BSES Limited

AGR2008150
PROVISION OF RESEARCH AND DEVELOPMENT SERVICES FOR THE ORD SUGARCANE PROJECT
May 2010

by

BARRY CROFT, BILL WEBB and GEORGE PIPERIDIS

CO10004

Contact:
Barry Croft
Program Leader
BSES Limited
Lot 207 Old Cove Road
Woodford Q 4514
Telephone: 07 5496 3357
Facsimile: 07 5496 3266
Email: bcroft@bses.org.au

George Piperidis
Program Leader
BSES Limited
26135 Peak Downs Highway
Mackay Q 4741
Telephone: 07 4963 6800
Facsimile: 07 4954 5167
Email: gpiperidis@bses.org.au

Bill Webb
Senior Extension Officer
BSES Limited
Brandon Q 4808
Telephone: 07 4783 8604
Facsimile: 07 4782 5487
Email: bwebb@bses.org.au

BSES Limited Publication
Consultancy Report CO10004 **June 2010**

CONTENTS

Page No

SUMMARY

The requirements for year 2 of the contract for delivery of research and development services to the Ord sugar project have been fully achieved.

The harvest results from two second ratoon, two first ratoon and two plant crop yield trials were analysed using BSES statistical procedures and the analysed results were provided to the WA Dept of Agriculture and Food. These data were used to identify promising new varieties for further propagation.

Barry Croft, BSES Program Leader Biosecurity (Plant Pathologist), and George Piperidis, BSES Program Leader Variety Adoption (Plant Breeder), visited the Ord from the 24-27 May 2010. They inspected selected varieties in yield trials and propagation plots for sugarcane smut, top rot and other diseases and made notes on growth of the varieties. Recommendations were made on the maintenance and further propagation of varieties that have performed well in yield trials and have acceptable reaction to sugarcane smut and top rot.

A heavy infestation of scale insects was noted on a few varieties in the 2008 propagation plot in block 6B. These insects have been seen before but this was a particularly severe infestation and the variety Q208$^{\phi}$ which has performed well in the Ord and is the major variety in Queensland was one of the varieties affected.

A borer that was attacking rice was collected. BSES is currently involved in an Australian Centre for Agricultural Research (ACIAR) funded project investigating biological control of borer species attacking sugarcane in Indonesia. Part of this study is to collaborate with other research groups that are DNA barcoding endemic and exotic moth borers and these samples will be submitted for DNA barcoding.

Recommendation 1:

Establish a mother plot in 2010 of the 18 varieties listed in Table 7 with cane that has been hot water and fungicide treated to enable the holding plots to be established with cane virtually free of sugarcane smut. These varieties have been identified as important varieties for establishing a new sugarcane industry in the Ord.

All existing propagation and trial plots should be destroyed once the mother plot canes have been established to reduce the source of inoculum of sugarcane smut disease.

Recommendation 2:

The 18 varieties listed in Table 7 should be planted into a holding plot in 2011.

1.0 STATEMENT OF REQUIREMENTS

The Department of Agriculture and Food Western Australia (DAFWA) require a suitably qualified provider to supply the research and development services for their sugarcane project.

SPECIFICATION
The minimum requirements for the supply of Research and Development Services for the sugarcane project at Kununurra Research Support Unit are:

- Provide technical advice and information on harvesting and processing of samples collected from FAT trials.
- Analysis of harvest results for six (6) x FAT's harvested in 2009.
- Advise clones for propagation in potential nursery on Frank Wise Institute (FWI).
- Annual visit by sugarcane breeder and pathologist to assess disease incidence and variety performance.

2.0 INTRODUCTION

BSES has provided the research and extension services to the Ord River Irrigation Area (ORIA) sugarcane industry under a cooperative agreement with the WA Department of Agriculture and Food since 2003. This contract was terminated in April 2008 after the Ord sugar mill ceased operations in 2007. The previous contract had operated successfully up to the time of the mill closure. A new contract was signed to provide continued plant breeding and plant pathology services to WA Department of Agriculture and Food to continue plant breeding trials, inspect sugarcane plots for diseases and pests and to advise WA Department of Agriculture and Food on maintenance of sugarcane varieties so they could be available for potential new sugarcane based industries in the ORIA.

