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ARTICLES **PAGE #**

EFFICENCY OF DIFFERENT RATES OF DUAL GOLD HERBICIDES FOR WEED CONTROL IN SUGARBEET

By

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ABSTRACT

Weeds are the main problem in sugar beet production. Weeds are plant species with particular ability to exploit distributed grounds. In natural, un-distributed, ecosystems they may be rare or absent, but any cultivation of soil for crops provide conditions in which they can flourish. Hence weeds have been inevitable, undesirable, companion of crops since the dawn of agriculture. Studies to control weeds by different doses of Dual Gold in sugar beet crops were carried out at Sugar Crops Research Institute, Mardan during 2003 to 2004. Dual Gold @ of 0, (control), 1500ml, 2000ml and 2500ml was sprayed on 3rd day of 1st irrigation. Spray of 2000 and 1500 ml Dual Gold/ha resulted into the average highest root yield of 64.26 and 59.48 tons respectively. Control treatment produced the lowest root yield of 54.96 tons/ha. Differences among the treatments for sugar content were also found non-significant. The highest sugar yield of 12.3 tons/ha was recorded for treatment of Dual Gold 2000 ml/ha had been sprayed.

INTRODUCTION

In Pakistan, NWFP is privileged to grow sugarcane and sugar beet crops in the same field on commercial scale simultaneously. In the region, sugarcane has been in commercial cultivation on an area more than 100 thousand hectares, while sugar beet an about 7000 hectares annually. Four of the sugar mills have been equipped with best slicing machinery and are working in Peshawar valley, where both sugarcane and sugar beet are extensively grown.

Weeds are the plants, which absorbed nutrients & other essential elements from the soil more quickly as compared to that of the crop plants. Different methods, a-chemical method, b-mechanical methods, c-biological methods, d-cultural methods are in use to control dissemination & dispersion of weeds. In this project one selective herbicide, with different concentration was used for the control of different weeds species in sugar beet. Research work has been done on the use of herbicides for control of weeds in sugar beet. Herbicides applied pre & post emergence have been found effective in controlling weeds in sugar beet and increased tonnage and quality. Baden and Swicer (1960), Chou (1966) and Garracho and Liazen (1971) found chemical weed control in sugarbeet not only better, but also more economical than hand weeding and hoeing. Moreover Irshad *et al.,* (1980) identified 20 weed species found in sugar beet field of Mardan and Thordher of NWFP province. In leading sugar beet growing countries i.e. Germany, USA, Japan, Iran & Belgium the use of herbicides in beet crop assisted in replacing mechanical/manual weeding system. However, problems like sever & short growing season, small land holding, less credit facilities, weed infestation with stagning inputs hamper successful production of the sugar beet crop. Moreover sugar beet is grown in odd season (October to June) with suppressed growth in winter and hot temperature in summer at harvest, resulting in reduced yield and sugar recovery of this crop. This weedicide study was replicated to find out the most effective dose of Dual Gold herbicide for economic weed control in sugar beet.

MATERIALS AND METHODS

The trial was conducted at Sugar Crops Research Institute, Mardan during 2003 to 2004. The experiment consisted of four treatments with four replications under randomized complete block design. Treatments were 0 (control), 1500 ml Dual Gold/ha, 2000 ml and 2500ml. A gross plot size of 9.50 x 4.80 square meters was maintained.

Fertilizer @ 120kg P_20_5 and first dose of 90 kg N/ha were applied before ridges formation. The 2nd dose of 50kg N/ha was side dressed in early spring. The scheduled rates of dual gold herbicide were sprayed five days after first irrigation before the emerging of weeds. All the required cultural and plant protection measures were carried out as and when required. Beet samples were collected at harvest time and analyzed for sugar contents. Root yield data was recorded at harvest time and statistically analyzed.

RESULT AND DISCUSSION

Different rates of Dual Gold did not significantly influence root yield and sugar content in the beet roots (Table-3). However spray of 2000ml and 1500ml Dual Gold/ha resulted into the average highest root yield of 64.26 tons/ha and 61.14 tons/ha, respectively. Control treatment gave the average lowest root yield of 54.96 tons/ha. Differences among treatments for sugar content were also found non significant. Sugar content of treated plots found better than control treatments.

Table-1 Root and sugar yield and sugar contents of different rates of Dual Gold for weed control during 2002-2003

Treatments	Root yield (tons/ha)	Sugar (%)	Sugar yield (t/ha)
0 (Control)	41.98	14.00	5.88
1500 ml DG/ha	45.37	14.40	6.53
2000 ml DG/ha	48.07	15.60	7.50
2500ml DG/ha	48.53	15.20	7.38
S.E for treatment	2.71	-	-

Table-2 Root, Sugar yield and sugar contents of different rates of Dual Gold for weed control during 2003-2004

Treatments	Root yield (tons/ha)	Sugar (%)	Sugar yield (t/ha)
0 (Control)	67.94	14.71	9.99
1500 ml DG/ha	76.91	15.17	11.67
2000 ml DG/ha	80.44	15.33	12.33
2500ml DG/ha	70.43	15.86	11.17
S.E for treatment	4.54	-	-

Table-3 Average root, Sugar yield and sugar percent of the efficacy of different rates of Dual Gold for weeds control in sugar

Treatments	Root yield (tons/ha)	Sugar (%)	Sugar yield (t/ha)
0 (Control)	54.96	14.35	7.94
1500 ml DG/ha	61.14	14.79	9.10
2000 ml DG/ha	64.26	15.47	9.91
2500ml DG/ha	59.48	15.53	9.28

The highest sugar yield of 9.91 tons/ha was recorded for treatments where 2000 ml Dual Gold per hectare had been sprayed. The lowest sugar yield of 7.94 was produced by control plots.

