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Super sweet corn cropping feasibility study for processing

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FINAL REPORT

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Super sweet corn cropping feasibility study for processing

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Horticulturist Nick MacLeod and Operations Manager Mark Betts of Golden Circle and Barry Donahoe of Syngenta Seeds discuss the quality and yield of super sweet corn grown on Doug Rankine's farm at Mareeba, November, 2001.

VG00091

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Purpose of report.

This report is a summary of the results of three field trials of supersweet corn hybrids conducted on the Atherton Tableland in north Queensland in three discrete environments during 2001. It also details results of a commercial trial conducted by a private grower.

The major objective of the project was to establish whether yields and quality of sweetcorn in these representative environments were sufficient to warrant the establishment of a processing (canning) industry in the region. Of critical importance was the need to test a range of geographical locations as potential production areas and to test whether year-round production was feasible.

Secondary objectives were to determine which hybrids were most suited to growing at particular locations at particular times of the year. To this end we tested a range of commercial and experimental hybrids in un-replicated "strip" trials, recording yields, sweetness, tenderness, kernel colour and kernel depth. Promising hybrids were then canned and assessments made of kernel recovery and quality parameters of the hybrids.

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2. State Development Department (Queensland)
3. Golden Circle Ltd
4. Queensland Dept of Primary Industries

Date of Report
October, 2002

1. Media summary

- This project was designed to test the feasibility of commercial production of super sweet corn in north Queensland, specifically the Atherton and Mareeba tablelands and areas in the immediate vicinity. To adequately test the proposition we decided to test a suite of commercial super-sweet hybrids and to sample a range of sweetcorn growing environments at various times of year. This led to the testing of nine commercial and experimental hybrids at three sites and three times of year.
- The criteria for evaluation purposes included yield of unhusked corn, tenderness, flavour, and kernel colour and kernel depth. These traits are key determinants of success for a commercial canning enterprise
- The Atherton Tablelands and surrounding areas have much to recommend them as the site for a canning industry. There is abundant water and suitable land, the potential to grow corn all year round, and a farming community with considerable expertise in growing quality crops. If we could demonstrate good yields of quality sweet corn and find no serious agronomic impediments to successful production, the next step would be to examine the economics of establishing a cannery.
- The results of testing lead us to conclude that successful all year round production of sweet corn is feasible in this area. However there is currently no single variety that combines good yields and adequate disease resistance with the eating quality required by export markets.
- Some temperate-adapted hybrids have the quality to satisfy overseas markets but are not suited to the summer production because of their susceptibility to Turcicum leaf blight a chronic disease in the wet season.
- Tropical hybrids developed at Kairi Research Station have superior resistance to Turcicum leaf blight and to the major insect pest Heliothis ear worm but they lack the sweetness and tenderness required for the export market. There is need for a breeding program to upgrade the eating quality of **tropical** sweet corn hybrids. This material has inherently high yield and kernel recovery, factors that greatly enhance the economics of production. As well it has disease and insect resistance to give security to production and reduce growing costs.
- My conclusion is that it is more feasible to improve quality traits such as sweetness, tenderness and kernel shape in tropical germplasm than to increase yield and kernel recovery and incorporate disease resistance in temperate germplasm.

Technical Summary

Production of sweet corn has historically been concentrated in the temperate areas of the world, in particular in the northern states of USA. This has meant that the major breeding effort has been directed at developing hybrids adapted to regions with low rainfall and relatively low disease and insect problems. Consequently the hybrids developed for those regions have been found to be poorly adapted to tropical regions where disease and insect pressures are much more severe.

Efforts have been made to develop supersweet corn hybrids for the tropical regions. The breeding programs have mainly been devoted to breeding for disease and insect resistance and have not placed as much emphasis on improving eating quality traits, such as flavour and tenderness. Accordingly when Japanese sweetcorn buyers compared the tropical hybrid H5 with the prominent US hybrid, Jubilee Supersweet Plus, they found H5 kernels to be too tough and not sweet enough in flavour.

The Japanese market for imported sweetcorn is very large and therefore offers an attractive opportunity for the development of an export-oriented tropical industry in Australia. The tropics offer the prospect of growing corn almost all year round enabling a cannery to keep a lower inventory and thus reduce associated costs.

This project therefore sought to do the following things.

