

Milestone Report

HRDC Project VG97036 “Insect pest Management in Sweet Corn”

Milestone 7 - Establish cultivar evaluation trials in major production regions. Cultivars to be evaluated for quality, yield and tolerance to pest and disease.

a) Improved varieties identified for disease resistance, tolerance to heliothis and yield and quality parameters.

b) Farm walks have been conducted and industry has evaluated varieties.

• **Cultivar evaluation - Summary**

Introduction

Emphasis has been on cultivar tolerance to insect damage since anecdotal evidence has suggested that there are differences between Australian sweet corn cultivars in their susceptibility to heliothis damage. Field observations have shown that cultivars such as *H5* and *Florida Staysweet* are more resistant to attack than cultivars such as *Goldensweet*. The main difference observed between cultivars appears to be mechanical, with very tight husks and good husk coverage likely to provide some resistance to movement of larvae through the silk channel and consequently reduce the likelihood of reaching the cob and causing damage. This has been found in the USA where a study of 27 commercial sweet corn hybrids found that damage ratings due to corn ear worm were significantly correlated with husk tightness. Field trials to compare the susceptibility of a range of cultivars in Australia to heliothis damage were carried out at Bowen in North Queensland in the 1998 and 1999 seasons and at Lindenow in East Gippsland in Victoria over the 1998 –1999 season.

1. Bowen

In **1998**, six cultivars were sown over a 17 day period commencing in late March in order to have all cultivars flowering at the same time so insect pressure would be similar for all cultivars. This period of the year generally experiences high levels of insect activity. The cultivars were *H5*, *Pac 377*, *Goldensweet*, *Gladiator*, *Florida Staysweet* and *Punchline*. No pesticides were applied and cobs were harvested and graded at maturity on the incidence of grub damage. Cob husk cover and tightness ratings were assessed as a mean rating for each cultivar and were found to be best for *H5* and worst for *Goldensweet*, with the other cultivars intermediate. **However cob damage ratings did not correlate with cob husk cover and tightness ratings. *H5* had the highest % of damaged cobs and *Punchline* the lowest with *Goldensweet* intermediate. Since *H5* was the earliest sown cultivar, it experienced earlier insect attack than the last sown cultivar, *Punchline* which grew under cooler conditions. This difference may explain some of the differences in levels of cob damage.** When minor damage (silk and tip damage) to cobs was added to the undamaged level, *H5* fared better while *Punchline* was again the lowest but *Goldensweet* had the highest % of damaged cobs. **This may indicate some impediment to the passage of the larvae through the silk channel in *H5*.**

A spray penetration comparison between ground-rig and aircraft was also carried out on this planting. *H5* had the highest spray deposit at the silk level from both spray application methods indicating some difference in plant structure, that allows better spray penetration.

This higher spray deposit in *H5* may explain some of the observed differences in cob damage between cultivars in commercial fields.

In the 1999 trial six cultivars (*Goldensweet*, *Gladiator*, *H5*, *Punchline*, *Sunsweet*, *Shimmer*) were sown at the same time but in larger plots (180sq.m cf 30sq.m) than were used in the 1998 trial. As in the previous experiment, the protection afforded by the husk cover and tightness were best for *H5* and worst for *Goldensweet*, with the other cultivars intermediate. Again, damage from heliothis did not correlate with these ratings. *Goldensweet* and *Gladiator* both had significantly less damaged cobs than all other cultivars with *H5* having the highest % of damaged cobs. **However, the bulk of damage to *H5* was in damage to the silks which again may indicate a slowing in the passage of larvae through the silk channel.** The later flowering of *H5* could also have coincided with a higher level of insect pressure.

Neither of these experiments have shown clear and consistent differences between cultivars in their susceptibility to heliothis damage. Both trials did provide some evidence that movement of larvae into the cob was restricted by the presence of a tight husk. However any cob damage or significant damage to the silks will still render the cobs unmarketable as whole fresh cobs particularly for export markets.

2. Lindenow

In this trial, ten cultivars of thirteen sown (three had insufficient germination) in late December 1998 were assessed for their susceptibility to heliothis damage. The cultivars assessed were *Honeysweet*, *HY769*, *HY720*, *Flair*, *Golden Pearl*, *Sno Sweet*, *Goldensweet*, *HY941*, *Gladiator*, *Shimmer*. Husk tightness ratings, husk channel length on individual cobs and cob damage ratings were made at maturity. The only statistical difference between cultivars was in relation to the position where the damage occurred. *HY769* had the tightest husk of the cultivars tested and the results indicated that in the majority of cases where damage occurred, the larvae did not penetrate the end of the husk to the tip. There were significant correlations between the husk tightness and the % of undamaged cobs, the larvae damage position and the damage rating level.

This trial gave a more detailed picture of the interaction between husk tightness and its effect on heliothis damage. **There was a very strong correlation between husk tightness and the degree of damage to the cob, with a tighter husk reducing the amount of damage when grubs did get to the cob. This presumably is a function of slowing down the progress of the larvae through the silk channel and into the cob.**

While the trial demonstrated that there were no clear differences between the cultivars tested in their susceptibility to attack by heliothis, it did indicate a relationship between the tightness of the husk and the number of undamaged cobs, the penetration of larvae into the cob and the amount of damage to the cob caused by heliothis larvae. A tighter husk appears to retard the movement of larvae through the silk channel and into the cob. Were a temperate cultivar with an extremely tight husk such as the tropical cultivar *H5* available to use in Victoria, it may have been shown to provide enough additional resistance to larvae movement to aid in control and reduce the amount of damage.

The trials at Bowen and Lindenow did not show a difference between cultivars, even though the Lindenow results showed that a tighter husk reduces the impact of heliothis attack on the cob. While the Bowen data did not demonstrate this, there was an indication that the very tight husk of *H5* had some effect on reducing the severity of damage to the cob. However while the degree of damage to the cob may be reduced the cob may still be rendered unmarketable for fresh whole and particularly export fresh

whole if there is even significant silk damage. The difference in maturity times for the various cultivars are further complicating factors when assessing the impact of *Helicoverpa* damage.