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PERFORMANCE OF *TRICHOGRAMMA* FOR THE CONTROL OF SUGARCANE BORERS IN FARMERS FIELDS AT VARIOUS DISTRICTS OF PUNJAB (PAKISTAN)

By
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ABSTRACT

Trichogramma, an agent of biological control was tested for its efficiency against sugarcane borers at 15 different locations of various districts in Punjab during 2003-2004. Borer infestation remained quite low in plots where *Trichogramma chilonis* was released compared with unreleased plots. The reduction in tiller infestation due to *Trichogramma* ranged from 29.3 to 61.4 percent whereas, the internode damage ranged from 28.6 to 59.7 percent. It was concluded from this study that *Trichogramma* is highly effective against sugarcane borers.

INTRODUCTION

Trichogramma chilonis (Fam. *Trichogrammatidae*) tiny wasps, occur naturally in almost every terrestrial and some aquatic habitats. Today *Trichogramma* species are the most widely used insect natural enemy in the World (1). They attack many important crop insect pests especially the caterpillar pests attacking sugarcane, corn, rice, cotton, vegetables, sugar beets, fruit trees, pine and spruce trees. Nine species of *Trichogramma* are reared in private or government owned insectaries around the World and released annually on an estimated 80 million acres of agricultural crops and forests in 30 countries (1). Entomological Research Institute, Faisalabad is a prestigious Institute, actively engaged in the development of biological control of insect pests especially of sugarcane crop. Current research studies strengthened the fact that *Trichogramma* can effectively be integrated in control programmes of sugarcane borers.

MATERIALS AND METHODS

Trichogramma @ 16 cards having 400 - 500 eggs per card were installed in sugarcane crop in farmer's field at 15 different localities of district Faisalabad, Toba Tek Singh and Jhang to know the efficiency of *Trichogramma* against sugarcane borers. The cards were applied fortnightly starting from April to September. The data regarding tiller infestation and internode damage were recorded during May - June and December-January, at crop harvest, respectively (Table).

Data were recorded from both treated and untreated plots at the same time. The tiller infestation was recorded by counting the dead hearts from total tillers of three rows 10 meters long in each plot and it was repeated at three spots selected at random. Similarly internode damage was recorded at crop harvest by taking 100 canes at random, counting total internodes and the attacked internodes both from treated and untreated plots from 3 different spots. Loss reduction percentage was calculated with the help of following formula.

$$\text{Loss reduction \%} = \frac{\text{Damage in untreated plots} - \text{Damage in treated plots}}{\text{Damage in untreated plots}} \times 100$$

RESULTS AND DISCUSSIONS

The results (Table) reveal that tiller infestation ranged from 2.7 to 7.0 percent in treated and 4.7 to 13.5 percent in untreated fields. The loss reduction in tiller infestation due to release of *Trichogramma* ranged from 29.3 to 61.4 percent. The internode damage ranged from 3.9 to 10.5 percent in treated and 9.6 to 18.6 percent in untreated plots. The internode damage reduction due to *Trichogramma* treatment ranged from 28.6 to 59.7 percent.

Shenhmar-M *et al.,* conducted large scale field demonstration using *Trichogramma chilonis* against stalk borer *Chilo auricilius* in Punjab, India during 2000-01. *Trichogramma chilonis* was released @ 50000 per hectare at 10 days interval from July to October. In terms of borer incidence they recorded a reduction in damage over the control by 52.04% during 2000 while 60.03% during 2001. These results are in accordance with the results of the present study.

Soula-B *et al.,* during 2002 released 15000 *Trichogramma chilonis* per hectare against spotted stalk borer, *Chilo sacchariphagus* Bojer, a major pest of sugarcane in Southern Asia, the Indian ocean islands and Mozambique in Southern Africa. The parasitoids were released at two sites Savannah (SAV) and Sainte - Marie (SMA) and compared them with untreated plots. In treated plots the percentage of bored internodes at harvest was 45% less than the controls at SAV and 35 % at SMA. This trend fully confirms the one obtained during the present studies.

In view of the research findings there in a natural conclusion that *Trichogramma* has reasonable potential for the control of sugarcane pests and hence it should be integrated in the control programmes of these pests.