1. Examine the feasibility of growing sweetcorn all year round on the Atherton and Mareeba Tablelands and surrounding areas,
2. Compare the performance (yield and eating quality) of a range of hybrids, both temperate and tropical, and
3. Identify any potential constraints to production posed by climate, soils, insects or diseases.

The project has established that excepting climatic extremes such as frosts (which are approximately a one in ten year event) and cyclones, it should be possible to grow sweet corn all year round if the production sites and planting times are strategically planned. Yields of corn in excess of 20 tonnes per hectare were achieved in summer, autumn and winter trials, the highest yield being 24.8 tonnes per hectare.

Two diseases, **Turcicum leaf blight** (Exserohilum turcicum) and **Polysora rust** (Puccinia polysora) were noted but good plant resistances exist. Three significant insect pests were encountered; **Green vegetable bug, Monolepta beetle** and **Heliothis corn ear worm.** All can be controlled with timely insecticide spraying.

Of the hybrids tested, one temperate hybrid, Hyl116 and one tropical hybrid H141 were superior for flavour and tenderness. H141 also possessed high yield potential and good disease resistance but it has been criticised because of its variability in kernel colour and for inadequate kernel size. It is unlikely that either of these hybrids will satisfy the high standards demanded by the premium Japanese market.

Introduction.

There is a large market for canned sweetcorn in some Asian countries, Japan being the main importer, but Korea and eventually China also importers of significance. The Japanese market, while presenting a great opportunity, also presents significant problems in that importers demand very high standards of eating quality, particularly in terms of **flavour** and **tenderness**, but also for **kernel colour** and **size**. At this time, most of the canned sweetcorn imported into Japan is sourced from USA. It will be necessary to match the quality of US sweetcorn if Australian product is to have any chance of accessing premium markets in Japan.

Northern Australia has the potential to grow sweet corn virtually all year round if suitable varieties are identified. This project was designed to quantify and compare the performance of a group of commercial and experimental super-sweet corn hybrids, both temperate-adapted and tropical-adapted, in a number of tropical growing environments at different times of year. Economically-viable year round production of quality sweet corn in the tropics would greatly encourage the establishment of a cannery in the area aimed at the export markets in Asia.

Although the Kairi sweet-corn breeding program has been in operation since 1969 the products of the breeding program have been used mainly in subtropical regions where disease pressure is less intense than in the tropics. The tropical industry has been restricted to small market garden type operations for supplying local supermarkets. Therefore this project with its alignment to the processing industry rather than the fresh market was a new departure. The processing industry requires high yield potential and high kernel recovery as well as superior eating traits but it does not need the cosmetic traits such as green husks, flag leaf and attractive cob shape that are important in the fresh market trade.

The project also sought to give potential growers for a canning industry their first experience (in most cases) of growing sweet corn and to identify the nutritional, irrigation and pest and disease control factors for the various environments.

Material and Methods

I. Trial Design

Because the project was essentially a commercial trial with one of its objectives the familiarisation of farmers with sweetcorn culture and because of the limited number of varietal entries we decided to use un-replicated" strip trial" designs rather than replicated small plot design. Strips were generally 8 rows wide and varied in length from 180 metres to 300 metres long depending on the farmer's paddock.

II. Varietal Entries.

A total of nine supersweet hybrids were tested during the course of the project. Varieties tested at each site and planting dates are listed in Table 1. We included two tropically-adapted hybrids developed in the Kairi program, H 5 and H141 and one from the joint QDPI/Pacific Seeds program, Pac377. There were two hybrids from the international company Syngenta, namely Sovereign and Dynasty, and from Snowy River Co-op Ltd we obtained four hybrids Matador, HY1012, HY 1116 and HY1164. Because of seed supply problems we were not able to test all hybrids at each of the 3 test sites.

Table 1. Varietal entries and planting dates of trials.

Site	Hybrids tested	Planting date
Innot Hot Springs	Sovereign, H5	17th January, 2001
Mareeba	Sovereign, H5, H141, Hy1012, Hy164, Matador,	3rd April, 2001
Mutchilba	Sovereign, H5, H141, Hy1012, Hy1164, Hy1116, Pac 377, Dynasty	6th June, 2001

III. Cultural Details

A four row vacuum planter was used for planting. This produced very uniform spacing and plant density. Target planting density was 63,000 plants per hectare (row spacing of 75 cm and intra-row spacing of 21cm). Most hybrids had densities approaching the target density. The exceptions was Dynasty which suffered with poor germinability.