3.0 SPECIFICATION 1: Provide technical advice and information on harvesting and processing of samples collected from FAT trials

BSES Variety Improvement staff provided advice to Gae Plunkett on harvesting sugarcane FAT trials and the processing of juice sugar content samples. DAFWA staff had problems obtaining suitable juice clarity for polarity analysis. Advice was given on the use of the clarifying agent OCTAPOL and BSES supplied additional quantity of OCTAPOL. This problem was successfully resolved. Trial harvest and juice analysis was successful and data were supplied to BSES for statistical analysis.

4.0 SECIFICATION 2: Analysis of harvest results for six (6) x FAT's 2009

A summary of the planting and harvest details of the variety trials included in this report are shown in Table 1. The average yield, sugar content and fibre of the trials by crop are given in Table 2.

Table 1 - Planting and harvest dates of the 2006-2008 trials

Trial	Date planted	Harvest Plant crop	Harvest first ratoon	Harvest second ratoon
ORD06-31	09/05/2006	17/09/2007	01/07/2008	30/06/2009
ORD06-32	30/05/2006	17/10/2007	24/06/2008	23/06/2009
ORD07-31	18/04/2007	22/07/2008	07/07/2009	-
ORD07-32	30/05/2007	28/07/2008	14/07/2009	-
ORD08-31	06/06/2008	04/08/2009	-	-
ORD08-32	04/08/2008	11/08/2009	-	-

Table 2 - Average cane yield, sugar content (CCS) and fibre of each crop

Trial	Crop	Average Cane yield (t/ha)	Average CCS	Average Fibre
ORD06-31	Plant	162	12.74	-
	First ratoon	111	13.79	12.70
	Second ratoon	118	11.97	16.47
ORD06-32	Plant	161	11.60	-
	First ratoon	98	14.16	13.90
	Second ratoon	126	13.60	14.44
ORD07-31	Plant	159	13.76	14.58
	First ratoon	124	15.22	15.06
ORD07-32	Plant	147	15.39	14.18
	First ratoon	118	13.34	15.39
ORD08-31	Plant	156	12.45	16.06
ORD08-32	Plant	113	11.46	16.67

The results from the plant, first and second ratoon crop of the 2006 series, the plant and first ratoon crop of the 2007 series and the plant crop from the 2008 series were analysed and tables 3 to 5 show the average yield and the relative Economic Genetic Value (rEGV) for the clones in these trials. rEGV is a selection index that combines TCH, CCS, fibre content and diseases together in such a way that each trait contributes to the index value differently according to its relative importance in terms of maximizing economic profits for the sugar industry.

Table 3 - Yield results from ORD06-31 and ORD06-32 averaged over plant, first ratoon and second ratoon harvests

Clone	Cane yield (t/ha)	CCS	Fibre %	rEGV
TCP87-3388	137	14.96	11.78	12.06
Q208Ⓟ*	141	14.07	15.75	11.19
VMC87-599	150	12.78	12.18	10.93
N26	139	13.52	13.58	10.87
SP89-1116[a]	134	13.64	13.20	10.86
R85/1124	145	12.84	12.29	10.79
R86/538	141	13.31	14.48	10.70
CCSP89-259	128	13.86	13.37	10.67
VMC71-238[a]	118	14.55	16.46	10.58
HoCP85-845[a]	131	13.73	15.14	10.49
Q200Ⓟ	132	13.75	17.04	10.44
R570[a]	129	13.52	14.70	10.38
N37	121	14.20	16.59	10.34
VMC93-313	142	12.50	12.72	10.32
CP95-1569	124	13.56	13.84	10.24
SP84-1431[a]	118	14.04	14.35	10.22
CCSP89-1997	119	13.64	12.76	10.18
Q241Ⓟ (QN92-1234)	135	12.87	15.21	10.07
CC93-4223	112	13.68	11.29	10.06
M1565/87	136	12.52	14.93	9.90
Q99*	117	13.41	13.14	9.89
QS96-54	138	12.33	14.69	9.88
FR95-245	129	12.63	13.73	9.75
HoCP96-509	115	13.50	14.02	9.74
N23[a]	143	11.59	12.87	9.62
FR96-33	116	12.84	16.37	9.09
Q96*	106	13.36	17.57	8.92
DB83-119	148	10.65	15.39	8.90
BJ82156	107	12.84	15.48	8.81
R86/473	133	11.10	15.10	8.66
H81-6025	126	10.62	14.63	8.00
FR96-238	127	10.48	15.68	7.81