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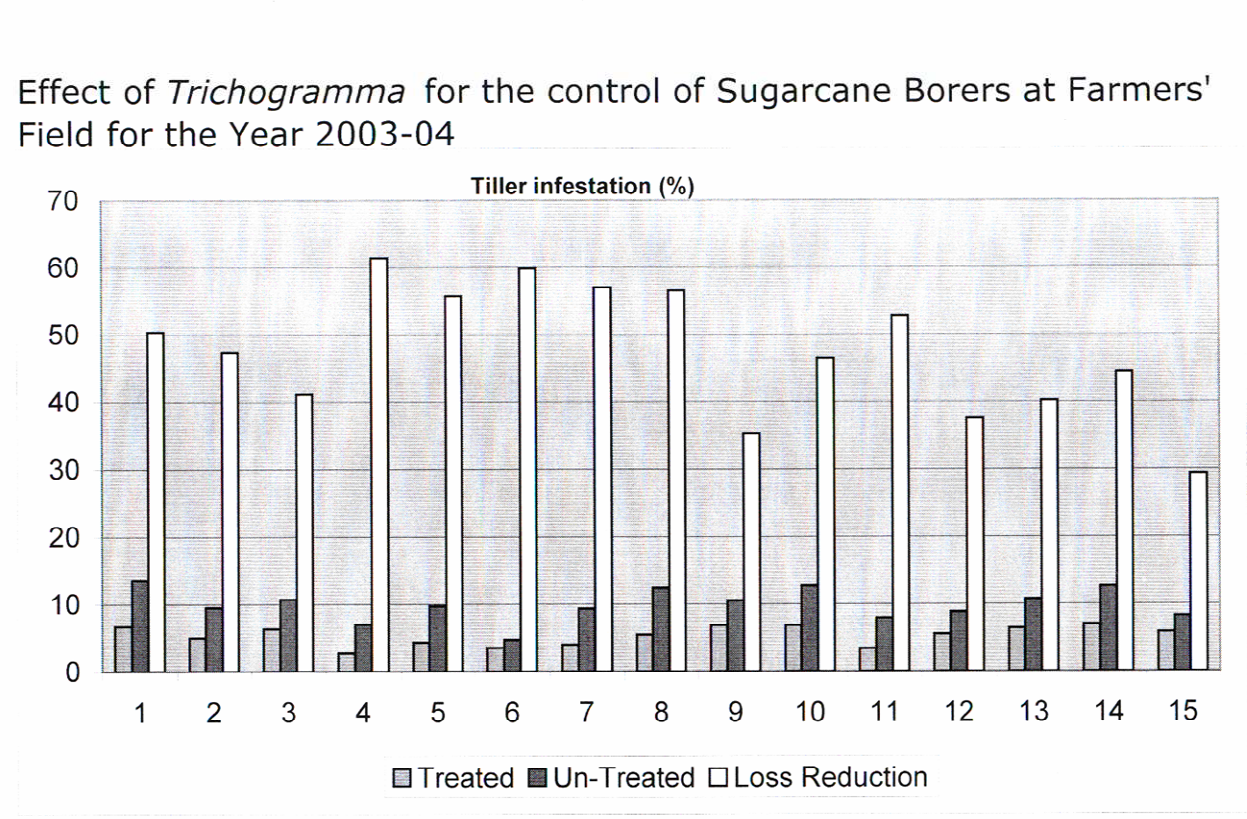
Table-1 Effect of *Trichogramma* for the control of sugarcane borers at farmer's field for the year 2003-04

Sr. No. Name of Farmers	Tiller infestation (%)			Internode damage (%)		
	Treated	Un-treated	Loss reduction	Treated	Un-treated	Loss reduction
1. Malik Allah Dad, Jusa Balochan, Jhang	6.7	13.5	50.4	10.5	17.2	38.9
2. M. Hayat, Chak Salara, Chiniot, Jhang	5.0	9.5	47.4	8.9	15.5	42.6
3. Master Fateh, Chak 161/RB, Faisalabad	6.3	10.7	41.1	9.4	16.5	43.0
4. Akhtar Ali, Chak 3, Ramdewali, Faisalabad	2.7	7.0	61.4	6.5	14.0	53.6
5. M. Raffique, Chandian, Talanwan, Faisalabad	4.3	9.7	55.7	8.7	18.6	53.2
6. Jamal Din, Dijkot, Faisalabad.	3.5	4.7	59.8	5.8	12.7	54.3
7. Yaqoob Ali, Chak 5281GB, Faisalabad	4.0	9.3	57.0	4.9	11.9	58.8
8. M. Saif, Chak 5271GB, Faisalabad	5.4	12.4	56.5	8.3	14.4	42.4
9. Rana Zobair, Chak 5281GB, Faisalabad	6.8	10.5	35.2	5.0	13.4	59.7
10. Abdul Qayyum, Chak 92, Dijkot, Faisalabad	6.8	12.7	46.5	9.3	14.8	37.2
11. M. Farooq, Mochiwala, Jhang	3.4	7.9	52.7	5.1	11.5	55.7
12. Noor Muhammad, Chak 161/RB, Faisalabad	5.5	8.8	37.5	3.9	9.6	59.4
13. M. Akram, Nathu Chak, Faisalabad	6.4	10.7	40.2	7.4	13.8	46.4
14. M. Nawaz Malik, Jusa Balochan, Jhang	7.0	12.6	44.4	10.5	14.7	28.6
15. Rana M. Hayat, Chak Rasyana, Faisalabad	5.8	8.2	29.3	6.7	12.8	47.6
Average	5.31	9.88	47.67	7.39	14.09	48.09



PERFORMANCE OF IMPROVED GENOTYPES OF SUGARCANE ON FARMER'S FIELD IN BANNU NWFP

By
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ABSTRACT

The response of total twenty four improved genotypes of sugar cane was studied on farmer's field at five different locations of Bannu division in plant/ratoon stages during 2003-04. Newly approved variety Bannu-Green (S84-I-282) exhibited the highest significant average cane yield of 125.23 t ha^{-1} with average sugar recovery of 10.81%, followed by variety SPF-238 producing average cane yield of 124.0 t ha^{-1} with average sugar recovery of 8.36% at single location. New varieties Bannu-3 and SPF-234 responded with maximum sugar recovery of 12.24 and 11.62% at another location.