At all sites fertiliser was applied at planting. Approximately 150 kg of a fertiliser containing 13.5% N, 15% P and 12.5% K was drilled about 5 cm from the seed. Urea was applied as a side-dressing about 25 days after planting at 300 kg per hectare (135 kg nitrogen per hectare).

The exception to this regime was at the Mareeba site. Here we used a higher rate of starter fertiliser (500 kg per hectare of 14:14:12) and side-dressed with 500kg of ammonium sulfate and 275kg of urea per hectare. The ammonium sulfate was used to correct a sulfur deficiency.

Weeds were controlled with 3.5 litres per hectare of Primextra Gold (a mixture of atrazine and metolachlor).

IV. Data measurement

Harvest of most plots was effected when kernel moisture was in the range 75% to 78%. Moisture percentage estimates were made using microwave drying of kernel samples.

Yields were estimated for each variety by harvesting five samples of 3 metres of row from each varietal strip and calculating the mean. Sample locations were selected to give a representative estimate of performance throughout the strip.

Kernel quality traits such as flavour, tenderness, and colour were assessed subjectively using a tasting panel of four persons. Each trait was rated on a 1 to 9 scale where the higher ratings indicated superior performance. Each tester evaluated 2 cobs meaning that 8 cobs were evaluated for each variety at each site.

Kernel depth was measured at the mid point of cobs. Each panellist measured two cobs.

Results

1. Yield of unhusked corn

Table 2 lists the yields achieved by hybrids at the three test sites and their mean yields for the sites at which they were evaluated. In some instances data was not collected if the variety performed poorly or if the plot had was damaged (for example by wallaby depredation).

Table 2. Yields (tonnes per hectare) of green corn for sweet corn hybrids at three test locations during 2001

Hybrid	Type	Innot Hot Springs (SUMMER)	Mareeba (AUTUMN)	Mutchilba (WINTER)	MEAN
H141	Tropical	NT	21.8	24.8	23.3
HY 1164	Temperate	NT	DNC	23.1	23.1
HY 1116	Temperate	NT	NT	22.6	22.6
H5	Tropical	22.5	23.9	20.6	22.3
HY 1012	Temperate	NT	19.1	23.1	21.1
PAC377	Tropical/Temp	NT	NT	17.7	17.7
Matador	Temperate	NT	17.2	NT	17.2
Sovereign	Temperate	16.8	16.4	DNC	16.6
Dynasty	Temperate	NT	NT	DNC	-

NT = NOT TESTED DNC = DATA NOT COLLECTED

The data clearly indicate the superior yielding ability and greater consistency of yields for tropical hybrids (eg H5 and H141) when compared with temperate material in the summer and autumn growing periods. In these seasons, fungal disease, particularly Turcicum leaf blight, can have a significant effect on yield.

In the winter trial at Mutchilba, the yield of Dynasty, was adversely affected by very small plant size. A similar phenomenon has been observed with purely temperate sweetcorn hybrids in south Queensland in plantings made about this time of year. This phenomenon has been observed for many temperate adapted hybrids grown in the tropics. It may be a response to the short daylengths in the tropics inducing rap[id flowering. There is also a theory that Dynasty has a high minimum temperature requirement for growth. Certainly temperatures at Mutchilba were very low during the early development of the plants. Whatever the cause, the effect of small plant size is to put a ceiling on yield.

The reduced performance of H5 at Mutchilba in winter is perplexing. It could suggest a lack of ability to cope with the low night temperatures experienced during the early growing period. Temperate hybrids, Hy1012, Hy1116 and Hy1164 all produced good yields in the winter trial. Although labelled as temperate, they possibly contain some tropical germplasm. This would help explain their superior performance to Dynasty, a genuine temperate-adapted hybrid.

2. Flavour

Flavour is clearly a very subjective trait and a very important one in the context of potential exports to Japan. The principal component, for most people is sweetness, but there are other components that add to or subtract from the final taste evaluation. Even the trait of sweetness elicits different reactions from evaluators. Some prefer maximum sweetness (and this seems to be the preference for the Japanese market) and others find extreme sweetness somewhat cloying.

The taste panel for this project had good agreement in most instances, which lends confidence to the calculated mean values. Table 3 lists these means for individual varieties at each site and the means across sites.

