified and documented during the 1997/98 sweet corn season. The first section of this milestone report contains the details of these pest management practices for all the sweet corn production areas of Eastern Australia.

The information contained in this report has been collected by project team members in all Eastern Australian sweet corn production districts by way of phone and/or personal interviews with growers, crop consultants, field officers and other appropriate stakeholders.

As a starting point in this pest management project, this process has provided an opportunity to undertake promotion of the project objectives and identify co-operating growers in each district for future on-farm trials. This baseline data of current pest management practices will be used in project evaluation, against which gains and improvements in sweet corn pest management can be judged.

Further data collection will occur towards the end of the project to record changes in the industry standard practice.

2. Using the above baseline data and current knowledge of pest management in sweet corn and other industries where similar pests, mainly Heliothis occur, **Best Management Options** (BMO) for pest management in sweet corn have been developed. These BMO's are practical strategies, and include a broad range of appropriate pest management components, including the strategic application of synthetic and biological insecticides, improved pesticide application techniques, insect scouting and crop monitoring procedures, and introduction, protection and fostering of naturally occurring and inundatively released beneficials.

These BMO's will be the basis of Research Station and on-farm trials in selected sweet corn production districts in Eastern Australia during the course of the project. These trials will compare the pest management outcomes of BMO's with present management practices, and the results of these comparisons will be promoted to the industry through farm walks, reports and technical notes and at industry conferences and workshops.[1]

[1] ** "Insect Pest Management in Sweet Corn"-Project VG97036, funded by HRDC (1997 to 2001).

1. PRESENT PEST MANAGEMENT PRACTICES.
(for sweet corn in Eastern Australia)

- **PRODUCTION DISTRICTS**

Sweet corn is grown in all states of Australia with NSW the major producer, followed by Queensland, Victoria, Tasmania, Western Australia and South Australia.

North Queensland (Dry Tropics) production is winter and spring dominant. The summers are hot and wet, whereas the winters are generally warm and relatively dry. Bundaberg production is generally all year round with peak production in May and Oct/Nov. Production from Southern Queensland through to Northern Tasmania is summer and autumn dominant.

The Australian Industry is dominated (in tonnage) by the processing sector where product is grown for freezing (Bathurst, NSW) and canning (Northgate, Qld.). The Bathurst/Cowra/Narromine districts of NSW produce about 50% of Australia's sweet corn tonnage, the majority being processed, whereas 55% of the Queensland's industry in tonnage terms is processed (13% by $value). Sweet corn in Victoria and Tasmania is now grown only for the fresh market.

Queensland

North Queensland

Bowen and Burdekin (Dry Tropics) districts produce sweet corn for fresh market only.

South Queensland

Bundaberg produces sweet corn only for the fresh market, whereas the Lockyer and Fassifern Valleys and Eastern Darling Downs produce for both processing and fresh markets.

New South Wales

Central west districts of Bathurst, Cowra, Narromine, Dubbo, and Forbes; and the Riverina (Gundagai to Hay) produce mainly for processing; and the Sydney Basin only for the fresh market.

Victoria

There are 4 main areas of production of sweet corn within Victoria and the crop is only produced for the fresh market. Approximately 70% of Victorian sweet corn is grown in the eastern part of the state with the most of this being in East Gippsland. 7.5% is grown in northern Victoria, 18% in the Melbourne area, and there are a small number of growers in the northern part of the state.

Tasmania

Small areas of sweet corn are grown in Northern Tasmania and in the Coal River area of SE Tasmania, for the fresh market only.

• CULTIVARS

Access to new cultivars within Australia is limited due to quarantine restrictions on the importation of seed. This is a major issue within the industry and is limiting its capacity to access domestic and world markets.

Queensland

North Queensland

All sweet corn produced in North Queensland is grown for the fresh market. The cultivar which is in greatest demand *Goldensweet,* due to its excellent cob appearance and eating quality., This cultivar however suffers from having a loose husk cover, an open tip which allows easy entry of heliothis larvae into the cob, and is susceptible to leaf blight (*Exserohilum turcicum*). It also has variable seed quality problems. Growers are continually seeking alternative cultivars with the desirable cob quality characteristics of *Goldensweet*.

Florida Staysweet is occasionally used for early season plantings as it has better tolerance to heliothis. Its use is restricted to early plantings due to its susceptibility to rust, particularly from July onwards. *Punchline* and *Mecca* have been grown for late harvests, and both appear to be to have less difficulties with heliothis damage than with *Goldensweet*. Cob size of *Punchline* is smaller than current market requirements and *Mecca* is susceptible to lodging.

Gladiator has been grown recently and growers have found less problems with heliothis than with *Goldensweet*, together with a good level of resistance to leaf blight. The cobs of *Gladiator* are often too large for the market and kernel colour is pale at the correct maturity stage. *H5* has been grown to a small extent, particularly where MDMV has been a problem adjacent to forage sorghum cover crops. However, this cultivar is much less favoured on the fresh market than *Goldensweet*, and since MDMV is only a very occasional problem in North Queensland, *H5* is a minor cultivar.

Bundaberg

H5, Golden Sweet and *Gladiator* are the main cultivars which are selected by growers on the basis of kernel colour, cob size (medium to large) and tip fill.

South Queensland

Fresh market cultivars are selected firstly for their suitability for the market, and then for their tolerance to pests and diseases as summer production in Queensland has to compete with product from southern states, where temperate cultivars perform quite well.

Golden Sweet is the predominant temperate fresh market cultivar grown during the early summer, with similar problems as listed for North Queensland. Pests are difficult to control, and more tolerant cultivars are being assessed. *Punchline* is being assessed as a replacement for *Golden Sweet*. *H5* is grown later in the season because of the need for a Maize Dwarf Mosaic Virus (MDMV) resistant cultivar in the mid to late summer production window.

Rosella 425 is the **main processing (canned) cultivar** grown and is planted in August for harvests commencing late Nov.. *Terrific* is grown where a very early crop is required. *H5* is planted from early Oct onwards (for harvests commencing early Jan), because of it's MDMV resistance, and tolerance to heliothis attack. Final harvests are usually made in March from a mid-Dec planting. *H44* is a promising replacement for *H5*.

New South Wales

Fresh market: Early production is dominated by *Punchline;* mid-season by *Gladiator* and *Golden Sweet* and late season production by *H5*. *Golden Pearl* and *Cabaret* are popular bicolour supersweets.