INTRODUCTION

The role of sugarcane as valuable cash crop could never be ignored at farming and Industry Level. It is not only a major source of sugar production but also generates several by products for other industries and creates employment on farm, industry and trade levels. Sugar Industry is 2nd to textile in our country. Thus sugarcane provides vast agro industrial base which improves the national economy and saves great foreign exchange. It is known fact at under the prevailing challenging situations i.e. ever rising population, un-employment and WTO regime, improvement of such important commodity is highly emphasized. It plays vital role in the overall economy particularly poverty elevation in the area. The average cane yield of NWFP and district Bannu is 46.27 and 40.41 t ha^{-1} (Anonymous, 2000), which is far below the average achievable yields (70-75 t ha^{-1}) under existing resources. Main causes for such poor yield are shortage of irrigation water and new suitable varieties in the area. Ahmad *et al.,* (2003) are also of the opinion that sugarcane contributes to wider base of employment and national GNP. They concluded that lack of high yielding, disease free varieties are the main causes for poor yield of sugarcane. Makhdom *et al.,* (2001) also reported that lower yield of sugarcane (40-45 t ha^{-1}) is due to poor varieties, agronomic and management factors. Considering the basic need of farming community, trial were conducted on farmers fields at five different locations to evaluate most promising varieties under the prevailing conditions in the locality.

MATERIAL AND METHODS

The performance of twenty-four improved varieties of sugarcane was studied for cane yield and sugar contents on farmer field at five different locations in plant/ratoon stages during 2003-04. The trials were conducted in RCB design in three replications under plot size of 4.0 x 7.5 m with rows 75 cm apart. The recommended and Basel dose of NP was applied @ 150-156 kg per hectare. Complete dose of P_2O_5 was applied at the time of seed beds preparations and nitrogen was applied in two equal doses during the month of May and June. Weedicide Gexapex Combi spray was performed @3.5 kg per hectare for the control of seasonal weeds in these trials during the month of February. Insectide Furadon granules were applied @ 20 kg per hectare in two equal doses during the month of May and June for the control of borer attack. Uniform cultural operations were adopted at appropriate stages in each trial. Data on cane yield and sugar recovery % were recorded at harvest stage. Data on cane yield were analyzed statistically using computer package MSTAT-C.

RESULTS AND DISCUSSION

Cane yield

According to table-1, varieties Bannu Green, SPF-238 and Bannu-1 showed significantly the highest and at par cane yield of 125.23, 124.0 and 123.78 t ha^{-1} respectively at village Pir Killa. Similar findings were reported by Bahadar *et al.,* (2002). They found higher cane yield of 123.19, 118.33 and 120.30 t ha^{-1} for varieties Bannu-1 and Naurang-98 on farmer's field. Chattah *et al.,* (2003) reported varieties CP-77/400 and CPF-237 with maximum cane yield of 173.30 and 165.30 t ha^{-1} in Adaptive Research Trials. Similarly Bahadar *et al.,* (2004) recorded higher and at par cane yield of 121.15, 120.41 and 120.30 t ha^{-1} for varieties Bannu-1, S90-SP-889 and COJ-84, respectively on farmer's field. Anonymous (2002) also obtained better cane yield (126.32 and 123.10 t ha^{-1}) for varieties Bannu-1 and COJ-84 on farmer's field.

Sugar recovery %

It is evident from table-5 that varieties Bannu-3 and SPF-234 responded with the highest sugar recovery of 12.24 and 11.62 % at village Danishabad. Similar results were also reported by other scientists. Chattah *et al.,* (2003) found the highest CCS % of 12.78, 12.70 % for varieties SPF-232 and CPF-237 in Adaptive Research Trials. Bahadar *et al.,* (2004) determined better sugar recovery of 11.89 % for variety S84-I-351 on farmer field. Bahadar *et al.,* (2002) also recorded the peak sugar recovery of 13.0, 12.80 % for varieties Bannu-3 and S86-US-402 on farmer fields. According to Anonymous (2002), comparatively higher and at par sugar recovery of 12.78 and 12.74 % was shown by varieties S86-US-402 and Bannu-3 on farmer's field.

Table-1 Varietal performance of promising varieties (Plant crop 2003-04) on farmers field at village Pir Killa

Sr. No.	Variety	Cane yield (t ha^{-1})	Recovery (%)
1	Bannu-1	123.78 a	90.43
2	Naurang-98	104.0 ef	10.74
3	S85-US-340	90.0 g	8.86
4	S88-US-479	122.0 a	9.44
5	S87-US-1327	120.0 ab	9.39
6	S84-I-351	118.0 a-d	9.44
7	Bannu-3	119.0 abc	10.83
8	CP-89/846	108.0 c-f	10.28
9	S87-US-1819	100.0 efg	9.96
10	S84-I-758	110.3 b-e	7.75
11	Bannu Green	125.23 a	10.81
12	S92-SP-57	103.0 ef	9.43
13	CPF-237	123.0 a	9.39
14	SPF-238	124.0 a	8.36
15	GT-11	107.2 def	9.64
16	CPF-213	102.1 ef	10.08
17	CPF-240	96.33 fg	10.35
18	S96-SP-1218	100.7 efg	8.24
19	S90-SP-889	108.0 c-f	8.12