Details of yield, quality and disease tolerance are in the following Tables.

- **Cultivar evaluation – Quality Yield and Disease Tolerance – North Queensland. Ross Wright, Bowen Research Station.**

Three cultivar trials were grown in the 1998 season. In the first trial sown in late May, eighteen cultivars were evaluated. These included the standard commercial hybrids as well as a number of new experimental hybrids from Snowy River, Hendersons, Yates, PAC Seeds, and Novartis. The entries tested and their performance are listed in Table 1. Results are from unreplicated plots. The 'B' grade cobs refer to the smaller or insect damaged cobs which are used in pre-packs.

Of the new experimental hybrids, *Shimmer* and *Sunsweet* showed the most promise, the major drawback with both being their paler kernel colour. Both have good husk colour and cover and attractive appearance. *941* had good cob appearance and good kernel colour but cob size was too small. *GSS7831*, a more disease resistant version of *Krispy King* produced cobs of good appearance with reasonable eating quality. Pericarp was slightly tough and texture was slightly starchy. It appears that this cultivar may pass through maturity fairly rapidly in tropical environments. *H141* produced quite good quality cobs but tip cover was variable with some tips exposed. Variation in kernel colour and reddish-pink tinges in the silks also detracted from its appearance. *PAC377* produced good quality cobs, but tip cover was variable, as was cob size. Basal blanking in some cobs was also of concern. This hybrid produced well but plant type has undesirable characteristics with tall, vigorous tillers.

Illini Gold yielded very well but cob quality was only fair with tip blanking, relatively pale kernels and below average sweetness and flavour. While *H5* yielded well and has been commercially available for some time, this cultivar is not popular with fresh market growers in the dry tropics region. The visual appearance and eating quality are considered inferior to cultivars such as *Goldensweet* and *Gladiator* despite the superior disease resistance of *H5*. Its major attribute is its resistance to Johnson Grass Mosaic Virus or JGMV which seriously affects sweet corn production in the Lockyer Valley but is of minor importance in North Queensland.

The second trial sown in early July was planted as a yield trial with 12 cultivars and 3 reps. However, heavy rain and strong wind at early silking caused severe lodging of the entire trial block which did not recover. The resulting pollination was nil to poor resulting in several cultivars producing almost no kernel set while a few cultivars produced reasonable set.

Severe leaf blight (*Exserohilum turcicum*) developed in the block and the only useful data gathered was a rating for *Turcicum* blight. This is included in Table 1 for the cultivars tested. The only additional cultivar tested in trial 2 was the bicolour *Madonna* that produced some excellent quality cobs despite the conditions and also had a low incidence of *Turcicum* blight. This cultivar is well worth further testing.

A further evaluation of these 12 cultivars was made in an early September planting and used for a grower farm walk in early November. Conditions for leaf blight were again favourable and growers were able to see the large cultivar differences in susceptibility. The earlier ratings for this disease were confirmed. Grower interest in the cultivar *Shimmer* was strong with its high level of resistance and good quality attributes. Of the cultivars which had a high incidence of leaf blight, *Goldensweet* is a major cultivar used in North Queensland and this susceptibility is a concern expressed by growers. The higher level of resistance in *Gladiator*

makes it a choice for early season plantings in North Queensland when the likelihood of wet weather is higher promoting the higher risk of *Turcicum* blight occurring.

**Table 1. (Combined trial 1 and 2 results 1998)
Cob Maturity Yield and *Turcicum* Ratings**

Variety	Days to 50% silk	Days to maturity	Marketable Cobs/plant	Av cob size in husk (g.)		Total Mkt yield t/ha	% A grade cobs	Turcicum Blight Rating (1-10)
				A grade	B grade			
Golden Pearl	53	77	1.05	356	201	17.8	76	-
Honeysweet	49	73	0.70	-	272	10.1	0	-
Florida Staysweet	58	84	1.35	304	187	20.3	81	-
Illini gold	55	81	1.80	309	209	26.5	67	8.0
H5	68	92	1.00	414	271	26.1	73	-
Cabaret	54	78	1.05	297	194	15.4	81	-
Green & Gold	51	75	0.90	*Av	336	16.1	6	8.0
Mecca	57	82	1.35	338	251	23.1	81	3.0
Sunsweet	54	78	1.00	*Av	338	18.0	35	3.0
Punchline	52	76	1.15	276	159	15.3	78	1.0
H141	66	90	0.95	407	227	20.1	95	-
Headstart	55	80	1.50	333	225	23.5	63	8.0
Goldensweet	57	82	1.15	305	206	17.6	83	6.0
Shimmer	60	86	1.00	334	207	16.8	85	2.0
GSS7831	55	80	1.15	345	188	20.3	91	7.0
PAC 377	60	86	1.40	298	195	20.6	79	6.0
941	58	82	1.15	257	160	14.2	74	8.0
Gladiator	59	84	1.00	335	-	17.8	100	3.0
Madonna	-	-	-	-	-	-	-	3.0

* Separation of A and B grade cob sizes unavailable
Rating 1 – Nil affected; 10 – 100% affected

In the 1999 season a cultivar screening trial to compare new available hybrids with the industry standards was grown in a late April sowing. This included twelve of the hybrids grown in the 1998 season and an additional five experimental hybrids. A further planting of all the available cultivars from the screening trials with some additional previously tested hybrids was sown in mid June 1999 for the benefit of industry members to view and examine at a field day in mid September. Maturity and yield data from single plots in the 1999 screening and maturity time for the field day planting are shown in Table 2. The maturity data are shown as sowing 1 and sowing 2 for the screening trial and field day trial respectively.