* Standard cultivars

[a] Clones planted in one trial only

TCP87-3388 remained as the top variety in the 2006 series after the second ratoon harvest. VMC87-599 and SP89-1116 also continued to perform well, with rEGV of 10.93 and 10.86, respectively. However, CCS for VMCC87-599 is low, and SP89-1116 results are from one trial only. N26 improved in the second ratoon to be ranked fourth overall in the 2006 series for rEGV, which is similar to its performance in the 2005 series trials

Table 4 - Yield results from ORD07-31 and ORD07-32 averaged over plant and first ratoon harvests

Clone	Cane yield (t/ha)	CCS	Fibre %	rEGV
QA89-3567	151	15.45	14.18	10.74
Q208$^{\Phi}$ *	159	15.04	15.45	10.62
QA91-1165	134	16.20	14.85	10.49
NA84-3013	156	14.94	15.92	10.35
96-811	151	14.99	15.09	10.25
NA85-1602	137	15.41	14.78	10.08
M1906/87	160	13.68	12.66	9.96
Q213$^{\Phi}$	154	14.07	13.20	9.90
QA90-3055	148	14.41	14.55	9.76
QN86-139	139	14.93	14.39	9.74
QN93-3515	129	15.04	12.95	9.66
QN91-408	133	14.80	13.95	9.52
CP95-1726	123	15.25	13.29	9.45
CC91-1880	105	15.91	11.88	9.40
Q99*	142	14.09	13.72	9.38
QA94-1332	146	14.12	15.49	9.31
CP84-1198	135	14.52	15.16	9.18
CCSP89-43	123	14.61	13.20	9.07
QA93-2002	156	13.24	15.80	9.04
FR97-47	129	14.87	17.58	8.94
CC92-2311	131	13.60	12.43	8.70
NA78-639	132	14.30	16.94	8.68
M1869/87	141	13.30	14.46	8.65
CC93-7513	135	13.26	13.04	8.55
TC9	129	14.02	16.60	8.38
QA94-6005	123	13.44	14.59	8.01
QA91-1768	122	13.33	18.52	7.35
QN89-69	116	13.15	19.82	6.73

* Standard cultivars

QA89-3567 remained as the top clone after the first ratoon harvest in the 2007 series. Other varieties that continued to perform well and should be considered for further testing or propagation are QA91-1165 and 96-811.