LSD @ 0.05 percent for cane yield = 11.71

Table-2 Varietal performance of promising varieties (Plant crop 2003-04) on farmers field at village Nar Hakim Khan

Sr. No.	Variety	Cane yield (t ha^{-1})	Recovery (%)
1	CPF-237	43.47 j	8.27
2	S90-SP-889	76.08 b-e	10.54
3	Bannu Green	90.3 a	11.01
4	MT-70-611	51.62 hij	10.18
5	CPF-236	65.1 efg	9.24
6	S87-US-1327	81.15 a-d	9.71
7	MS-92-CP-717	46.23 j	10.94
8	CP-89/846	59.77 ghi	10.20
9	Bannu-3	47.32 ij	9.34
10	GT-11	84.22 abc	10.54
11	S84-I-758	73.35 c-f	10.61
12	S86-US-226	62.48 fgh	10.9
13	S88-US-479	70.64 d-g	9.93
14	S84-I-351	87.0 ab	11.05
15	MS92-CP-716	60.6 gh	9.07
16	SPHS-2	75.05 b-e	11.28
17	MS91-CP-626	78.79 a-d	10.63

LSD @ 0.05 percent for cane yield = 12.53

Table-3 Varietal performance of promising varieties (Ratoon 2003-04) on farmers field at village Mandan (Bannu)

Sr. No.	Variety	Cane yield (t ha^{-1})	Recovery (%)
1	Bannu-1	131.21 ab	9.30
2	S90-SP-889	124.2 abc	7.81
3	COJ-84	116.9 bc	5.50
4	S87-US-1327	117.62 bc	10.48
5	TCP-3110	120.6 abc	7.12
6	S84-I-351	135.0 a	9.80
7	SPSG-384	97.6 de	8.64
8	S86-US-642	94.53 e	8.76
9	S86-US-226	11.94 cd	10.81

LSD @ 0.05 percent for cane yield = 16.55

Table-4 Varietal performance of promising varieties (Ratoon 2003-04) on farmers field at village Bachkan Ahmedzai

Sr. No.	Variety	Cane yield (t ha^{-1})	Recovery (%)
1	TCP-3110	101.6 bc	8.44
2	COJ-84	104.3 ab	8.94
3	Bannu-1	114.6 a	8.82
4	S84-I-758	69.9 d	8.82
5	S78-US-421	112.1 ab	9.20
6	S84-I-351	109.4 a	9.21
7	S87-US-1327	104 5 ab	8.16
8	S88-US-479	91.8 c	8.53

LSD @ 0.05 percent for cane yield = 11.66

Table-5 Varietal performance of promising varieties (Plant Crop 2003-04) on farmers field at village Danishabad

Sr. No.	Variety	Cane yield (t ha^{-1})	Recovery (%)
1	S90-SP-889	120.38 a	11.09
2	Bannu-1	71.14 de	11.0
3	MS-91-CP-626	97.80 c	9.45
4	S86-US-406	84.00 d	10.28
5	COJ-84	121.31 a	9.02
6	Bannu-3	68.20 e	12.24
7	SPF-234	98.06 c	11.62
8	SP-70/3370	105.56 bc	9.34
9	MS-91-CP-176	110.48 b	9.71
10	Thatah-8	100.74 c	11.30

LSD @ 0.05 percent for cane yield = 14.37

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SUGAR INDUSTRY ABSTRACTS

By

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FACTORY PROCESSING

Copersucar benchmarking program

La. D. Paes, D. T. Oliveira, J. L. Donzelli and A. Ella Neto
Proc. Int. Soc. Sugar Cane Technol., 25: 125-133

For the past 14 years the Copersucar Technology Center (CTC) has been conducting a benchmarking program called Mutual Control. This program makes available reports that contain index numbers of agricultural and industrial efficiencies. The indexes allow participants to compare the agricultural and industrial performances, and the overall program allows participants to share experiences. In these 14 years, the released information has been used as an important management tool for the production areas as well as to drive research programs of the CTC. The Copersucar Benchmarking Program comprises a tool for technological status classification and a comprehensive data bank of agricultural industrial mutual control indexes. The Copersucar Benchmarking Program is described in detail here.

Prioritising options to reduce the process steam consumption of raw sugar mills

B.P. Lavarack, J.I. Hodgson and R. Broad foot
Proc. Int. Soc. Sugar Cane Technol., 25: 134-141

Low world sugar prices are making it increasingly difficult for raw sugar mills to remain competitive, and many milling companies are embarking on new revenue earning opportunities. In almost all new ventures, the energy from bagasse (as steam or cogenerated electricity) or the fibre itself provides an important basis for generating the additional revenue. Integral to increasing the economic viability of such projects is the need to cost effectively reduce the steam consumed by the factory for sugar manufacture. The Sugar Research Institute has completed a comprehensive study of numerous options to reduce the process steam consumption of factories, and to determine the financial implications of the different options. Process simulation software for evaporators, pans and heaters were integrated with a basic high pressure steam model. For each process steam efficiency option, the effects on boiler load, fuel consumption, and cogeneration output could be accurately assessed for selected steam conditions at the boiler. The outputs from the integrated process model were directly linked to the financial model. For nominated input conditions, the project determined a prioritised list of technically and economically attractive options for reducing the steam consumption of the factory. The analyses were undertaken for three scenarios which include sale of export electricity, sale of surplus steam or sale of surplus bagasse. This paper describes the development of the integrated models and the results for a base case study. The results show a quintuple station is the preferred evaporator configuration for circumstances where the steam on cane is reduced from current levels of approximately 50% on cane to about 40%. To reduce the steam consumption below this level, a sextuple arrangement is preferred. A quadruple set shows inferior results for all steam on cane values. Options for steam on cane to below 30% were found to be technically feasible for cane factories, but these configurations are not likely to be economically justified.