In a further planting sown in early August 1999, twelve cultivars were selected for a replicated yield trial. This included the industry standards for the region, (*Goldensweet* and

Gladiator), several which are being grown elsewhere such as the Lockyer Valley (*H5*) and southern Australia (*Sunsweet*, *Sovereign*), experimental hybrids which have had some commercial testing and others which have little or no commercial exposure (*Mecca*, *Pac377*, *H141*, *Shimmer*, *1039*, *1094*, *Dominion*). Maturity and yield data for these twelve cultivars are shown in Table 3. Fresh cob yield is that which can be packed as whole cobs while the smaller and damaged cobs are in the pre-pack category.

The plantings in 1999 were relatively free of disease so no assessments on cultivar susceptibility to disease could be made in these trials. The days to maturity in Table 2 demonstrates the large difference in maturity time as temperatures experienced become cooler. Maturity time differences between cultivars in warmer periods are much less obvious.

Of interest in the yield data presented in the three tables is the relatively consistent higher yields obtained with the tropical hybrids *H5* and *H141* and the tropical x temperate hybrid *Pac377*. By comparison, the temperate standard cultivars *Goldensweet* and *Gladiator* tended to be towards the lower end for total marketable yield. This is particularly so in the replicated trial where these cultivars significantly outyielded *Goldensweet* and *Gladiator* for total marketable yield. In this trial, the five highest yielding cultivars for both fresh cob and total marketable yield are *H5*, *H141*, *Pac377*, *Mecca* and *Sunsweet*. None of these cultivars are grown in the dry tropics region of North Queensland, although *Mecca* and *H5* have had limited commercial use. The industry standard cultivars *Goldensweet* and *Gladiator* and the promising newer hybrids *Dominion*, *Shimmer* and *1094* were in the middle to lower order of yields in both categories. These cultivars also were of most interest at the 1999 field day.

Growers have indicated that while yield is a consideration, cob quality is of utmost importance and demand is higher for the more attractive and superior eating quality cultivars. Important features noted by growers were a dark green husk colour, relatively tight husk cover with good cover over the tips of the cob, presence of flag leaves, straight kernel rows, 16-18 rows, bright yellow or golden kernels, deep kernels with flattened rather than rounded ends, tender kernels with high sweetness and flavour, cylinder shaped cob with rounded rather than tapering end. Plants should be erect and not prone to lodging, cobs at medium height, few or no tillers, resistant to common rust (*Puccinia sorghi*.) leaf blight (*Exserohilum turcicum*) and preferably *JGMV* and with good seedling vigour and high germinability.

From the trial data collected and the observations made, a summary of the cultivars tested and their likely place in the fresh market industry in the dry tropics is as follows:

Industry standard cultivars.

Goldensweet - Currently the major cultivar grown in the dry tropics region. Excellent eating quality and cob appearance with bright golden kernels, tender pericarp and dark green husk with abundant flag leaf. Grown through the main season, not high yielding but fairly consistent. Main disadvantages are its loose husk cover, high tillering tendency and susceptibility to leaf blight. This cultivar has dominated the industry for many years and major efforts to replace it have been intense. Recent improvements in seed quality have assisted this cultivar.

Gladiator - Has become established since the mid 1990's as a robust cultivar. Used often for early and some late plantings. Has relatively good leaf blight resistance, good eating quality,

tight husk cover, dark green husk colour and few tillers. Main disadvantage is the paler kernel colour. Cob size can sometimes be too large.

Occasionally used cultivars.

Florida Staysweet - Has been grown on occasions in earliest plantings. Tight husk appears to afford some insect protection and this cultivar can produce high yields. Eating quality is average. Main disadvantage is its susceptibility to common rust which is more problematic in late season sowings. An old cultivar which has generally been replaced by *Gladiator*.

Headstart - More recent cultivar (mid 1990's) which has similar eating quality to *Goldensweet*. It matures earlier than *Goldensweet* and has been used as a catch-up option when normal sowings are delayed. Main disadvantage is its susceptibility to common rust and leaf blight.

Commercially tested but generally not grown.

Krispy King - Attractive cob, good eating quality, used elsewhere for processing. Main disadvantages are the low cob height in this environment which causes problems with harvesting and its high susceptibility to diseases. Poor seed quality problems have also been an issue with this cultivar.

H5 - High yielding cultivar due to large cob size. Resistant to *JGMV*, common rust and moderate resistance to leaf blight. Popular cultivar in Lockyer Valley for fresh market and processing due to *JGMV* resistance. Main disadvantages for fresh market are its lack of flag leaf, tough pericarp, tip blanking and lower eating quality than the standard cultivars.

Punchline - Attractive cob, good eating quality, very uniform plants, early maturing. Has been considered as a catch-up cultivar, but main disadvantage is its smaller cob size under North Queensland conditions. It is also susceptible to common rust.

Mecca - High yielding cultivar, average to good eating quality. Main disadvantage is the tendency for the plant to lodge making harvesting difficult. Tapering cob shape is also less desirable.

Pac377 - High yielding cultivar, first of the tropical x temperate hybrids. Attractive looking cob with good tip-fill. Disadvantages are its relatively tough pericarp, lack of flag leaf, variable degree of tip cover, non-uniformity of cobs, basal blanking (lack of kernel set at the base of the cob) in some cobs, produces many large tillers. Likely to be discontinued.

Tested experimentally and commercially and showing promise.

Shimmer - Newer cultivar with attractive cob and good eating quality. Kernel colour paler than *Goldensweet* but acceptable. Has good resistance to leaf blight. Results from commercial testing in 2000 have been mixed with some problems of poor cob setting. Future for this cultivar is undecided.

Dominion - Only limited testing so far. Attractive cob with dark green tight husk, good kernel colour. Amongst the better yielding temperate cultivars after limited testing. Some problems with harvesting have been reported but still appears to have promise.