Table 5 - Yield results from ORD08-31 and ORD08-32 averaged over plant harvests

Clone	Cane yield (t/ha)	CCS	Fibre %	rEGV
KQ228$^{\Phi}$	160	13.80	15.26	11.54
CC92-2154	135	14.04	15.12	10.89
QN91-295	148	12.95	15.29	10.63
FR96-67	160	11.83	13.49	10.52
QA93-1979	127	13.80	15.53	10.44
Q208$^{\Phi}$ *	140	12.82	15.29	10.26
FR96-1	140	12.97	16.29	10.25
VMC92-189	148	12.43	17.18	10.11
QC93-745	156	12.05	17.81	10.07
M1869/87	159	10.75	14.15	9.79
Q99*	136	12.06	14.67	9.74
NA73-2596	118	13.50	17.67	9.72
NA89-1090	143	11.68	15.11	9.70
Q235$^{\Phi}$	134	12.03	15.67	9.58
NA96-2929	128	12.63	17.74	9.53
QA89-3305	142	11.93	18.00	9.52
VMC96-134	135	11.97	16.02	9.51
Q232$^{\Phi}$	137	12.18	18.51	9.49
FR99-116	136	11.80	15.78	9.46
FR91-384	117	12.40	14.49	9.32
VMC96-120	157	10.77	18.19	9.29
FR97-45	126	12.16	16.70	9.26
CCSP92-3191	131	11.54	18.31	8.89
FR99-307	126	11.08	14.92	8.81
QA96-1351	114	12.15	17.87	8.74
CC93-3803	137	10.24	14.19	8.73
FR98-2	114	11.79	16.84	8.66
FR99-38	128	10.62	18.06	8.27
VMC93-331	130	10.11	20.85	7.73
QC93-1210	97	10.36	14.64	7.43
FR99-331	106	10.08	17.58	7.29

* Standard cultivars

In the 2008 series plant crop, KQ228$^{\Phi}$ and CC92-2154 were the top two performers, and should be propagated for further testing or potential commercial production. Other clones that performed well and were tentatively selected for inspection during the visit were QN91-295, FR96-67, QA93-1979 and VMC92-189.

Q208$^{\Phi}$ continued to perform well in all trials as a standard variety for comparison.

5.0 SPECIFICATION 3: Advise clones for propagation in potential nursery on Frank Wise Institute (FWI)

6.0 SPECIFICATION 4: Annual visit by sugarcane breeder and pathologist to assess disease incidence and variety performance

Barry Croft, BSES Program Leader Biosecurity and George Piperidis, Program Leader Variety Adoption, visited the Ord from 24-27 May 2010 with the objectives of:

- inspect sugarcane field trials and propagation plots for diseases
- make recommendations on the future potential of the varieties for cultivation in the Ord River Irrigation Area
- provide advice on future propagation, hot water treatment and disease control for varieties recommended for sugarcane holding plots in the Ord
- summarise disease inspections and other recommendations on the future management of sugarcane varieties in the Ord

Selected varieties were inspected in propagation plots and yield trials for smut, top rot, other diseases and general appearance. A summary of the observations are shown in Table 6. Some tentative selections from the yield trials had too much smut or were severely affected by top rot and we recommend that these varieties should be discarded.

The varieties recommended for propagation are listed in Table 6. Three varieties have proven commercial production in the Ord and three varieties have excelled in yield trials and could be released commercially with no further testing. A further 12 varieties were identified that have performed well in yield trials, have good disease resistance and we recommend that these varieties be propagated for further assessment in the future.

Samples were taken from a number of the selected varieties for DNA fingerprinting and for ratoon stunting disease analysis (Table 7). The results from the DNA testing confirmed that the plots tested were true to type. The samples taken for RSD testing have been tested and are all negative for RSD.

Varieties were selected taking into consideration that any new sugar industry in the Ord may produce a range of products from sugarcane such as sugar, ethanol and electricity.

Propagation protocols

On the advice of the DAFWA staff that the sugarcane project will not be continued and that a sugar industry is unlikely to be established in the near future, we recommend that a long term holding plot be planted in 2011. This plot should consist of one row (approximately 80-90 m) of each of the selected varieties and the planting material for the plot should be obtained from a mother plot planted in 2010. A guard row of a smut resistant variety (KQ228$^{\Phi}$) should be planted on either side of the holding plot to protect the propagated varieties.