Table 3. Flavour ratings for supersweet corn hybrids at 3 test environments

Hybrid	Innot Hot Springs SUMMER	Mareeba AUTUMN	Mutchilba WINTER	Mean
Hy1116	NT	NT	6.3	6.3
Dynasty	NT	NT	6.3	6.3
H141	NT	6	6.5	6.3
Hy1012	NT	6.3	5.8	6.1
Hy1164	NT	6.3	5.5	5.9
Sovereign	5.8	NT	NT	5.8
H5	6.1	5.5	5.3	5.6
PAC 377	NT	NT	5.5	5.5
Matador	NT	4.5	NT	4.5

NB: 1.Ratings are on a 1 to 9 scale (9 = sweet, 1= bland).
2. The poor rating for Matador was due to late harvest.

In general the temperate hybrids were superior to those adapted to the tropics. (For example Dynasty is a temperate hybrid well known for its exceptional sweetness). This is perhaps more a reflection of the much greater breeding effort that has gone into this trait in US breeding programs than in the tropical breeding programs rather than any intrinsic superiority possessed by temperate hybrids.

Supporting this idea is the rating of H141, a tropical hybrid that produced a high rating for flavour in both the trials it was involved in. This supports the theory that we can incorporate quality flavour in tropical hybrids, something that is important for the development of a tropical sweetcorn industry.

Our understanding of the requirements of the Japanese importers is that the flavour rating will need to be near a rating of 7 to satisfy requirements.

3. Tenderness

Tenderness in sweet corn is generally thought to have two main components. The first relates to the resistance of the pericarp or outer layer of tissue on the corn kernel. The second is a function of the endosperm, the main tissue of the kernel. This latter is sometimes referred to as texture. Since pericarp resistance is the first sensation one has on biting into a corn kernel, it tends to have an over-riding influence on how tenderness is perceived. Japanese corn buyers prefer a pericarp that is very thin and does not stick to the teeth. Some hybrids, such as H5 have a relatively crisp pericarp which once broken is not persistent. Others have a thick, rubbery pericarp that persists and detracts from eating enjoyment.

Table 4. Tenderness ratings for super-sweet corn hybrids at three locations on the Atherton Tableland, 2001 season.

Hybrid	Innot Hot Springs SUMMER	Mareeba AUTUMN	Mutchilba WINTER	Mean
Dynasty	NT	NT	6.3	6.3
Hy1116	NT	NT	6.0	6.0
Sovereign	5.6	NT	NT	5.6
Hy1012	NT	5.8	5.3	5.6
H141	NT	5.8	5.2	5.5
Hy1164	NT	5.4	5.3	5.4
H5	4.4	4.8	4.8	4.7
Pac 377	NT	NT	4.5	4.5
Matador	NT	3.8	NT	3.8*

Ratings: 1 = tough , 9 = tender *Matador was probably over-mature at the time of evaluation.

As expected, the temperate hybrid Dynasty was the superior hybrid for this trait, but the experimental hybrid Hy1116 was only slightly inferior. The mediocre ratings achieved by hybrids with tropical germplasm (H5, Pac377) illustrate the improvement that will be necessary to get a tropical hybrid acceptable to the Japanese market. Since these hybrids share a common parent, much of the problem can probably be attributed to this inbred.

The performance of H141 shows that genes for tenderness exist in tropical sweetcorn germplasm. Individual plants in experimental populations combining tropical and temperate germplasm have also been found to have extremely good flavour and tenderness. It will be necessary to progressively accumulate these genes through recurrent selection breeding methods.

4. Kernel colour

Visual traits are an important feature for sweetcorn kernel samples. Kernels can be too pale or too dull or variable in colour. A uniformly bright yellow kernel with minimal embryo tissue in the cut kernels is preferred.

Japanese buyers found H5 to be very acceptable for kernel colour. Therefore the ratings listed in Table 5 reveal that most of the hybrids under test had acceptable colour. Dynasty suffered from pale coloured kernels and H141 from variable colour (mottled colour on cobs).

Table 5. Kernel colour ratings for super-sweet corn hybrids at 3 locations on the Atherton Tableland, 2001 season.