1094 - Similar quality attributes and cob and plant appearance to *Gladiator* but with improved kernel colour. This cultivar may replace *Gladiator*.

Experimentally tested but unlikely for commercial production.

720 - Early maturing cultivar which showed promise for catch-up plantings. Good eating quality. Major disadvantage is the high proportion of ‘fasciated cobs’ (flattening of the cob lengthwise to give an oval shape in cross-section), also referred to as ‘bears paw’. This condition has been found in 30%-50% of cobs in experimental plots and was observed at high levels in a commercial trial in 2000.

H141 – Tropical cultivar with significantly more tender pericarp than H5 and showed promise earlier as a possible improved quality tropical type. Major disadvantages are its variable kernel color with varying shades of yellow, shallow kernel depth, tendency for the cob to become exposed through the husk at the tip, pale green husk and lack of flag leaf.

Sunsweet – Showed some promise with a reasonable level of leaf blight resistance, good husk cover and attractive appearance. Main disadvantages are its pale kernel colour and lower eating quality lacking sweetness with a starchy texture.

Sovereign (formerly GSS7831) – Similar cob shape and size to *Krispy King* but with a higher cob height. Has resistance to common rust. Main disadvantage is its tougher pericarp and susceptibility to leaf blight.

Illini Gold – High yielding in limited testing. Main disadvantages are its poorer sweetness and flavour than the standard cultivars, tip blanking and pale kernels.

1039 – Attractive cob, good eating quality, early maturing. Main disadvantage is its small cob size.

941, 1032, 1076, 1100 – All tested experimentally but have been discontinued.

Table 2
1999 Sweetcorn Cultivar Screening

Cultivar	Days to Maturity		Mkt. cob Number/ Plant	Mkt. Cob wt t/ha
	Sowing 1	Sowing 2		
1076	68	80	0.90	12.73
Punch line	70	-	0.95	11.69
720	71	79	0.95	13.52
Sovereign	73	85	0.95	16.04
Head start	73	84	1.00	12.45
Madonna	75	82	0.95	15.37
Shimmer	75	87	0.95	12.93
Goldensweet	75	88	0.95	13.43
Mecca	76	86	1.00	14.69

1032	77	85	1.10	15.54
Pac 377	77	90	1.00	13.53
Florida Staysweet	77	-	1.00	15.37
Gladiator	77	87	0.90	12.95
1100	78	-	0.80	12.38
1094	78	91	0.95	13.80
H141	88	96	1.00	17.34
H5	92	99	0.85	16.86

Table 3

1999 Sweet Corn Cultivar Yield Trial

Cultivar	Days to Maturity	Fresh Cob Yield t/ha	Pre-pack yield t/ha	Total Mkt Yield t/ha
Shimmer	74	11.80	2.99	14.80
Mecca	73	14.78	1.70	16.49
Sovereign	73	9.06	6.20	15.26
Sunsweet	72	12.32	4.25	16.57
Goldensweet	74	12.22	2.11	14.33
Gladiator	75	11.84	3.00	14.85
Dominion	75	12.23	3.21	15.45
1039	71	12.05	3.65	15.71
H5	84	16.98	2.37	19.35
H141	81	15.48	7.69	17.18
PAC 377	75	12.62	4.96	17.58
1094	75	9.68	4.19	13.87
LSD ≤ .05	-	2.88	2.61	1.73

• Cultivar Evaluation – Susceptibility to Heliothis and Diseases; Yield and Quality – East Gippsland.

Evaluation of the Impact of Cultivar on Corn Earworm Damage, Yield and Quality – East Gippsland

R Dimsey, Siva-Subramaniam, P Ridland

There is anecdotal evidence of differences between Australian cultivars in their susceptibility to corn ear worm attack and the incidence of damage. The main differences observed between cultivars appear to be mechanical, with very tight husks and good husk coverage seemingly likely to provide some impediment to movement of grubs through the silk channel and consequently reduce the likelihood of grubs reaching the cob and causing damage. In USA, in a study of 27 commercial sweet corn hybrids, Wiseman and Isenhour (1994) found

that damage ratings due to *Helicoverpa zea* were significantly correlated with husk tightness ($r = -0.83$).

What Have We Done for the 1998-99 Season ?

The aim of this field trial was to compare the susceptibility of a range of Australian cultivars to damage by *H. armigera*. Cultivars were planted in December so that plants would be silking when the period of peak insect activity was likely. In East Gippsland, based on data collected over the last 5 years, this occurs around the middle of February onwards.

How The Trials Were Carried Out

The trials were planted on 21/12/98 in Lindenow, the centre of the main sweet corn production area in East Gippsland but away from commercial crops. The plots were established on the northern edge of a bean paddock. This paddock is broken up into segments using maize as windbreaks established prior to planting the trial. The maize is not sprayed with any pesticides and the trial plots were untreated with any pesticide.

Cultivars planted: *Golden Sweet, Krispy King, Dynasty (Improved), Shimmer, Gladiator, HY769, HY720, HY941, Golden Pearl, GS7831, Sno Sweet, Honey Sweet, Flair*. The cultivars were all planted at the same time and consequently there was some difference in the commencement of silking. This has the disadvantage that variation in damage may occur due to differences in moth activity at times of silking. The other option of staggering planting dates so that silking of all varieties coincided, would not be exact and some cultivars would be exposed to a higher pest pressure over a longer period and this was deemed to be less satisfactory. The plots were planted using a hand seeder and later thinned. The plots were 4 rows wide, 6 metres long and replicated 3 times. Only the middle 2 rows and 4 metres of each plot were sampled.

Measurements

Fifteen cobs were sampled from each plot and evaluated for grub damage. Husk tightness was evaluated on a subjective basis and rated 1-5. This ranged from extremely tight (1) to the cob being exposed (5). The length of the husk channel from the tip of the husk to the tip of the cob was measured but a loose husk could mean that a cob could be exposed and still have a long husk channel.