Sugarcane smut is currently present at light to moderate levels in some of the selected varieties in the propagation plots. We recommend that a mother plot be planted in June 2010 well away from any remaining cane in an attempt to eliminate smut from the varieties before propagation in the long term holding plot. The sugarcane yield trials and propagation plots on the Experiment Station should be destroyed as soon as the varieties have been successfully established in the mother plot to reduce the chances of re-infection. The mother plot should be

planted with cane that has been hot water and fungicide treated (52°C for 45 min followed by 5 min dip in 1 ml/L propiconazole, Throttle or Tilt) to eliminate smut. The best way to hot water treat the cane would be to use a small (accurate) water bath heater and treat one-eye setts. These setts should be pre-germinated in peat pots and transplanted to the field with a seedling planter. The long term holding plot could be planted with cane from this hot water treated mother plot. Twenty plants of each variety would supply enough planting material for the holding plot. Further details of the procedure for planting this hot water treated plot and a proposed plan of the plot are provided in Appendix 1. This would allow any new industry to be established with planting material with very low levels of sugarcane smut.

Table 6 - Field observations on selected clones in propagation and trials in the Ord in 2010

Variety	Observations	Decision
96-811	Good growth, tall and straight, no smut	prop
CC92-2154	Excellent growth, very light smut	prop
Co7804	Good growth, light smut, heavy scale infestation	prop
CP70-1133	Reasonable growth, heavy smut	discard
DB70-172	Good growth, no smut	discard
FR96-67	Poor-reasonable growth, heavy smut	discard
KQ228$^{\Phi}$ (KQ98-673)	Excellent growth, very light smut	prop
KQ91-71304	Reasonable growth, moderate smut	discard
N26	Good growth, no smut	prop
Q171$^{\Phi}$	Reasonable growth, very light smut	prop
Q200$^{\Phi}$	Moderate growth, thin stalks with many stalks per stool, no smut	prop
Q208$^{\Phi}$	Excellent growth, moderate smut mostly side-shoots and small tillers, smut was not affecting growth, heavy scale infestation in one plot, light infestations in other plots	prop
Q96	Poor growth, moderate to heavy smut with whole stools severely stunted	discard
Q99	Reasonable growth, light smut, few stools severely affected by smut	prop
QA89-3567	Reasonable growth, thin stalks, large stool, very light smut	prop
QA91-1165	Poor-moderate growth, thin stalks, light smut	discard
QA93-1979	Reasonable growth, no smut	prop
QC93-745	Reasonable growth, thin stalks, no smut	discard
QN91-295	Good growth, moderate to heavy smut	discard
SP80-3280	Good growth, no smut	prop
SP83-5073	Reasonable growth, moderate smut, light top rot	prop
SP87-344	Good growth, no smut	prop
SP89-1116	Reasonable growth, light smut	discard
TC5	Good growth, light smut	prop
TCP87-3388	Excellent growth, no smut	prop
VMC87-599	Good growth, very light smut	prop
VMC92-189	Reasonable growth, thin stalks, light to moderate smut	prop

Table 7 - Varieties selected for propagation

Variety	Status	Smut rating	Source	DNA test	RSD test[b]
Q171[Φ]	commercial	1	2008 prop 6B	yes	yes
Q208[Φ]	commercial	4	2008 prop 6B	yes	yes
Q99	commercial	1	2008 prop 6B	yes	yes
KQ228[Φ] (KQ98-673)	release	2	2007 prop 6B	yes	yes
N26	release	1	2008 prop 6B	yes	yes
TCP87-3388	release	2	2008 prop 6B	yes	yes
96-811	TS[a]	1	2006 prop 5A		yes
CC92-2154	TS	2	2007 prop 6B		
Co7804	TS	4	2008 prop 6B		
Q200[Φ]	TS	3	2005 prop 5A	yes	yes
QA89-3567	TS	2	2006 prop 5A		yes
QA93-1979	TS	4	2007 prop 6B		yes
SP80-3280	TS	1	2008 prop 6B		
SP83-5073	TS	1	2008 prop 6B		
SP87-344	TS	1	2008 prop 6B		
TC5	TS	1	2008 prop 6B		
VMC87-599	TS	1	2008 prop 6B		yes
VMC92-189	TS	4	2007 prop 6B		yes

[a] TS = tentative selection
[b] RSD = ratoon stunting disease

7.0 RECOMMENDATIONS

Recommendation 1:

Establish a mother plot in 2010 of the 18 varieties listed in Table 7 with cane that has been hot water and fungicide treated to enable the holding plots to be established with cane virtually free of sugarcane smut. These varieties have been identified as important varieties for establishing a new sugarcane industry in the Ord.