Processing: *Jubilee* is the dominant processing cultivar. A range of other cultivars including *supersweets* are being tested, as also are replacements for *Jubilee*, such as the rust tolerant *Heritage*.

Victoria

The major cultivar grown in Victoria is *Golden Sweet* because of its suitable cob appearance, eating quality and rust resistance. There have been variable problems with establishment, particularly early in the season.

East Gippsland

Sweet corn is currently only produced for the **fresh market**, although some crops have also been grown for use in minimally processed vegetable mixes. In the recent past, crops have also been grown for vacuum packed product. The required cultivar characteristics for both markets are the same. Cultivars currently grown are super sweet and predominantly yellow, with some bicolour cultivars used. *Golden Sweet* is currently the dominant yellow cultivar grown and *Golden Pearl* the dominant bicolour cultivar. *Honey Sweet* may be grown early with its faster maturity time. *Punchline* is also a cultivar that has been grown early. It is not grown later in the season due to its rust susceptibility. *Mecca* has also been grown but lodging has been a problem.

Northern Victoria

Crops are produced for the fresh market with a range of super sweet cultivars being used. *Golden Sweet* is the main yellow cultivar, but others including *Honey Sweet* and *Sno Sweet* are grown. The main bicolour cultivar is *Golden Pearl*.

Southern Victoria

Sweet corn is produced for the fresh market and are all super sweet cultivars. Mainly yellow cultivars are grown including *Honey Sweet* and *Punchline* for early crops and *Golden Sweet* and *Florida Staysweet* for main season crops. The only bicolour cultivar grown is *Golden Pearl*.

Tasmania

Fresh market cultivars *Honey Sweet, Sugar Sweet, Sno Sweet* and *Terrific* are grown, with *Honey Sweet* being the most popular. *Krispi King* and *GS57851* are being experimented with by one grower. Bicolour cultivars have not been grown in recent years.

• PLANTING TIMES

Queensland

North Queensland

Plantings usually commence in mid to late March and continue through until late August, with harvesting extending from late May to mid November.

Bundaberg

First plantings occur in early February, and continue each month until August, unless July and August are too cold, with harvests from May to January.

South Queensland

The fresh market season commences with first plantings in early August (harvesting in early November) and last plantings being made at the end of February (harvesting in mid June).

Rosella 425	mid August planting	100 days to harvest
	mid Oct planting	75 days to harvest
H5	early Oct planting	90 days to harvest
	mid Oct (Eastern Downs)	110 days to harvest
	mid Dec planting	80 days to harvest
Golden Sweet	August planting	95 days to harvest
	mid Dec planting	65 days to harvest

New South Wales

Inland Districts

		planting	**harvesting**
Riverina	-	September to December	(harvest December to March)
Central West	- Narromine	September to December	(harvest January to May)
	- Cowra	October to January	(harvest January to May)
	- Bathurst	November to December	(harvest March to April)
	- Gundagai	November to December	(harvest February to March)

Coastal

Sydney Basin	-	August to late February	(harvest November to late May/June).
		Plantings through to May for MDMV resistant H5.	

Victoria

Planting usually commences in early October and extends to early January, while harvesting occurs from mid January through to late April.

East Gippsland

Honey Sweet	September/October planting	95 days to harvest
Golden Sweet	October planting	120 days to harvest
	November planting	115 days to harvest
	December planting	95-110 days to harvest
	January planting	120 days to harvest
Punchline	September/October planting	110-115 days to harvest
Golden Pearl	September/October planting	110-115 days to harvest
	November planting	110 days to harvest
	December planting	100 days to harvest.

Northern Victoria

Plantings commence slightly earlier than in East Gippsland, producing earlier harvests also. Planting commences in early September and continues through to December with harvests commencing in late December and continuing until April/May.

Honey Sweet	September planting	105 days to harvest
Sno Sweet	September/Oct. planting	110 days to harvest
Golden Sweet	October planting	115 days to harvest
	November planting	105 days to harvest
	December planting	95 days to harvest
Golden Pearl	September/Oct. planting	110-115 days to harvest
	November planting	110 days to harvest
	December planting	100 days to harvest.

Southern Victoria

Production times are similar to East Gippsland, with crops sown from early October to January and harvests from late January until April/May.

Tasmania

All crops are grown for the local fresh market, with a relatively short summer season. Planting occurs from mid October to mid November, when soil temperatures rise sufficiently for satisfactory seed germination. Harvest commences in mid February.

The recently defunct processing industry (McCains freezing), harvested sweet corn from February into early April with crop maturity staggered by cultivar and district (two cultivars, Terrific and Jubilee) for factory convenience. 300 hectares (in total) were planted during November each year, in blocks of 10-20 hectares.

• DENSITY AND SPACING

Queensland

North Queensland

Sweet corn is sown in rows 75 cm apart at a density of 55,000 to 60,000 plants/ha. Higher populations have been found to reduce cob size of *Goldensweet* and reduce the penetration of sprays. This is particularly the case for *Goldensweet* which tillers heavily and has dense foliage above the cobs. Growers have suggested that the lower incidence of heliothis in the cultivars *Gladiator* and *Punchline* is due to their more open plant habit allowing sprays to penetrate more easily. Some growers conduct germination tests prior to sowing and adjust sowing rate accordingly.

Bundaberg

Various spacing and row arrangements are used, depending on the rotation crops used with sweet corn. Equipment for planting and cultivation is adjustable for various row spacings and arrangements:-

- Double rows 24 in (60 cm) apart, and plants 12-16 in (30-40 cm) apart within the row on beds 4 ft 8 in (140 cm) centre to centre (36,000-47,000 plants /ha).

- Borders of 10 single rows separated by a headland for tractor access; 28 in. (70 cm) between rows; 9-12 in. (20-30 cm) between plants in the row (36,000-47,000 plants per planted hectare.
- Double rows 12 in (30 cm) apart on 4 ft 10 in (150 cm) centre to centre spacing; 12-18 in (30-45 cm) between plants in the row (30,000-45,000 plants / ha.

South Queensland

Fresh Market (all cultivars) 30 - 32" (760-810 mm) row spacing;
- 24,000 plants/acre (59,000/ha).

Processing 30" (760 mm) row spacing;
Rosella - 28,000 plants/acre (69,000/ha)
H5 - 25,000 plants/acre (61,000/ha)

Row spacing is determined by harvesting, planting, and cultivating machinery, and cannot be readily modified without major changes especially to harvesting machinery.