The position of the grub or damage was also rated from 1-6.

- 1 - silk damage only.
- 2 - the tip of the husk channel.
- 3 - middle of the husk channel.
- 4 - base of the husk channel
- 5 - cob tip (this also included side damage where it occurred).
- 6 - base cob damage (this occurs with loose husks and the grub enters the cob after going between the loose husk to the base).

The cobs were also rated as undamaged and marketable whole, marketable as a trimmed (topped and tailed) cob or suitable as domestic market with slight damage. The level of damage was rated from 1-3 with 1 = 0-2 cm of tip damage, 2 = 2-4 cm of tip damage and 3 = 4-6 cm of tip damage. The lowest level of damage (1) was rated as a potential domestic cob as a rough pass.

What did we find?

Poor germination and stands resulted in plant stands too poor to harvest for 3 cultivars. These were *Krispy King*, *GS7831*, and *Dynasty Improved*. This was in part due to heavy rain just after seeding however the remaining 10 cultivars produced adequate stands and plant densities.

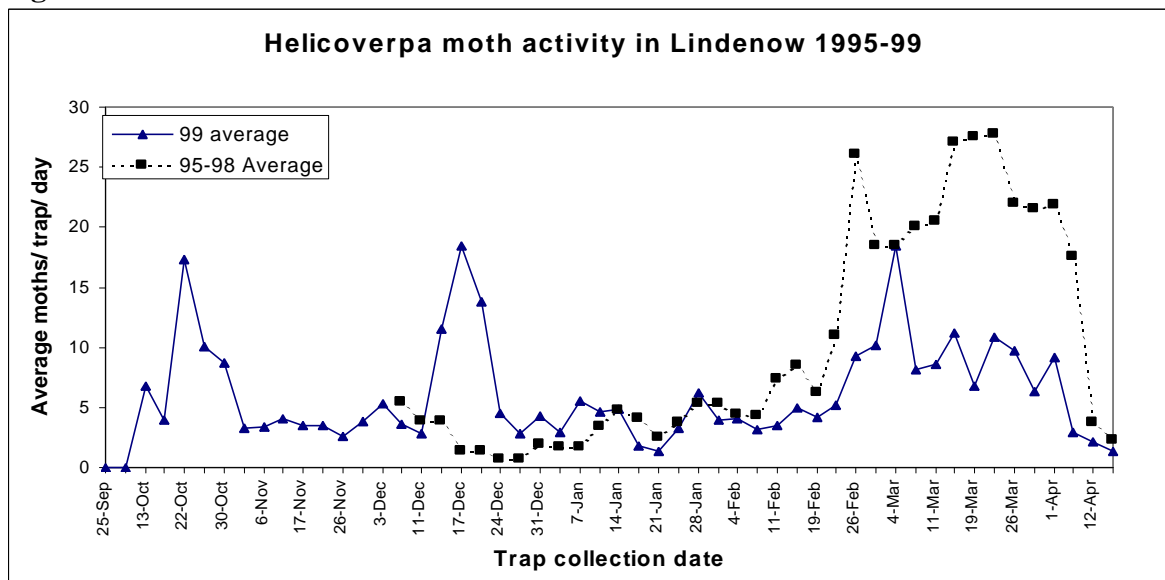
The harvest dates and days to planting are shown in the following table as well as a comparison of the physical parameters, husk tightness and the length of husk cover from the tip of the cob to the end of the husk channel. Husk tightness was rated on a scale of 1-5 with and extremely tight husk (1) and an exposed cob (5).

Table 4

Cultivar	Harvest Date	Days Planting to Harvest	Husk Tightness 1-5	Husk Cover Length mm
Honey Sweet	10/3	77	4.1	36
HY769	10/3	77	2.5	34
HY720	23/3	90	3.6	35
Flair	23/3	90	4	35
Golden Pearl	24/3	91	4	44
Sno Sweet	24/3	91	2.9	38
Golden Sweet	29/3	99	3.7	23
HY941	29/3	99	3.3	34
Gladiator	1/4	102	3.8	27
Shimmer	1/4	102	3	32
			LSD .05=.38	LSD .05=7.5

The earliest silking cultivars were *Honey Sweet* and *HY769* with silking beginning around the 10th of February. Moth activity in the area is shown in the following graph and indicates more consistent activity during this period in comparison with earlier in the year.

Fig 1.



The cultivar *HY769* had a significantly tighter husk than any of the other cultivars. *Sno Sweet*, and *Shimmer* also had tight husks but there was a marked difference between those and *HY769*.

Husk length was much more variable but differences were still evident between cultivars. However husk length was irrelevant when considering whether or not the cob was exposed for it was quite possible to have an exposed cob with a long husk channel, the cob being exposed out the side of a loose husk.

The results of the cultivar comparison are shown in the following table:

Table 5

Cultivar	Undamaged Cobs %	Damaged Cobs %	Domestic cobs %	Tip Damage Rating 1-3	Not Marketable %	Grub Damage Position 1-6
Honey Sweet	13.3	66.7	26.7	2.2	3.3	4.9
HY769	43.3	53.3	53.3	1.2	3.3	4.3
HY720	23.3	73.3	33.3	1.7	3.3	4.8
Flair	28.7	66.7	21.0	1.8	6.7	5.0
Golden Pearl	11.7	85.7	22.7	2.0	2.7	5.0
Sno Sweet	30.7	58.7	7.7	1.6	10.7	4.6
Golden Sweet	23.3	76.7	30.0	1.8	0	5.0
HY941	30.0	70.0	40.0	1.6	0	4.5
Gladiator	23.3	76.7	16.7	1.8	0	5.1
Shimmer	20.0	76.7	20.0	1.9	3.3	4.9
	NS	NS	NS	NS	NS	LSD P _{.05} =0.33

The only statistical difference between cultivars was in relation to the position where the grub damage occurred. Only one cultivar, the tightest husked *HY769* had an average value approaching 4 indicating that in the majority of cases where damage occurred, the grub did not penetrate the end of the husk to the **cob** tip. *HY941* which also had a reasonably tight husk was similar to *HY769*.