Hybrid	Hot Springs SUMMER	Mareeba AUTUMN	Mutchilba WINTER	Mean
Hy1116	NT	NT	6.5	6.5
Matador	NT	6.2	NT	6.2
Pac 377	NT	NT	6.2	6.2
H5	6.5	5.7	6.3	6.2
Sovereign	5.9	NT	NT	5.9
Hy1164	NT	6	5.2	5.6
Hy1012	NT	4.8	6.3	5.6
H141	NT	5.3	5.5	5.4
Dynasty	NT	NT	4.5	4.5

Rating scale: 1= poor colour, 9 = good colour

Hy1116 was judged to be the outstanding performer but any hybrid with a rating higher than 6 is probably acceptable for the Japanese market as Japanese buyers have stated that the colour of H5 is satisfactory.

The low rating for H141 is a reflection of its mottled kernel colour. Dynasty produced a pale yellow colour that would not be favoured in the Japanese market.

5. Kernel Depth

An important aspect of processing corn production is kernel recovery percentage. This is the weight of kernels canned from an input of a given weight of unhusked corn. A recovery of 45% as recorded for H5 compared with the 35% commonly achieved by temperate hybrids provides cost savings in transportation of the corn as well as in the factory .

To date it hasn't been feasible to measure kernel recovery in the laboratory. We would need to be able to simulate the spring-loaded slicers used in the cannery. One trait that has some bearing on recovery and is easily measurable in the field is kernel depth. Kernel depth also has a bearing on yield and the attractiveness of kernel sample.

Table 6 lists details of kernel depths for the hybrids under test.

Table 6. Kernel depth (mm) of super-sweet corn hybrids at 3 locations on the Atherton Tableland, 2001

Hybrid	Hot Springs SUMMER	Mareeba AUTUMN	Mutchilba WINTER	Mean
Matador	NT	12.5	NT	12.5
Sovereign	12	NT	NT	12.0
Hy1116	NT	NT	12	12.0
Hy1012	NT	11	12.2	11.6
Pac 377	NT	NT	11.4	11.4
H141	NT	10.8	11.7	11.3
Hy1164	NT	11.7	10.7	11.2
H5	12	10.5	10.5	11.0
Dynasty	NT	NT	10.5	10.5

The surprising feature is the relatively poor result for H5. Given that it is renowned for high kernel recovery one might have expected it to have superior kernel depth. It did well in the summer trial at Innot Hot Springs but produced shallow kernel depth in the autumn and spring trials. It is possible that water was limiting late in kernel development. The remarkable depth of Matador at Mareeba possibly resulted from over-mature harvest

6. Disease and insect considerations.

In order to get an appreciation of the disease and insect problems the industry might expect to encounter and to measure the reactions of the hybrids under test, we refrained from spraying the trials with insecticide or fungicide.

6.1 Diseases

As we had anticipated **Turcicum leaf blight** (Exserohilum turcicum) was the main disease problem. We didn't rate the hybrids for this disease but the following broad categories of susceptibility can be drawn.

Turcicum blight susceptible hybrids
Hy1116, and Dynasty

Moderately resistant hybrids
Pac 377, Sovereign and Hy1164

Resistant hybrids
Matador, H5, H141, Hy1012.

We expected that **Polysora rust (Puccinia polysora)** might prove to be a problem but only light infection was noted at Mareeba and Innot Hot Springs. Nevertheless it could assume greater significance if a large-scale industry eventuates. Fortunately we have good resistance to the disease in our dual-purpose breeding populations.

With overhead irrigation **Bacterial top rot (Erwinia sp)** would have been no surprise but although noted it was not a significant problem.

Common rust (Puccinia sorghi), a pathogen with the capacity to be serious in southern growing areas, was scarcely seen.

6.2 Insect problems

Heliothis (Helicoverpa armigera) proved to be the major insect pest. It was particularly so on temperate varieties. H5 and H141 and to a lesser extent Matador, had virtually no problem. Dominion, the quality hybrid, suffered high infestation.

Red-shouldered lady beetle (Monolepta sp) threatened the Mareeba trial but arrived too late to inflict serious damage. This silk-chewing insect will need to be monitored closely if an industry develops.

Green vegetable bug proved to be a problem at Mareeba. It was particularly damaging on Matador, but this might have been an artefact of its positioning on the windward side of the trial plots.