New South Wales

Row and plant spacings vary according to harvesting machinery and district practices. Row spacings vary from 76 to 96 cm (76 cm is most commonly used).
In row spacings vary from 21 to 35 cm; 30 - 35 cm being more popular with fresh market producers. Plant populations are typically:-

processing - 55,000 plants per hectare
fresh market - 45,000 plants per hectare

Victoria

East Gippsland

Row spacing is fairly consistent at 78-79 cm, and a plant density of 55,000 plants per hectare.

Northern Victoria

Density is fairly consistent at around 55,000 plants/ha although row and plant spacings do vary to achieve this density.

Southern Victoria

Row spacings vary more widely, ranging from 80 cm between rows and 30 cm between plants (42,000 plants /ha), to closer spacings producing densities from 50,000 plants/ha and higher.

Tasmania

Typical fresh market production areas are 1-3 hectares in size. Densities range from 52 000 to 59 000 plants per hectare. Row spacings range from 75 cm to 81 cm.

• IRRIGATION

Queensland

North Queensland

At Bowen, sweet corn is grown entirely under trickle irrigation, and in the Burdekin, entirely by flood irrigation methods.

Bundaberg

Most crops are trickle irrigated. Travelling irrigators are occasionally used.

South Queensland

The majority of irrigation is carried out using travelling irrigators, either water winch or lateral move types. Some flood irrigation and small amounts of trickle irrigation are used.

New South Wales

The majority of irrigation is carried out using travelling irrigators (water winch, lateral move and centre pivot types).

Victoria

Irrigation systems vary from district to district. In East Gippsland travelling irrigators are used (moveable pipes may be used for establishment), and in other parts of the state, travelling irrigators and furrow irrigation are both used.

Tasmania

The majority of irrigation is carried out using travelling irrigators.

• WEED CONTROL

Queensland

North Queensland

Several herbicides, as well as inter-row cultivation are frequently used. *Eptam*, *Dual* and *Atrazine* formulations have been used and experimental areas have been treated with *Starane* with the expectation of it becoming registered in Queensland. Inter-row applications of *Sprayseed* are also made during the first few weeks after emergence.

Bundaberg

Atrazine for grass control and *2,4-D* for broad leaf weeds are used by some growers, depending on the following crop in the rotation. Interrow cultivation is also used for weed control.

South Queensland

Dual (metolachlor) is the most widely used herbicide. *Eptam* (EPTC) is used only where nut grass is a problem. Interrow cultivation is used for incorporation of side dressing fertilisers and for soil aeration, hilling and weed control. *Atrazine* is not used in the Lockyer Valley because of the residue effects on following vegetable crops.

New South Wales

Crop rotations and thorough soil preparation are used to minimise weed problems. Interrow cultivation is usually necessary and is often combined with fertilizer sidedressing. Registered herbicides that are commonly used with inter-row cultivation are:-

Propachlor, metolachlor, metolachlor + atrazine or atrazine

NB: Atrazine use is influenced by crops following sweet corn in the rotation.

Victoria

Two main herbicides are used, these being: A*trazine*, under a range of product names, and *Gesaprim* (metolochlor) as well as *Primextra*, an atrazine plus metalochlor mix. Where atrazine is used it is quite often applied at low rates to reduce potential residue effects for

following crops. Most growers would use a herbicide on the majority of crops. Two inter-row cultivations are also used as part of the weed control process. This operation serves to incorporate fertiliser, aerate the soil and hill around the base of the plants.

Tasmania

Gesaprim, Atrazine and *Bladex* are used in weed control.

• SOIL INSECTS

Queensland

North Queensland

Plant losses are sometimes experienced through cutworm and wireworm activity. Where these are a problem, *Lorsban* is used, preferably applied late afternoon. This will also assist control of mole crickets which damage irrigation tape. *Lorsban* is not routinely applied but used only when soil insect damage is noticed or can be anticipated because of large amounts of trash in the ground.

Bundaberg

Cutworms and crickets are occasional problems.

South Queensland

Earwigs and cutworms are occasional pests. H5 seed is thiodicarb (*Semiven*) treated. Chlorpyrifos (*Lorsban*) bait is used regularly in trashy conditions during planting.

New South Wales

Pests encountered:

i. Those which feed on the sweet corn seedling below groundlevel eg. wireworm, false wireworm and African Black Beetle.
ii. Those which feed on seedlings above ground eg. cutworms, lesser armyworm.

The larger areas of processing sweet corn are treated with chlorpyrifos (*Counter* ®.) for control of these pests.

Victoria

East Gippsland

Soil pests are not a major issue, the exception being African Black beetle which can cause significant seedling damage from time to time in the Orbost area. Applications of chlorpyrifos have been used around the seed at planting. This treatment has provided variable results. Post emergent applications of other organophosphate compounds have also been used.

Other Production Areas

Cutworms and wireworms can cause significant problems, depending on location and paddock history. *Lorsban* or *Thimet* have been used with limited success. Red legged earth mite has caused some problems in Northern Victoria.

Tasmania

Soil insects are generally not a problem.

PESTS, DISEASES AND DISORDERS

Queensland

North Queensland

Goldensweet suffers from having a loose husk cover and open tip which allows easier entry of heliothis larvae into the cob. It is also susceptible to leaf blight (*Exserohilum turcicum*). *Florida Staysweet* is restricted to early plantings due to its susceptibility to rust, which has the highest incidence from July onwards in the Dry Tropics.

Bundaberg

Wallaby Ear is most common in December-January plantings. Young plants are often sprayed twice weekly for the leaf hopper vector in January plantings.
Maize Dwarf Mosaic Virus (MDMV) is not a common problem.
Rust is a problem when sequential plantings and susceptible cultivars are used.
Turcicum leaf blight is a problem if it appears in early crops and showery weather persists. This disease is often more severe in winter when heavy dews occur.

South Queensland

Wallaby Ear - December plantings are checked for Leafhoppers and sprayed if required. Usually only 1 or 2 sprays are required in early plantings. Crops beside lucerne usually have the highest incidence of leafhoppers and Wallaby Ear.

Maize Dwarf Mosaic Virus (MDMV) - see cultivar section. H5 is grown where this disease is the most limiting factor to production for harvests from January onwards.

Leaf Diseases are managed by cultivar selection and crop rotation. No fungicides are used by either the fresh or processing industries.