A rating above 5 it indicates that there was damage at the base of the cob. This was the case where the husk (not just the tip) was very loose and occurred on *Flair* and *Gladiator*.

Although *HY769* appears to have a higher level of undamaged cobs there was still some variability within plots with a number of different cultivars having some plots with similar numbers of cobs unaffected by grubs. Consequently there were no differences between cultivars.

There were very few cases where cobs were considered unmarketable and it was due to either side damage or base damage of the cob rendering them unsuitable for topping and tailing and marketing as a trimmed pre pack product.

The tip rating indicates the amount of grub damage to the cob. It would be expected that the looser the husk and the easier access to the cob would result in those cobs showing greater levels of damage. This was not demonstrated by the trial results probably due to the variability of damage, the impact of different silking times and timing of moth flights.

Impact of Husk Characteristics on Damage

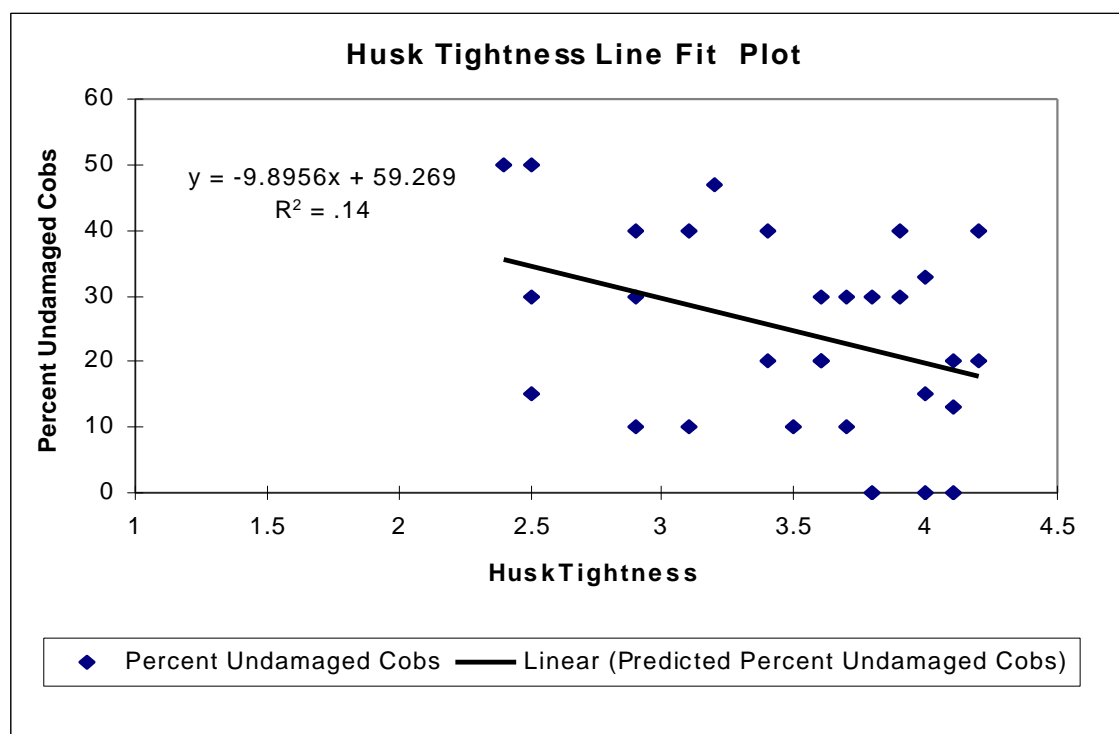
There was no significant correlation between the degree of husk tightness and husk length covering the tip ($P > .05$, $r = 0.07$). This was due to situation where a cob could be exposed out the side of a loose husk but still have a long husk cover.

There were no correlations of husk tightness against the percentage of cobs suitable for domestic market or suitable for the production of trimmed prepacked cobs. The latter because all damaged cobs are suitable for prepacks, as long as there is a minimum useable length of 7cm of cob.

There were significant correlations between the husk tightness and the percentage of undamaged cobs ($r = 0.38$), the grub damage position ($r = 0.68$) and the damage rating level ($r = 0.49$).

With an increasing level of husk tightness the, going down the scale the number of undamaged and marketable cobs increased. As can be seen from figures 2, 3 & 4 this relationship is not as strong as for the other two parameters.