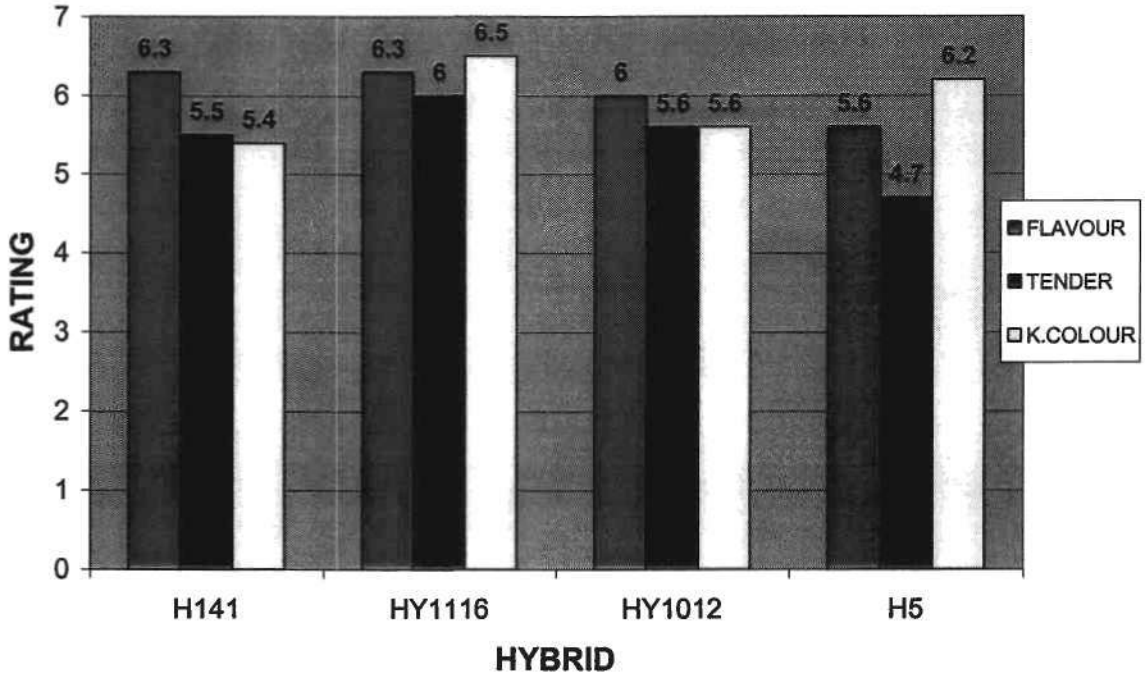
All three of these insects will need to be monitored closely around and after flowering if a large-scale industry develops.

7. Varietal performance for eating quality

The paramount requirement for sweetcorn to gain entry to the most remunerative Japanese market is eating quality. In Figure 1 the main traits applying to eating quality are graphed for the most successful varieties in this project.

Unfortunately, due to seed unavailability for the early trials, Hy1116 was only tested in one trial, so the results shown here need to be supported by further evaluation. H5 (lack of tenderness) and H141 (segregating kernel colour) have yield and disease resistance but lack the required quality factors. In summary none of these hybrids has the necessary quality to secure a place in the premium quality trade in Japan.

Figure 1. Quality traits for supersweet hybrids on the Atherton Tableland, 2001 season.



Looking at these results it is clear that HY1116 is the best all-round hybrid from an eating quality viewpoint. Dynasty, which is not included in this figure, had flavour and tenderness to match HY1116 but, in its one exposure to testing, had very pale kernel colour, a feature that would likely exclude it from success in Japan.

8. Discussion and conclusions.

- **Attainable commercial yields**

Prior to undertaking this project we had no idea what commercial yields of sweetcorn were attainable on the Atherton Tableland. As a result of the project we now know that yields as high as 25 tonnes per hectare are feasible. Since the original target yield for economic viability was 20 tonnes per hectare, this outcome is most satisfactory.

- **Seasonal production levels**

The project has proved that year round production of sweetcorn is feasible on the Tableland if appropriate sites and hybrids are chosen for the particular seasons. We planted in summer, autumn and winter and achieved yields in excess of 20 tonnes per hectare. The only period of year not evaluated was spring but since this is likely to be the most favourable climate for sweetcorn production. Production in the cooler months does have one disadvantage, namely that crop duration is increased by about 20 days when compared with mid summer plantings. This is due to low heat units in the midwinter months of June and July. Also there may be a higher irrigation requirement which increases costs substantially.