CO-PRODUCT

Products from cane bagasse and trash fast pyrolysis fluidised bed system: the Brazilian experience
J.D. Rocha, J. M. Mesa Perez, E. Olivares Gomez and L A. B. Cortez
Proc. Int. Soc. Sugar Cane Technol., 25: 424-430

The fast pyrolysis process has been developed in a fluidised bed pilot plant scale in Brazil since 1995. The country has raw material such as cane bagasse and trash to feed the process and all appropriate conditions in terms of human and natural resources. The experiments were carried out in the pilot plant located at Centro de Tecnologia Copersucar in Piracicaba by students and staff from Universidade Estadual de Campinas in Campinas. The progress of this technology will put Brazil ahead of the all Latin American countries in this important area. Bio-oil, fine charcoal, and low calorific value gas are the products of biomass pyrolysis. Samples and operational parameters are obtained in the demonstration facility. Fast pyrolysis temperature is in the range of 450-500°C, and the pressure is atmospheric. The pilot plant feed capacity is 200 kg/h of dry (approximately 15% wt of moisture) biomass and particle size smaller than 1 mm. Fluidised bed reactor has 0.5 m as external diameter and 5 m long. The cleaning gas system has two cyclones to retain the charcoal fine particles, a wet scrubber to recover the bio-oil, and pyrolysis gas is burned in a combustion chamber to recycle the heat in the process. The technology is fully instrumented, being able to be operated continuously by 2 workers per shift. The aim in this technological development is an innovative technology to process residual biomass to produce new biofue1 and material as a contribution to cane industry diversification and to create new jobs and income mainly in the rural areas of the country. The applications for the main product, bio-oil, is its use as fuel to replace fuel oil and diesel in electricity generation, to be an additive to emulsify heavy petroleum fraction, an additive to food industry, and a substitute to petrochemical phenol in phenolic (PF) resins, etc. Charcoal has also attractive applications for iron ore pelletisation, briquetting, and activated carbon.

Feasibility of cottage-level sugarcane-based product diversification in Sri Lanka
G. Chandrasena, A. P. Keerthipala and M. K. B. F. Jayasuriya
Proc. Int. Soc. Sugar Cane Technol., 25: 431-436

Sugarcane jaggery/sakkara and syrup production, which had been a thriving cottage industry in sugarcane growing areas in Sri Lanka, has plunged into crisis after market liberalisation due to cheap imported sugar, badly affecting the livelihood of the cane growers and jaggery/sakkara and syrup millers. Sugarcane-based product diversification has been a dire need to provide a more secure livelihood for the sugarcane growers/millers in distant areas where cane cannot be transported to vacuum-pan sugar mills. Technical and financial feasibility of introduction of sugarcane-based fruit juice drink, vinegar and mushroom as a cottage industry was studied by conducting both laboratory and field studies, which included small-scale production of these three products and testing them and collection of relevant information. Costs and returns of the individual products were estimated and the viability of their production as an integrated project was evaluated by net present value, benefit/cost ratio and internal rate of return. It was found that, apart from jaggery/sakkaralsyrup, production of good quality sugarcane-based fruit juice drink, vinegar and mushroom could be successfully carried out under the existing conditions. A ready market was available for these products. Jaggery/sakkara production has become *less* lucrative than fruit juice drink, vinegar and mushroom. Vinegar and mushroom were more attractive in financial terms than fruit juice drink. Integrated production of these products was more beneficial though its viability was highly sensitive to changes in costs and product prices. Thus diversification of cottage-level sugarcane industry by integrating with fruit juice drink, vinegar and mushroom was found to be a

better alternative for the revival of the industry in distant cane-growing areas of Sri Lanka. But further studies are required to find ways of minimising costs of production of the sugarcane- based products to make them more viable home-business ventures.

AGRICULTURE

Agronomy

Forecasting South Africa's sugarcane crop with the canesim crop model
A. Singels1and C.N. Bezuidenhout
Proc. Int. Soc. Sugar Cane Technol., 25: 184-191

Forecasts of the size of the sugarcane crop provide essential information for the industry to optimize sugarcane milling and sugar selling. The aim *of* this paper is to briefly describe a model-based operational system to forecast sugarcane yields and to report on the accuracy *of* forecasts. Data from approximately 70 weather and rainfall stations are used to simulate crops for each month *of* the milling season. Seasonal rainfall outlooks are used to generate likely future weather data. Mean yields are calculated for homogenous climate zones, mill areas and the industry and expressed as a percentage *of* the yield *of* the previous year. The accuracy of forecasts was determined by comparing estimates with actual data from 1980 to 2003. Forecast error is due to (1) inaccuracies inherent to the system (system error) and to (2) uncertainties associated with climate forecasts. System error was calculated as the root mean square deviation between estimated and actual yields expressed as a percentage of actual yields. The system error was 5% for industry average yield. The average error for mill average yield estimates was 11%. System errors were lower than the inter-annual variation in actual yields for 13 out *of* 15 mills, suggesting that estimates should be useful to industry and mill management. Results suggest that further improvements are needed to estimate yields for irrigated mill areas, but that estimates for most dry-land areas are sufficiently accurate to be of value to mill management. Early season operational model forecasts *of* industry average yield outperformed conventional forecasts in three of the past four seasons.