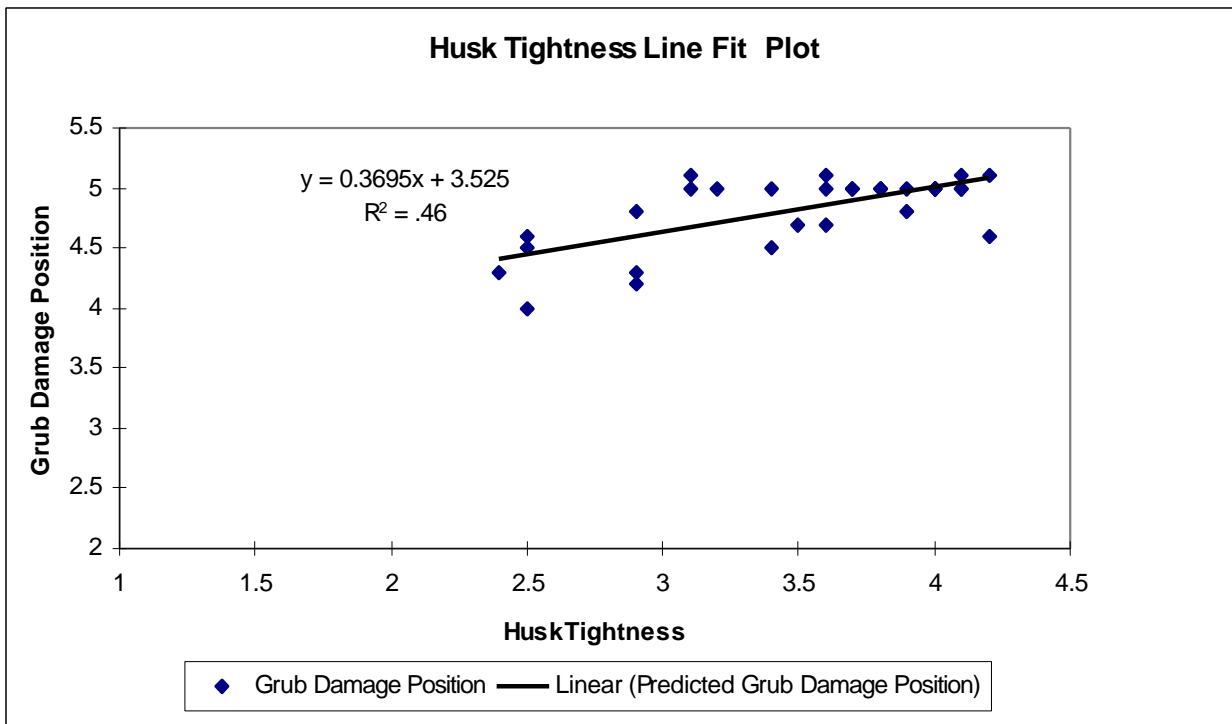
Fig 2.



The correlation of increasing husk tightness with the grub damage position is stronger as can be seen in the following graph. As husk tightness increased the number of grubs that made it all the way to the tip of the cob decreased.

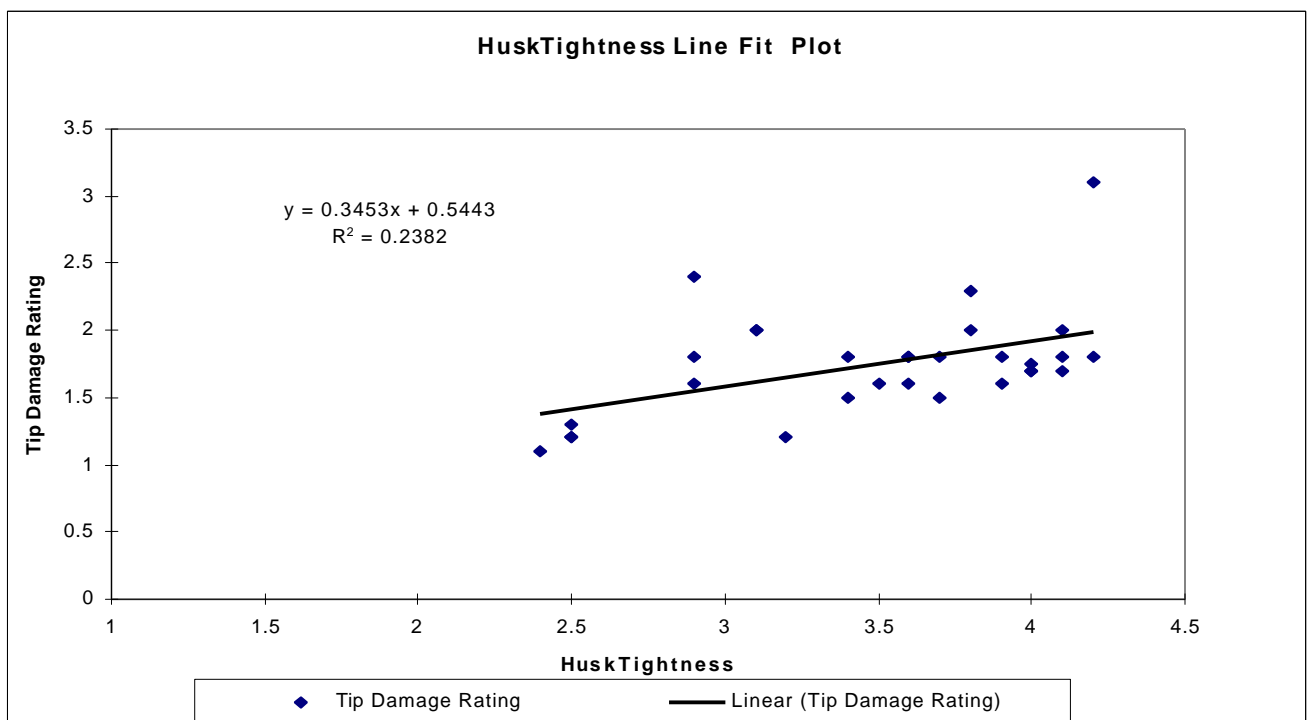
This indicated that the degree of husk tightness could provide some impediment to the movement of the grub into the tip of the cob.

Fig3.



There is also a very strong correlation of husk tightness with the degree of damage to the cob with a tighter husk reducing the amount of damage when grubs did get to the cob. This presumably again is a function of slowing down the progress of the grub through the silk channel and into the cob.

Fig 4.



Yield Comparisons from Cultivar Trial

Thirteen cultivars were planted, but the plant stands from *GS 7831*, *Krispy King* and *Dynasty* were too poor in this planting to evaluate these cultivars. This was due to a low plant population due poor germination and consequent low emergence.

Of the cultivars compared for yield, *Golden Pearl* had a lower germination percentage than most of the other cultivars. This consequently results in a low yield per square metre. The yield results are indicated in the table below.

Table 6.