New South Wales

Leaf Diseases:

- Rust is the dominant disease problem in the Sydney Basin and coastal areas where most fresh market crops are grown.
- Turcicum leaf blight occasionally causes severe crop damage in late crops.
- MDMV has been a concern to coastal growers.

Cob Diseases:

- Boil Smut is of concern as its spreads to non infected areas. In infected areas, the industry is learning to live with the disease.
- Disorders: mesocotyl strangulation recently caused serious losses in the bicolour cultivar Golden Pearl.

Victoria

Major pest and disease issues apart from heliothis include:
Aphids - These may cover the plant, particularly the tassels as well as the cobs. They are occasionally sprayed for and an aphicide would often be included in a heliothis spray program.
Rust - Not usually a problem due to the use of rust tolerant cultivars. It can occur later in the season (January onwards), as the more rust susceptible cultivars, all grown in the early season, allowing rust to buildup. Fungicides are seldom used for control.

Mites - Usually occur when the season is hot and dry. They cause discolouration of leaves, cobs and flag leaves. They are not usually sprayed for, but control is becoming increasingly important in export crops.
Turcicum Leaf Blight - This is confined to East Gippsland, where occurrence is variable and incidence confined to the late season plantings (January onwards), when most crops are well established. Yield of crops will be affected if infection occurs in the early growth stages. Fungicides are seldom used.

Tasmania

Diseases are not usually at a level where control measures are necessary.

• ROTATIONS

Queensland

North Queensland

Where possible growers in Bowen rotate sweet corn with other crops such as beans or tomatoes on their own land or by leasing neighbouring land. In the Burdekin, sweet corn is mainly rotated with sugar cane. Occasionally lablab is used as a summer rotation crop.

Bundaberg

Sweet corn is grown in rotation with a range of other vegetable crops and sugar cane.

South Queensland

Sweet corn following any intensive vegetable crop is useful in taking advantage of the remaining nutrients. Sweet corn is a good indicator of poor soil structure, which can be a problem following a wet harvest or where heavy machinery is used during the harvesting operation.

New South Wales

Sweet corn is considered a valuable rotation crop with other vegetable crops and pastures, reducing soil borne disease levels and weed problems.

Victoria

Sweet corn is a favoured crop because of its benefits in crop rotation, in areas intensively cropped to a range of other vegetables. Sweet corn is consequently useful in breaking disease cycles such as clubroot in brassica vegetables.

Tasmania

Fresh market sweet corn is grown in a vegetable/pasture rotation, following peas, onions, broccoli or pasture and preceding broccoli or carrots.

• BUGCHECKING and DECISION MAKING

Queensland

North Queensland

The timing and chemical to be used to manage pests is advised by crop monitoring consultants employed by growers. Smaller growers may do this checking themselves.

Bundaberg

Growers usually check crops once or twice per week. There is no formal system of monitoring used and no written records are usually kept. During tasselling and silking, more regular inspections (3-4 times a week) are made. Personal experience is used to determine treatment thresholds. Some growers commence spraying on a schedule once 15-20% of plants start to show silks.

South Queensland

Crops are checked twice per week, and more often if heavy egg lays occur. The technique does not include keeping continuous written records of the levels of eggs, larvae or beneficials. Checking is carried out by the grower or field officer. Spray decisions are based on experience rather than actual recorded levels of pest activity. Only 2-3 plantings on each farm may need to be checked each time, as this usually gives a good idea of what is happening on the whole farm.

New South Wales

Bug checking as a routine practice is not common. Rather, an informal process of crop inspections is undertaken at critical times from planting to harvest by producers, company representatives and processing company field services. More formalised scouting is being encouraged, eg. in the Central West during the 1997/98 season, crops are being checked once or more per week. Critical times for checking are when tassels and silks first appear, and then through to harvest.

There are no verified threshold levels for eggs or larvae.

Victoria

There is no commercial bugchecking of crops currently carried out in Victoria. Several growers monitor moth presence using pheromone traps. In the main production area in East Gippsland growers have been utilising the monitoring and trap data produced from projects administered by Agriculture Victoria. A number of growers are more closely monitoring their own crops by observing the presence or absence of larvae, rather than using egg or moth counts.

Tasmania

Currently most fresh market growers inspect silks at weekly intervals and apply sprays when larvae are detected. Application is with ground rig booms or misters and control is variable.

Until the late 1980's, processing crops were sprayed by air after weekly checks of silks (say 20 cobs per crop by consultants) revealed more than 5% infestation (often not detected until mid instar larvae). This was abandoned when research showed such late sprays to be ineffective. Thereafter, until closure of the industry in 1997, damage was tolerated since it was restricted to a small number of apical kernels which were discarded during processing.

Infestation of processing crops varied from 1 to 40% of cobs, with average levels of 12-13% in the worst two of five study seasons. No crops were rejected although some cobs were. Damage to fresh market crops was probably higher in these seasons.

Pheromone trap forecasting of heliothis was studied by DPIF, but catches during four seasons were extremely low despite sometimes substantial cob infestation. The earliest catch of this migratory species was late November, and most moths were detected in January and February.

It remains uncertain whether pheromone traps would indicate occasional very severe seasons since none occurred during the study. Corn earworm (*Helicoverpa armigera*) has not been found on other crops in Tasmania.
Occasional native budworm (*H. punctigera*) infestations (up to 18% on occasions) of the ears of processing crops were linked to the presence of *Erodium* and other hairy-leafed weeds acting as egg laying sites and nursery plants for young larvae.

- **INSECT PEST MANAGEMENT (mainly heliothis)**

a) ***Young plants (1 m high; 3 to 4 wks from planting) to tasselling***.

Queensland

North Queensland

Insecticide applications during the pre-tasselling stage have increased in frequency in recent years as early infestation of heliothis, particularly in developing tassels, leads to a build-up of the insect population before silks appear. Larvae then drop down from the emerged tassels onto the silks and leaves adjacent to the cobs and can penetrate the tips of cobs from early silk development. Some growers use a ground rig set-up in conjunction with early cultivation or inter-row herbicide applications so that insecticide can be applied over early stage corn while carrying out other cultural operations. Generally this is done twice, followed by two boom spray applications by a contract sprayer using a 'spray-coup' ground rig. These applications are made prior to tassel emergence.

Bundaberg

See Diseases section for Wallaby Ear control. Heliothis is generally of no concern at this stage.