All existing propagation and trial plots should be destroyed once the mother plot canes have been established to reduce the source of inoculum of sugarcane smut disease.

Recommendation 2:

The 18 varieties listed in Table 7 should be planted into a holding plot in 2011.

8.0 ADDITIONAL ACTIVITIES

Scale insects

A heavy infestation of scale insects was noted on a few varieties in the 2008 propagation plot in block 6B. These insects have been seen before but this was a particularly severe infestation and the variety Q208$^{\phi}$ which has performed well in the Ord, and is the major variety in Queensland, was one of the varieties affected (Figure 1). All stools of Q208$^{\phi}$ growing in a plot on the northern side of the block and the neighboring plot of Co7804 were heavily infested. The scale was seen in other plots of Q208$^{\phi}$ but they were limited to the nodes of the stalks.

Previous samples were tentatively identified as belonging to the genus *Symonicoccus.*

Figure 1 - Scale insects on Q208$^{\phi}$

Rice borers

A borer that was attacking rice research plots on the Frank Wise Research Station was collected. Borers have previously been reported on rice in the Ord and were identified as *Scirpophaga innotata.* Other Scirpophaga species are listed as important borers of sugarcane in South East Asia. BSES is currently involved in an Australian Centre for Agricultural Research (ACIAR) funded project investigating biological control of borer species attacking sugarcane in Indonesia. Part of this study is to collaborate with other research groups that are DNA barcode endemic and exotic moth borers and the samples collected from the rice will be a valuable addition to the DNA barcodes for borer species present in Australia.

Appendix 1

Mother plot

A mother plot of hot water and fungicide treated cane should be planted in 2010 to provide a disease-free source of planting material for the holding plot which should be planted in 2011. The mother plot described below should supply sufficient cane to plant an 80-90 m row of each variety and extra cane of KQ228$^{\Phi}$ to be planted in the guard rows of the holding plot.

1. Cut stalks of each variety. Select stalks that have no side-shooting or smut whips. Avoid plants from stools where other stalks are showing smut whips.

Variety	Source	Stalks	One-eye setts to germinate	One-eye setts to trans-plant to peat pots
Q200$^{\Phi}$	2005 prop 5A	4	40	20-24
96-811	2006 prop 5A	4	40	20-24
QA89-3567	2006 prop 5A	4	40	20-24
KQ228$^{\Phi}$ (KQ98-673)	2007 prop 6B	35	350	240
CC92-2154	2007 prop 6B	4	40	20-24
QA93-1979	2007 prop 6B	4	40	20-24
VMC92-189	2007 prop 6B	4	40	20-24
Q171$^{\Phi}$	2008 prop 6B	4	40	20-24
Q208$^{\Phi}$	2008 prop 6B	8	80	40-48
Q99	2008 prop 6B	4	40	20-24
N26	2008 prop 6B	4	40	20-24
TCP87-3388	2008 prop 6B	4	40	20-24
Co7804	2008 prop 6B	4	40	20-24
SP80-3280	2008 prop 6B	4	40	20-24
SP83-5073	2008 prop 6B	4	40	20-24
SP87-344	2008 prop 6B	4	40	20-24
TC5	2008 prop 6B	4	40	20-24
VMC87-599	2008 prop 6B	4	40	20-24