Early-season predictions of sugarcane yield in Florida, USA
T.R. Sinclair, R.A. Gilbert, J. M. Shine, Jr and R.E. Perdomo
Proc. Int. Soc. Sugar Cane Technol., 25: 192-197

Schedules for harvest and milling operations are initiated well in advance of the actual harvest. Yield estimates are a critical component of this planning and currently these estimates are generally based on observations by experienced scouts. This study was undertaken to supplement and to improve these yield predictions by developing a hybrid forecast scheme based on a combination of mechanistic crop modeling and empirical correlations with yield history. An early season forecast of yield (1st May for harvesting initiated in the following November) was developed and based on the influence of temperature on leaf development of young sugarcane plants. Regression of cumulative temperature (base temperature= 10°C) for the period between 15th January and 30th April for 34 years from 1963 to 1996 against the subsequent yield in each season resulted in a significant correlation (r^2= 0.69). A forecast made on 1st August was based on the amount of solar radiation intercepted by the crop up to that point. Again, a significant correlation was obtained (r^2 = 0.60), but this later forecast was not superior to the early season forecast. Two crucial issues were identified in the analysis of these data. First, an early season frost had a large impact on yield that could be accounted for by resetting the tabulation of cumulative temperature and cumulative

radiation interception to zero at the time of the frost. Second, sugarcane yields since 1998 have been substantially greater (+ 12.6 t/ha) than predicted from historical yields.

Agriculture Engineering

Progress with mechanizing field operations in the Guyana sugar industry
H. B. Davis, N. W. Friday and A. D. Dey
Proc. Int. Soc. Sugar Cane Technol., 25: 364-370

Mechanization of agricultural operations has been difficult and very slow to evolve in the Guyana sugar industry, which has developed along the Atlantic coast and flood plains of the major rivers. The main difficulties are heavy clay soils with high moisture retention properties and poor internal drainage. A presentation review of land management approaches over the past 20 years is described. The aim has been to modify traditional cambered bed culture to layouts more suited to traffic of machinery and, at the same time, to continue to exploit the advantages of cane transport by water. Traffic of field equipment, and loaded infield equipment in particular, during wet periods creates problems of compaction and restricted surface drainage, both of which can impact on yield sustainability. A combination paratill/scarifying cultivation device has been developed that successfully alleviates these conditions. In addition, this implement has been found useful in primary tillage, where it is applied to strip tillage.

Field design for green cane harvesting in Colombia
R. Cruz V. and J. Torres A.
Proc. Int. Soc. Sugar Cane Technol., 25: 371-377

The Colombian sugar industry is compelled to stop all agricultural burning at the beginning of 2005.The change to green cane harvesting requires an increase in mechanised harvesting with combines to compensate for the low output of cane cutters in un-burnt cane. If harvesting and other operations are to be mechanised, it is necessary to carry out the preparatory improvements in field layout and cultural practices in advance. These include inter-row spacing, row length, ridge height, size and location of infield and haulage roads, precision land-levelling to eliminate cross-drains, replacement of deep irrigation ditches by the use of flexible tubing or PVC gated pipe, the construction of bowls as tertiary drainage ditches, and the choice of suitable cane varieties. A field reconnaissance of actual field design criteria and two field tests were conducted to establish the effect of furrow length on harvester performance and irrigation and surface drainage efficiencies. The traffic pattern and the required turning radius of machinery were measured, and infield roads of 5-6 m in width were recommended. A furrow length of 90 to 120m should be adopted for high rainfall areas, while longer furrows of 120 to 150m are suitable for dryer areas. The row direction of consecutive small paddocks should be collinear to enable final harvesting runs of 400 to 600m when three or four paddocks are harvested as a single unit. It is mandatory to replace earthen irrigation ditches with flexible fluming or PVC gated pipe. The geometry of the drainage ditch should be as flat as possible to facilitate the passage of farm equipment. The main benefits of the field design criteria were a reduction of 32% in harvester turning and in field road crossing time, and a reduction of 400 m^3 water/ha per irrigation due to the use of flexi pipe. The total cost saving amounted to US$14.5/ha per irrigation event due to water plus labour savings. The use of new field design criteria is a key factor in decreasing the cost of green cane management.