Cultivar	Cob weight with husk gm	Husked cob weight gm	Husked cob length mm	Husked cob diameter mm	Tip fill 1-10	Yield of 1 st cobs/m ² kg
Honey sweet	356	270.6	196	47	9.1	1
Hy 769	339.6	224.9	191	44	10	1.03
Hy 720	408.2	335.6	207	50	9	1.32
Sno sweet	425	324.6	199	50	8.7	1.05
Flair	443.1	367.1	197	53	8.7	1.55
Golden Pearl	475.6	387.8	203	54	9.6	0.78
Hy 941	366.2	281.4	182	49	9.7	1.05
Golden sweet	441.2	345.3	199	51	9.4	1.47
Shimmer	448.8	335.4	194	52	9.2	1.27
Gladiator	442.4	354.3	201	53	8.6	1.4
LSD=.05	35.8	35.63	10.9	2.3	0.4	0.35

The yield per square metre is based on the 4 metres of double row sampled with 0.8 metres between rows and based on 6.4m².

The best yielding cultivars were *Flair*, *Golden sweet*, *Gladiator*, *Hy 720*, and *Shimmer* on an area basis. This is a function of plant population and the cob weight.

There were significant differences between cultivars in relation to tip fill but since all cultivars were planted at the same time silking was not the same for all cultivars and it is the conditions at silking that have a significant impact on tip fill. Consequently the tip fill comparisons may not accurately reflect the comparative performance of the cultivars. *Hy 769*, *Golden Pearl* and *Hy 941* were the better performing cultivars in relation to tip fill.

Golden pearl, *Flair* and *Gladiator* produced the largest cobs after the husk was removed and *Golden Sweet* and *Shimmer* were not significantly less in weight than *Flair* and *Gladiator*.

However in terms of flavour and tenderness subjective assessment rates *Hy 941* and *Golden Sweet* as the best cultivars followed by *Hy769*, *Golden Pearl*, *Krispy King* and *GS 7831*.

Other pests and diseases were not a major issue in this trial with some small amounts of rust present on susceptible cultivars. *Gladiator*, *Golden Sweet* and *7831* have rust resistance and *Golden Pearl* some rust tolerance. There an outbreak of aphids within the trial but since no pesticides were applied this was quickly cleaned up by natural predators. This natural control would have been helped by the isolation of the trial from other corn crops and the low incidence of pesticides used on the adjoining bean crops.

Northern leaf blight occurs occasionally and when it does may cause some problems. However its incidence varies from year to year and when it does occur is generally late in the season when its impact is limited. In this cultivar evaluation there was no incidence of the disease and tolerance could not be assessed.

Of the cultivars evaluated currently the main ones grown in Victoria are *Honey Sweet*, due to its earliness and *Golden Sweet*. *GS 7831* will probably be grown more extensively in the future. For the cultivars evaluated, this trial produced no evidence that any of the other cultivars were significantly better in terms of yield and quality.

What Have We Achieved ?

The main of the trials was to assess the impact of cultivar on susceptibility to corn earworm. The evaluation in terms of yield and other pest and disease incidence was secondary.

The trials demonstrated that there were no clear differences between the varieties tested, in their susceptibility to attack by corn earworm. It did demonstrate that there are cultivar differences in husk tightness, length and other physical parameters but this was known. What was unknown was the effects of these, if any, on the potential to resist attack by corn earworm. For the current and potential commercial cultivars grown in southern Victoria the differences in these physical characters were not large enough to provide significant resistance to attack by corn earworm.

It must also be remembered that different cultivars silking at different times may be exposed to different levels of pest pressure due to the timing of moth flights. The earliest silking cultivar, *Honey Sweet*, when scouted during the period of silking of the majority of cultivars had the highest numbers of grubs already present.

The trials however did indicate a relationship between the tightness of the husk and the number of undamaged cobs, the penetration of the grub into the cob and the amount of damage to the cob caused by the grubs. A tighter husk appears to retard the movement of the grub through the husk and into the cob. However none of the cultivars evaluated, had what could be deemed as the tightest possible husk, that is, something as tight as maize or the Queensland cultivar *H5*. Consequently that extreme could not be tested.

However given that no such variety is commercially available, the trial data shows no difference between cultivars, even though a tighter husk appears to have reduced the impact of earworm attack on the cob. There were also no new outstanding cultivars identified in terms of yield and the impact of pest and disease.

It may be that an extremely tight husk, if such a commercial cultivar were available, may provide enough additional resistance to grub movement to aid in control and reduce the amount of damage. It must also be remembered that although the trial was carried out at the time of peak pest pressure that the pest pressure in Victoria is much lower than in other production areas such as Queensland.

The issue will be to balance yield and quality parameters with the physical parameters for tight husk to slow down the incursion of *Helicoverpa*. Unless cultivars with good commercial

characteristics and an extremely tight husk becomes available there would appear to be no benefit in pursuing this line of investigation further. The development of resistant temperate cultivars remains a challenge for Australian researchers.

Reference

Wiseman, B.R. and Isenhour, D.J. (1994) Resistance in sweet corn to corn earworm larvae. *Journal of Agricultural Entomology* 11: 157-163.

• **Conclusion**

Cultivar choice depends on a range of quality characteristics and market acceptability. Good husk cover protection is a desirable attribute to protect cobs from weather and harvesting damage as well as providing some protection from insect attack. The development of good quality temperate and tropical cultivars with this attribute is a desirable plant breeding objective and remains a challenge for breeding programs.

• **Farm walks and field days.**

The latest available cultivars were on show to growers at a farm walk in early November 1998 and a field day in mid September 1999, at Bowen. The 1998 farm walk provided an opportunity to demonstrate the reaction of available cultivars to heavy disease pressure from turcicum blight. New resistant cultivars such as *Shimmer* provided a good contrast to the susceptible commercial cultivar *Goldensweet* and the quite acceptable resistance of *Gladiator*. The field day in 1999 demonstrated further new available and experimental hybrids from all available commercial sources to a range of industry stakeholders. New cultivars of interest were *HY1094* and *Dominion* which have since been trialed by growers. No further new cultivars were available for testing in 1999.