2. Cut one-eye setts and place in onion bags with a label (Figure 2).

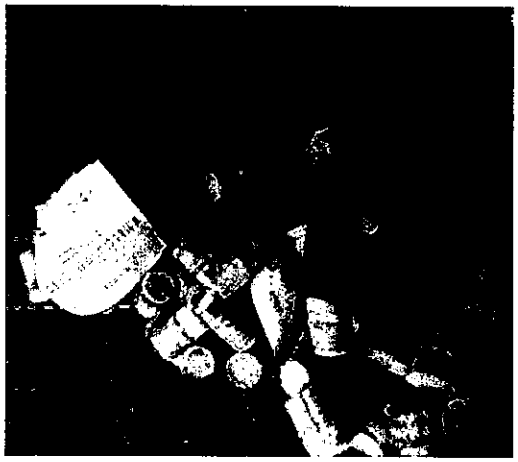

Figure 2.

3. Hot water treat – 45 min at 52°C in a circulating water bath (start timing from when setts dropped in tank, do not over load tank to ensure good circulation, Figure 3).

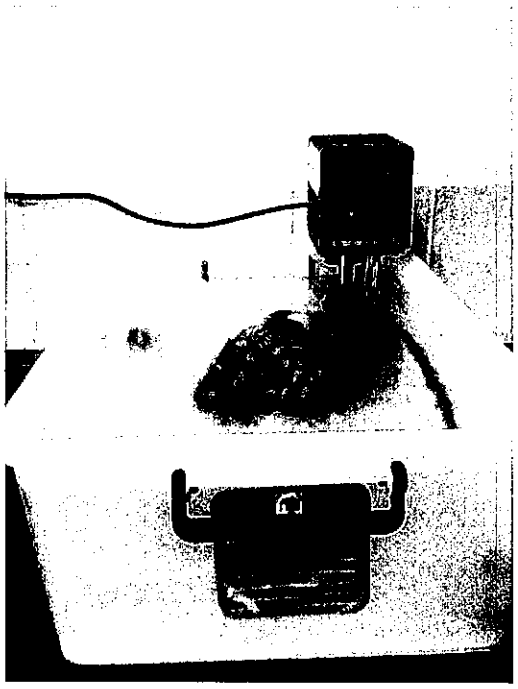

Figure 3.

4. Immediately after the hot water treatment dip the setts for 5 min in fungicide – 10 mL in 10 L of Tilt or Nufarm Throttle (250g/l propiconazole)
5. Plant setts in shallow punnet trays in vermiculite or good quality potting mix, water immediately and place in shade house. Keep moist but do not over water (Figure 4).

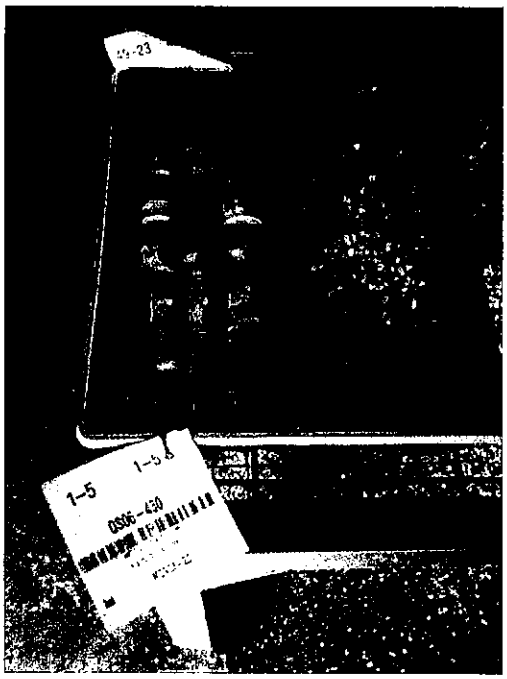

Figure 4.

6. Approximately 3 weeks after planting, transplant plants with strong top and root growth into 75 mm peat pots (plastic pots if peat pots not available) in good quality potting mix with addition of slow release fertilizer (Osmocote or Nutricote). Ensure plant roots do not dry out and water immediately after transplanting.
7. Grow plants in shade house or outside bench for 6-8 weeks (Figure 5).