South Queensland

In fresh market crops, there is a concern about large heliothis larvae which are not doing a great deal of damage to this growth stage, but have the potential for downstream effects at a later growth stage. Up to 3 weeks prior to tasselling, the presence of larvae would trigger a spray with *Bacillus thuringiensis* (Bt), as these larvae can migrate from the worls and developing tassels and enter the side of cobs.

In processing crops, the presence of heliothis larvae at this stage are not a concern.

New South Wales

Aphids in crops destined for export are controlled at this stage to prevent the buildup of honey dew.

Victoria

In general, no pest control is required at this growth stage.

Tasmania

For young plants the main pest is cutworm for which a single *Lorsban* ground rig spray is applied on a reactive basis. Some growers do so every season while others do so less frequently or never.

When the processing industry existed, ryegrass stem weevil *Hyperodes bonariensis* was a seedling pest on certain soil types when corn followed pasture. The processing company used seed treatments on an experimental basis for several years but was unable to obtain reliable efficacy data.

b) ***Tasselling (pre-silking).***

Queensland

North Queensland

At this stage scouting is generally carried out twice per week depending on time of year and insect pressure. Some growers will spray on a 3 day program. Generally, in the pre-silking stage, a range of insecticides are applied, with the carbamates used sparingly. *Endosulfan, Azodrin, Parathion* (ground application only), *Bt's,* and *Pyrethroids* are used during the period up to and including tasselling.

Growers have observed that with plantings being sown every week from late March to mid August, it is necessary to keep levels of insect activity down as far as possible during the pre-tasselling and tasselling stage to reduce the population by the time silks appear. When sweet corn is grown in the intensive tomato growing areas, the heliothis population is generally lower than in more isolated areas adjacent to pastures or scrub country where the level of insect activity is generally higher. Sweet corn grown in the sugarcane areas is generally isolated from other vegetable farms.

Bundaberg

Spraying for heliothis only occurs if there is a possibility that these larvae will migrate down to the developing cobs. *Bacillus thuringiensis* and synthetic insecticides are used.

South Queensland

Fresh market - There is a concern about large heliothis larvae which are not doing a great deal of damage to this growth stage, but have the potential for downstream effects at a later growth stage. Up to 3 weeks prior to tasselling, the presence of larvae would trigger a spray with *Bacillus thuringiensis* (Bt), as these larvae can migrate from the worls and developing tassels and enter the side of cobs.

Processing - Methomyl (*Lannate*) is sprayed at tasselling if required. Rosella 425 is always sprayed and H5 is never sprayed at this stage. (H5 appears to attract a less egg laying from heliothis moths, and tasselling and silking are at different times from other cultivars.

New South Wales

In processing crops, a pre-silking spray when tassels first appear has been useful. This is then followed by one or two further sprays during the silking stage. All spraying is determined by the presence of eggs and larvae.

Victoria

Generally sprays are not applied until silking commences, unless there are very high numbers of larvae infesting the tassels or in the centre of the plant. This is not a common occurrence.

Tasmania

Generally sprays are not applied until silking commences.

c) ***Silking to harvest***

Queensland

North Queensland

The intensity of scouting increases during silking, often being every two days (sometimes every day), depending on insect pressure. While a range of insecticides have been used at this stage, growers report a preference for carbamates, particularly methomyl. Even when there are reported levels of very high resistance to methomyl, growers believe they are still achieving better results with this insecticide than with alternatives. Applications are often made at two day intervals during this period, depending on insect pressure. Intervals have been as often as daily to as little as two sprays over the life of the crop.

Bundaberg

Once silking commences or heliothis eggs are found, spraying will occur every two days. Methomyl, methyl parathion and Bt are used. During cooler weather the spraying frequency will extend to once or twice per week during the silking stage.

South Queensland

Processing - Methomyl (*Lannate*) is applied at 50% silking and then at 4-5 day intervals until the silks have died off. Endosulfan is not used in the processing industry because of the risks of organo-chlorine residues in the by-products used for cattle feed. Synthetic pyrethroids are sometimes used as the final spray.

Fresh Market - Methomyl (*Lannate*), thiodicarb(*Larvin*), endosulfan (various trade names) or synthetic pyrethroids (various trade names) are applied every 2 days from 50% silking (sometimes earlier if heavy egg lays occur) until 7-10 days prior to harvest (silks brown 7-10 days before harvest). Late season plantings which harvest in May and June are often not sprayed during tasselling or silking.

New South Wales

Methomyl and other insecticides, (usually SP's) are used. Most concern is for tip damage and there is less concern for side damage to ears in processing crops.

Processing Crops. Typically 1 or 2 sprays are applied commencing at 10% silking. Follow up sprays vary between 3 and 10 days depending on insect pressure, time of year and availability of machinery. The number of applications varies from 0 to 3. Some growers will carefully weigh up the cost of spraying and sometimes determine that they will be better off financially by not spraying. A pre-silking spray when tassels first appear has been shown to be useful. This is then followed by one or two further sprays. Decisions relating to all spraying is dependent on presence of eggs or larvae.

Semi processed crops. (eg. vacuum pack). Depending on insect pressures and buyer specifications, 2 to 6 or more sprays may be applied at 3 to 10 day intervals (typically 4 to 6 day intervals).

Fresh market crops. The number of applications range from 0 to 6 or more (up to 10), beginning at 5-10% silking. Sprays are applied at 2 to 4 day intervals and are completed when silks brown off.

Victoria

East Gippsland

Generally sprays are not applied until silking commences unless there are very high numbers of larvae infesting tassels or in the centre of the plant. Spraying commences at the first sign of silking or when 10% of cobs are showing silks. Sprays are then applied on a weekly basis until the silks brown off. The interval between sprays will be reduced if pest pressure is high and or temperatures increase significantly. These conditions often occur in the latter half of the season when spray intervals may be reduced to 3 to 5 days. Where sprays are missed, particularly early in the silking period, crop damage is often higher and effective control is not recovered. Pest pressure is typically higher in crops silking after the middle of February. This appears to be a critical period, and tends to coincide with an increase in moth numbers and subsequent pest pressure and damage to crops.

Insecticides applied include methomyl (*Lannate*), synthetic pyrethroids (*Dominex, Karate, Ambush, Hallmark*) and thiodicarb (*Larvin*). *Azodrin* is occasionally used.