- **Tropical versus temperate varietal comparisons**

It is apparent there are two distinct categories of hybrids, firstly there are tropically adapted hybrids which have yield, insect and disease resistance but lack adequate palatability for the Japanese market and then temperate-adapted hybrids which have better eating quality than the tropicals but tend to be deficient in yield and disease/insect resistance. This analysis is a little simplistic since there are exceptions such as the temperate hybrid Hy1116 which combined good yields and eating quality and the tropical hybrid H141 which had moderately good quality combined with high yield and disease resistance.

The conclusion is inescapable that a developing industry would be best served by a tropical variety with improved quality that approached or equalled that of Domimion. At this time no such variety is known to exist. Given the potential value of an export industry (perhaps $15 million annually), I consider that a breeding program to achieve this objective is not only warranted but highly desirable. There are good indications from individual plants in our breeding program at Kairi that quality similar to the best temperate hybrids exists in the tropical gene pools

The alternative is to attempt to put disease and insect resistance into temperate germplasm. Some of the private companies are attemptiing to do this but quality is often lost in the process.

- **Feasibility of growing temperate sweetcorn hybrids in the tropics**

Most purely temperate hybrids tend to suffer with Turcicum leaf blight in the summer plantings with consequent low yield. In the winter they show a lack of vigour and plant size again with consequent low yield. It would appear that some tropical content in the genome is necessary for hybrids to perform adequately on a year round basis.

- **Quality aspects**

The project has clearly demonstrated that excellent kernel quality (sweetness and tenderness) can be achieved in the tropics in virtually any season. We did not experience problems with fermentation in the temperate hyrids despite heavy rainfall and high temperatures at Innot Hot Springs. However it would not be wise to discount the threat that this event could pose to temperate hybrids with poor husk cover. The recurrent selection breeding project which is running concurrently with the hybrid evaluation project has identified individual plants in semi-tropical breeding populations with levels of sweetness and tenderness comparable with the best US hybrids. This encourages us to believe that we can meet the standards for the Japanese market in a tropical background of yield and disease resistance.

- **Diseases**

Early indications from the breeding project are that there is a good probability that hybrids will be developed that combine eating quality with adequate resistance to **Turcicum leaf blight.** Ideally we should be looking to develop hybrids with resistance to **Polysora rust** as well. Resistance is present in sweetcorn gene pools held at Kairi.

No other diseases manifested significantly. **Common rust,** a problem in southern growing areas, did not assume significant proportions in the trials under consideration here.

- **Insects**

The scale of the insect problem is somewhat harder to predict. **Heliothis** will obviously become more serious if a large scale industry develops. In our trial plots we refrained from using insecticide; consequently almost every ear of the temperate hybrids had a Heliothis larva. Even the tropical hybrid H5,despite its tight husk cover, required one spray of Lannate and Larvin in the larger area plots grown at Mareeba to get adequate control of corn ear worm. We are selecting stringently for resistance to Heliothis in our recurrent selection breeding and there is evidence we are making good progress. **Monlolepta** beetles will definitely be a problem but one that can be managed with timely spraying. A similar strategy will apply to **Green Vegetable Bug.**

- **Summary**

The project set out to investigate the feasibility of sweetcorn cropping in far north Queensland. The results have been encouraging. The project has confirmed our initial prognosis that, given the moderation of summer temperatures conditioned by the elevation of the Atherton and Mareeba Tablelands, succesful sweetcorn production in the summer months is entirely feasible; also that temperatures in the winter months are adequate to support good yields of sweetcorn. Eating quality to the standards demanded by the Japanese markets is achievable, insect problems have not proved to be acute at this stage but may become so on expansion of cropping.

Unfortunately no one hybrid encompasses all the requirements of a premium quality processing hybrid. In my view a breeding program with defined objectives will be needed to supply a hybrid to ensure the success of a canning industry in the tropics.

Clearly the horticultural aspects of sweetcorn cropping will not limit cropping although there is room for improvement in the adaptation of hybrids. The decisive factor will be how the economics of sweetcorn production measure up against those for other major crops in the region, particularly sugar cane. Sweetcorn has in its favour that it is a shoort duration crop with all that implies for cash flow and it is probably less likely to fluctuate in price and thus more consistent in returns to grower. It can also be slotted into current cropping systems and thus contribute additional income on existing farm land.