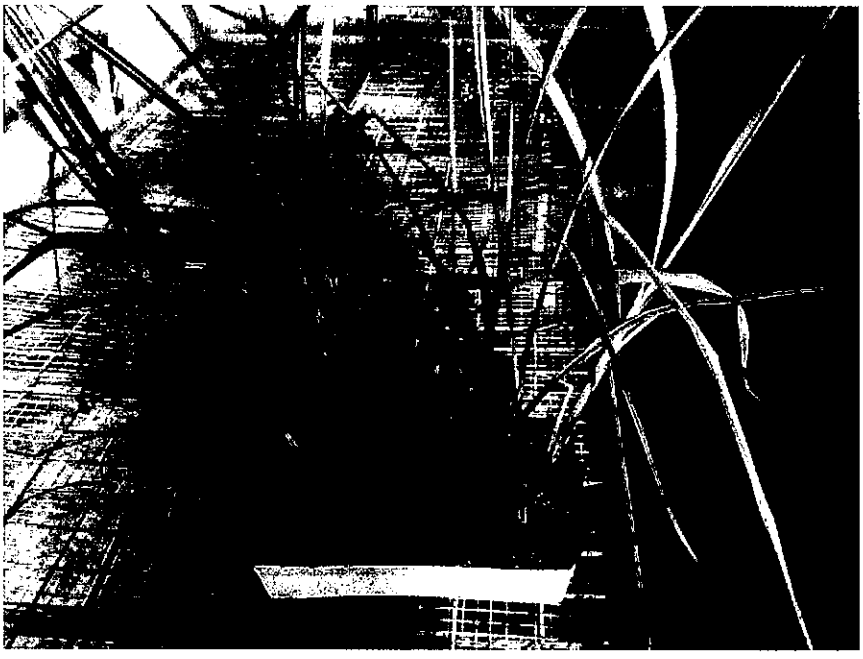

Figure 5.

8. Trim the leaves of the plants and plant to the field, approximately 2 plants per metre. Fill in rows and water immediately after transplanting. Keep plot well watered until the plants establish and then maintain a regular watering regime. Fertilise with a low rate of a general NPK fertilizer. The aim should be to grow a moderate size crop with minimal lodging.
9. The proposed plan for the mother plot is shown in Figure 6. The mother plot should consist of 9 m plots of each variety with a guard row of KQ228$^{\Phi\Phi}$ on either side of the plot. The KQ228$^{\Phi}$ for the guard rows should receive the same treatments as the plots of the other varieties. No guard is required on the end of the rows. There should be a 1 m gap between plots.

	Plot	**Row 1**	**Row 2**	**Row 3**	**Row 4**	**Row 5**	**Row 6**
9 m	1	KQ228$^{\Phi}$	KQ228$^{\Phi}$	Q99	VMC87-599	SP87-344	KQ228$^{\Phi}$
		1m gap	1m gap	1m gap	1m gap	1m gap	1m gap
9 m	2	KQ228$^{\Phi}$	KQ228$^{\Phi}$	N26	96-811	TC5	KQ228$^{\Phi}$
		1m gap	1m gap	1m gap	1m gap	1m gap	1m gap
9 m	3	KQ228$^{\Phi}$	Q208$^{\Phi}$	TCP87-3388	Co7804	CC92-2154	KQ228$^{\Phi}$
		1m gap	1m gap	1m gap	1m gap	1m gap	1m gap
9 m	4	KQ228$^{\Phi}$	Q208$^{\Phi}$	Q200$^{\Phi}$	SP80-3280	VMC92-189	KQ228$^{\Phi}$
		1m gap	1m gap	1m gap	1m gap	1m gap	1m gap
9 m	5	KQ228$^{\Phi}$	Q171$^{\Phi}$	QA89-3567	SP83-5073	QA93-1979	KQ228$^{\Phi}$

Figure 6 - Proposed plan for mother plot.