Northern Victoria

Insecticides from various groups are used, including carbamates (*Lannate* and *Larvin*) and some synthetic pyrethroids such as *Dominex*. In some cases the emphasis is on the use of carbamates and a synthetic pyrethroid with Larvin used occasionally, and in others Larvin is used with a synthetic pyrethroid and Lannate occasionally. Applications are weekly or every 10 days early in the season, and as the season progresses spraying intervals will be reduced.

Southern Victoria

Insecticides used include *Lannate* and synthetic pyrethroids such as *Hallmark* and *Ambush,* with sprays applied around 7 day intervals which are brought closer when pest pressure is higher.

Tasmania

Currently most growers inspect silks at weekly intervals and apply sprays when larvae are detected. Some report that sprays are not needed every season, others spray every season. Others use a scheduled spray program beginning early in cob growth at 14 day intervals reducing to 7 days as the crop matures.

Fresh market growers use synthetic pyrethroids such as *Hallmark* and *Ambush*. Low levels of resistance in processing crops were measured in 1988.

Common armyworm (*Mythimna convecta)* has been frequently noted by entomologists, chewing off exposed silks and spoiling them with frass.

• PESTICIDE APPLICATION.

Queensland

North Queensland

Pesticides are either applied by air from fixed wing aircraft fitted with micronare equipment or by conventional booms fitted to ‘spray-coups’ or tractors. Combinations of ground and aerial application are also used. Droppers have been tested on a ‘spray-coup’ boom but tangling of the droppers with the corn leaves. Where growers have used both aerial and ground application they have not been able to distinguish between the effectiveness of either

method. One aerial operator also uses ground rigs in his business to cater for difficult areas to spray by air and for growers who have a preference for ground application. In the Burdekin the preference is for ground rigs. One grower is using a turbomiser air boom but is unsure if it is more effective than his conventional boom. Another is using a John Deere trike boom spray with droppers covering 28 rows per pass.

Bundaberg

All spraying is done by ground rigs (hydraulic boom sprays with droppers, one each side of the double row). The droppers have two to four nozzles at cob height and there are one or two nozzles over the top of the rows. There are a few minor problems with the droppers catching on leaves. Wet weather is not a problem as the soil drains quickly or headlands and spray rows are used, allowing all-weather access.

South Queensland

Up to 80% of fresh market crops grown to temperate cultivars in the early part of the season (up to mid Feb) are sprayed using ground rigs. All other crops are sprayed by air (micronaire), mostly by fixed wing aircraft and occasionally using a helicopter. Aerial application is used because of the large areas to be covered, the timeliness of operations required and because of the height of the H5 cultivar used in the main season. Many growers (particularly processing growers) do not have ground rigs which are capable of being used in sweet corn. The same applies to some fresh market growers who 'contract' grow sweet corn for a packhouse.

Application occurs early in the morning, and costs are $8-$11 per acre plus chemical.

Some growers would use ground rigs if the following obstacles could be overcome:-

- # spray rows reduce the area available for cropping.
- # wet weather reduces the accessibility of fields for spraying.
- # ground rigs are significantly slower in covering the same area; most growers plant 25 acres (10 ha) in each planting.
- # ground rigs are slower to transport between farms.
- # each farmer would need to own a ground rig to ensure timeliness of spraying.

New South Wales

Processing sweet corn. The aim is to spray early morning or late evening using mainly aerial application methods in the Central West.

Victoria

Wet and or windy weather can interrupt application times. When conditions improve, it is often difficult to get back on schedule particularly when a contractor is used for spray application.

A major issue is effectively managing irrigation and spray timing.

Access using ground rigs can be an issue after heavy rainfall or irrigation but this will vary with regions. Some regions eg, East Gippsland generally have well drained soils and access will only be an issue after very heavy rainfall or if the rainfall is preceded by an irrigation. However in other areas with heavier soils this is more of an issue.

East Gippsland

In the recent past pesticides have been applied by ground rigs including misters and boomsprays, as well as by air. In 1996/97 only one crop was sprayed by air and in 1997/98 no

crops will be sprayed by air. Aerial application was used in the past for convenience and the unavailability of suitable ground rigs. Problems did occur due to inclement weather, either wind or rain, making it difficult at times to maintain spray programs.
Currently in East Gippsland, there are two modern high clearance inter-row ground rigs (without droppers) in use, one on contract spraying and the other owned by an individual grower. A third ground rig, an older tobacco sprayer with droppers, is used by one grower. A mister is also used by a contractor to spray some crops. The contract spraying costs $30/ha, plus chemical. Traffic lanes (spray rows) are not used for the boomsprays, as the high clearance rigs move through the crop, the soils are generally free draining and access is not a major issue unless there is excessive rainfall or good rainfall follows an irrigation.

Northern Victoria

Application is by both ground rigs using high lift booms or by aerial application

Southern Victoria

Application is by ground rig and a mister.

Tasmania

All spray application is with ground rig boom sprays or misters.

• HARVESTING, PACKING, and MARKETING.

Queensland

North Queensland.

Machine harvesting is the major harvesting method. During packing, cobs infested by heliothis larvae in the tip of the cob are detected by feel and by silk damage. Not all infected cobs are able to be detected and removed. Affected cobs are discarded or used for pre-packs. The pre-pack market has grown in recent years but the proportion of pre-packs accepted is around 20-30% of the total fresh corn market. At times when a high proportion of cobs are damaged by grubs the ratio of pre-packs on the market is substantially higher than this level and the price for these becomes uneconomic. *Aphids* in the husk cover leaves also cause problems, particularly for export markets. All fresh sweet corn exports from the region to New Zealand are therefore sent as pre-packs to avoid quarantine problems.

Bundaberg

The majority of sweet corn is hand harvested.

South Queensland

Fresh Market - Machine harvesting is the major harvesting method. During packing, cobs infested by heliothis larvae in the tip of the cob are detected by feel and by silk damage. Not all infected cobs are able to be detected and removed. Affected cobs are discarded or used for pre-packs.

Processing - All sweet corn destined for canning is machine harvested.

New South Wales

All processing sweet corn is machine harvested, and the majority of fresh market sweet corn is hand harvested.

Victoria

Both machine and hand harvesting is used in sweet corn. There is also some interest in machinery which pulls the cobs from the plants resulting in less cob damage during the harvesting operation.

Tasmania

All sweet corn is hand harvested.

========== ◊ ==========

APPENDIX 1. - Managing Insecticide Resistance in Sweet Corn in Victoria.

DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENT

CORN EARWORM IN SWEET CORN - NOVEMBER 1997

MANAGING INSECTICIDE RESISTANCE

Corn earworm (*Helicoverpa armigera*) is the dominant pest in sweet corn in Australia. Sweet corn growers throughout eastern Australia have had enormous problems controlling *Helicoverpa* in supersweet cultivars.

MULTIPLE INSECTICIDE RESISTANCE FOUND IN EAST GIPPSLAND

Larvae collected in Victoria during 1996 were tested by Robin Gunning (NSW Dept Agric.). She found high levels of resistance to fenvalerate (96%), methomyl (50%), endosulfan (35%) and profenofos (6%). These results were very similar to those found in other sweet corn areas in Australia.

Testing of *Helicoverpa* from various parts of Australia has shown that resistance to carbamates (methomyl and thiodicarb) is now widespread in larvae collected from sweet corn.

RESISTANCE TO SYNTHETIC PYRETHROIDS

Resistance to synthetic pyrethroids is shown in large caterpillars and moths, but not in the young (early instar) caterpillars. This is important because it means that the young caterpillars are still readily controlled by chemicals at the registered application rates. It is unlikely that the existing resistance levels will be reduced, but it is possible to prevent them from increasing.

There is a considerable danger that further levels of resistance will develop if insecticide schedules throughout the season do not alternate the different classes of insecticides.

Insecticides registered for corn earworm in Victoria @ 29 Nov. 1997 (S7 chemicals - **)

SYNTHETIC PYRETHROIDS

alphamethrin	Dominex, Fastac
cypermethrin	Cymbush, Polytrin, Scud, Sonic, Cypermax, Cypermethrin, Cyrux
deltamethrin	Decis Forte
esfenvalerate	Hallmark, Sumi-alpha,
permethrin	Ambush, Permesect, Zeeper, Barmac

CARBAMATES

methomyl	Lannate**, Marlin**, Methomex**, Nudrin**, Electra**
thiodicarb	Larvin, Showdown

ORGANOPHOSPHATES

monocrotophos	Azodrin**, Nuvacron**,Monocron**, Phoskill**

ORGANOCHLORINES

endosulfan	Thiodan**, Endosulfan**

S7 chemicals can only be applied by holders of an Agricultural Chemical Users Permit.

PREDICTING AND SCOUTING FOR INFESTATIONS

Careful examination of silks at regular intervals (every 2-3 days) will reveal the onset of egg laying and young larvae.

Newly hatched caterpillars are about 2 mm in length and gradually graze their way down the silk before they enter the cob. They are quite noticeable and leave behind a distinctive and fine trail of excreta (frass). Infestations may be patchy, and so sampling at several locations in the crop is necessary.

Disclaimer:

The advice provided in this publication is intended as a source of information only. Always read the label before using any of the products mentioned. The State of Victoria and its employees do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purpose and there fore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.

For further information contact:

Rob Dimsey — Natural Resources and Environment — Bairnsdale 03 - 51520600

Peter Ridland — Institute for Horticultural Development — Knoxfield 03 - 92109222

SWEET CORN SPRAY PROGRAM FOR CORN EARWORM

TIMING

Green silks are highly attractive egglaying sites for *Heliothis* moths. Since silks grow so fast, it is essential that spraying commence at the "shaving brush" stage (when silks first appear on 10% of cobs) or earlier and continue until silks dry off. The aim is to protect silks at all times.

DON'T GUESS! COUNT 100 COBS - BEGIN SPRAYING WHEN 10 COBS HAVE THE FIRST SIGN OF SILKS. FOR UNEVEN CROPS START ASSESSMENT IN THE MOST ADVANCED SECTION OF EACH CROP.

Don't spray before silking, unless large number of larvae are in tassels. Don't attempt to control larger caterpillars; these are well protected within the cob, and will not be readily controlled.

Apply sprays when eggs and young caterpillars (2 mm) larvae appear on the silks.

If corn earworm pressures are high and temperatures are high, spray schedules of 3-5 days over the silking stage will be needed to produce undamaged cobs.

Cultivate crop residues as soon as practical to kill the pupae which are in the ground. This will prevent the crop residues acting as a reservoir for the pest.

CULTIVATE TO A DEPTH OF 5 CM AS SOON AFTER HARVEST AS POSSIBLE.

This tactic will reduce the numbers of over-wintering resistant pupae.

APPLICATION

Control all *Helicoverpa* caterpillars before they reach 5 mm in length.

Use carbamates [methomyl or thiodicarb (Larvin)] only at larvicidal rates (the higher rate on the label).

Use carbamate for initial spray (10% silking). Follow up with mixture of carbamate and synthetic pyrethroid. The aim is to mop up young larvae resistant to carbamates. For an alternative chemical group, the third spray could be an organophosphate. Alternate the classes of insecticides throughout the season. **It is essential that the following schedule is strictly followed:**

1. **Alternate synthetic pyrethroids** with those from other classes. The insecticides with ovicidal properties (methomyl and thiodicarb) should be used at the larval (higher) rate.

2. **Do not respray** with pyrethroids where it is suspected that a pyrethroid spray has failed. Similarly, do not respray with methomyl if a correctly applied methomyl spray has been ineffective.

3. **Target only** small larvae (less than 5 mm) and eggs. Applications on larger corn earworm (not native budworm - *H. punctigera*) are likely to be ineffective.

4. **Reduce spray interval** when temperatures are high or there is a significant increase in moth numbers (ie a large flight).

Avoid regular use of endosulfan, as this may also induce resistance to this chemical. REMEMBER 42 DAY EXPORT SLAUGHTER INTERVAL (ESI) FOR ENDOSULFAN ON PLANT MATERIAL USED AS LIVESTOCK FODDER NB: If trash is likely to be used as livestock feed, it is essential to observe the ESI for livestock. Follow withholding periods and label recommendations for all chemicals.

Timing	**T**arget	**A**lternate	**M**onitor
At 10% silking	small larvae	chemical groups	crops to check response

2. BEST MANAGEMENT OPTIONS.

Best management Options (BMO's) have been compiled using current knowledge and practice of pest management in sweet corn, together with knowledge from other industries where similar pests, mainly heliothis, occur.

A range of stakeholders, especially sweet corn growers have contributed to the following BMO's for each of the major sweet corn production regions in Eastern Australia.

These BMO's are practical strategies, and include a broad range of appropriate pest management components, including the strategic application of synthetic and biological insecticides, improved pesticide application techniques, insect scouting and crop monitoring procedures, and introduction, protection and fostering of naturally occurring and inundatively released beneficials.

These BMO's will be the basis of Research Station and on-farm trials in selected sweet corn production districts in Eastern Australia during the course of the project. These trials will compare the pest management outcomes of BMO's with present management practices.

The results of these comparisons will be promoted to the industry through farm walks, reports and technical notes and at industry conferences and workshops.

a) Lockyer Valley - South Queensland

Best management Options will incorporate changes to present management practices as follows:-

Cultivars
* Tropical supersweet cultivars - heliothis tolerant and suitable for the fresh and export markets. ie H5, H44
* and/or temperate cultivars which must be market acceptable.

Application
* Improved targeting of silks with the use of boom sprays on ground rigs.
* Selective targeting of silks with ground rigs fitted with droppers.

Scouting
* More formal scouting for, and recording of pests and beneficials (all life stages) using an established protocol.
* Trichogramma assay to determine the level of natural parasitism.
* Spray decisions based on this scouting information, including information on:-

  weather, crop stage, cultivar, time of the year, market destination etc.

Pesticides *a) pre silking*

* No synthetic insecticides for heliothis management (to ensure beneficials protection and buildup).
* 'Soft' chemicals where possible for aphids and leafhopper management when required.
* Bt first preference for heliothis management.

b) silking

* Less disruptive and more selective insecticides for heliothis management (biologicals only; broad spectrum synthetics as last resort).
* NPV (Gemstar) as the basis of insecticide choice and applied when required using scouting information.
* Synthetics as a last resort.

Density and spacing No changes envisaged.

* Row spacing is determined by planting and harvesting machinery and cannot be economically changed.
* In-row spacing will vary according to cultivar and market.

b) <u>Bowen - North Queensland</u>

Best management Options will incorporate changes to present management practices as follows:-

Pre-Tasselling

* Sweet corn trials will be monitored twice weekly for pest and beneficial activity commencing at the 4 leaf stage.
* Observations on beneficial insect species and activity to be recorded ,and spray decisions based on monitoring information.

Insecticides

* Nuclear polyhedrosis virus (NPV) (*GemStar*) and Bt (*DiPel Forte*) will be applied in rotation during pre-tasselling, when required.
* Sprays to be applied to target peak egg hatching.

GemStar rate: 375 ml/ha (7.5x1011 PIBs/ha)
DiPel Forte rate: 425g/ha
Spray volume: 200L/ha applied by ground rig
Adjuvants: Molasses @ 1%

Innundative release of egg parasitoids

***** A sample of 40-50 heliothis eggs will be taken approximately 2 weeks prior to estimated time to tasselling, to identify naturally occurring egg parasitoid species, and levels of parasitism.

* Based on parasitism levels in sampled eggs, inundative releases of *Trichogramma pretiosum* (ex Bugs for Bugs) will be made approximately 10 and then 5 days prior to tasselling and timed (where possible) to coincide with an egg lay.

T. pretiosum release rate: 250,000 wasps/ha

Tasselling/Silking

* Sweet corn trials will be monitored 3 times per week from tassel emergence and rechecked 2 days after spraying.

* A sample of 40-50 heliothis eggs will be taken at tassel emergence to determine parasitism levels. GemStar to be applied during silking, with applications timed to coincide with egg hatch.

* Insecticide applications will be made late in the afternoon where possible.

GemStar rate: 500 ml/ha
Adjuvants: Molasses @ 1%
Spray Volume: 250L/ha applied by ground rig

* Trials will be monitored and GemStar applications made as required through until harvest.

* Observations of beneficial insect species and activity will be made. Dominant species will be counted in conjunction with heliothis monitoring

Application

* UV dye will be included in sprays mid-pre-tasselling, at tasselling, early silking and mid to late silking to assess performance of spray rig and to evaluate spray coverage.

c) Central West - New South Wales

Best management Options will incorporate changes to present management practices as follows:-

Cultural Practices

* Overwintering pupae destroyed by deep ripping.
Insecticide resistance management strategy determined in consultation with the cotton industry.

* *Trichogramma pretiosum* released during pre-silking, according to

scouting data.

Cultivars

* Cultivars which are tolerant to heliothis and acceptable to the market.

Scouting

* A scouting (monitoring) protocol which is practical and economical, will be used to record pest and beneficial activity, crop growth stage, heliothis egg parasitism levels and weather data.
* Scouting (once per week) will commence 2 weeks prior to tasselling.

Application

* Improved application equipment and techniques will be employed to improve targeting, with decisions made using scouting data to achieve improved timing of applications.
* UV dye will be used to assess effectiveness of coverage during pre-silking and silking growth stages.

Pesticides

* Biological insecticides will be used where possible. Eg Gemstar and Bt.

Silking stage.

* Monitoring will occur 2 to 3 times per week, and biological insecticides applied according to scouting data.

d) East Gippsland - Victoria

Best management Options will incorporate changes to present management practices as follows:-

Cultivars

* New cultivars which are heliothis tolerant and suitable for export and domestic markets will be compared with standard cultivars. These cultivars must be market acceptable and should encompass yellow and bicolour types and must include improved varietal vigour and quality.
* Bt sweet corn will be compared when commercial cultivars are available in Australia.

Scouting

* A scouting protocol and moth trapping will be used, with thresholds identified for decision making. This will be a grower friendly system for scouting (monitoring) which does not require high levels of expertise.
* Parasite levels will be assessed to assist in decision making.

Application

* Improved targeting of silks, using improved application methods (boom sprays) with or without the use of droppers.
* Improved spray timing, taking into account pest pressure, temperature effects on life cycle and spray intervals. This will identify appropriate spray intervals which may be from 7 to 10 days early in the season down to 3 days in mid-season.
* For export crops, mite monitoring and seasonal expectations of mite levels will be critical for decision making.

Pesticides **Pre silking**

* No pesticides will be applied unless the control of other pests such as aphids is necessary. Synthetic insecticides used only when necessary, to allow build up of beneficials.
* Beneficials will be released in early crops prior to silking, to allow build up early in the season and before first crops commence silking.

Silking

* More selective biological insecticides (such as NPV and Bt) will be applied when indicated by scouting and trap records.
* New generation chemicals used where necessary. Synthetic pesticides used as a last resort.

Cultural Practices

* No major changes envisaged at present.

========== ◊ ==========