Plant Breeding

The impact of molecular marker and genetic map information on breeding and selection strategies

M. K. Butterfield
Proc. Int. Soc. Sugar Cane Technol., 25: 481-486

In the sugarcane variety development program conducted by SASRI, molecular markers have been used as breeding tools since 2002, aimed in particular at improving resistance to smut and the stalk borer *Eldana saccharina.* Currently, this activity is being expanded to identify and map markers contributing to yield components and sucrose content within the parent germplasm used in the breeding program. The availability of genetic maps of individuals making up the breeding population reveals the underlying genetic structure contained within it. The question then is, how to effectively use this information to improve breeding efficiency, while taking traditional breeding concerns based on quantitative genetic theory into account. Problems that must be addressed, among others, include the following: What is the level of selection pressure that can be placed on a small number of marker loci without negatively affecting genetic diversity within the breeding population, or drastically skewing the population structure? How should genotypes without marker information be effectively incorporated into the overall strategy, and should breeding populations be sub-divided? What are the physical constraints that may limit the wide scale use of markers and map information, and how can resources be optimised? How can these questions be addressed by either designed experiments or by simulation models? This paper seeks to address the issues that are faced in breeding programs when detailed genetic information on the breeding population is available.

A molecular approach to breeding for stem borer resistance in sugarcane

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Proc. Int. Soc. Sugar Cane Technol., 25: 487-492

Lepidopteran stem borers, such as the Mexican rice borer (MRB) *Eoreuma loftini* and sugarcane borer (SCB) *Diatraea saccharalis,* are important insect pests of sugarcane *(Saccharum* spp.) worldwide. Alternative control strategies are needed for both species due to the high costs associated with insecticides and resulting environmental concerns. One of the most promising control strategies is host plant resistance. However, few breeding programs actively breed for insect resistance because of the absence of effective selection procedures. Recent advances in sugarcane molecular biology, such as the development of molecular markers, offer new opportunities for selection and breeding for stem borer resistance. Damage levels of both the MRB and SCB were quantified by the number of emerging shoots killed (deadheart) and percentage of internodes damaged by larvae from a diverse population of 24 sugarcane clones. These clones represented cultivars and elite clones of known and unknown reaction to both borers. The evaluation was conducted under natural infestations in a randomised complete block replicated five times, where genotypes with extreme reactions were identified. Evaluation indicated L97-128 as the most susceptible cultivar with a mean of 15 deadhearts and 7% damaged internodes, while several clones averaged less than one deadheart and less than 1% internode damage. Twenty-nine microsatellite (SSR) fragments were evaluated for their association with resistance to both borers. Twenty-three SSR fragments were obtained from disease and insect resistance genes identified by the Sugar Cane Expressed Sequence Tag Project (SUCEST) and six SSR fragments were from the Sugar Cane Microsatellite Consortium (SMC). Microsatellite analysis identified informative markers developed from sugarcane disease and insect resistance genes. One of these markers showed a possible association with stem borer susceptibility and is being evaluated further.

Pathology

Cultural characteristics, response to fungicides and aggressiveness of isolates of *Ceratocystis paradoxa*

J. F.Y. Moutia, J. B. G. Permalloo and A. S. Saumtally
Proc. Int. Soc. Sugar Cane Technol., 25: 686-690

The fungus *Ceratocystis paradoxa* is an important pathogen of sugarcane that causes pineapple sett rot, a decay of seed pieces. At times, complete control of the disease by dipping cuttings in a fungicide has failed. A number of factors could be responsible for this situation, one of them being fungicide resistance. A study was undertaken to examine variability of the pathogen and to find alternative fungicides and methods for disease control. Nineteen isolates of C. *paradoxa* were isolated from 73 soil samples obtained from various regions of Mauritius. The isolates differed in their colony morphology, growth rate and sensitivity to temperature. The inhibitory effect of the fungicides benomyl, thiophanate-methyl and difenoconazole + carbendazim were compared *in vitro*. The effective dose of benomyl that inhibited growth of colony size by 50% (ED_{50}) varied from 0.31 to 0.88 ppm. The ED_{50} for thiophanate-methyl was higher, 13-24 ppm, while that of difenoconazole+carbendazim was 0.21-0.23 ppm. The latter mixture was most effective and all isolates were equally sensitive to it, in contrast to the two other fungicides. When difenoconazole was used on its own, its ED_{50} was 0.28 ppm. A pathogenicity test with the 19 isolates was carried out on varieties M 1176/77, M 52/78 and R 570. One isolate did not cause any infection, some infected only one or two varieties, while others infected all three. Based on the progress of the infection, M 1176/77 was most resistant and R 570 was least. The variability of the fungus is of interest in understanding its epidemiology and the establishment of appropriate control measures.

Sugarcane yellow leaf virus in the world collection of sugarcane and related grasses at Miami, Florida

J. C. Comstock, J. D. Miller, R.J. Schnell and T. Ayala-silva
Proc. Int. Soc. Sugar Cane Technol., 25: 691-694

The status of Sugarcane yellow leaf virus (SCYLV) infection was determined in *Saccharum* clones maintained in field plots at the World Collection of Sugarcane and *Related* Grasses at the USDA-ARS Subtropical Horticultural Research Station at Miami, Florida to identify putative virus-free and infected clones. Five leaves were collected from each clone from different plants in the 3m plot. The SCYLV infection status was determined by the tissue blot immunoassay. The incidence of SCYLV infection varied among *Saccharum* spp. The incidence of SCYLV was 5.6% for 252 S. *spontaneum* clones, 12.7% for 55 S. *barberi* clones, 45.9% for 37 S. *sinense* clones, 60.0% for 55 S. *robustum* clones and 78.2% for 325 S. *officinarum* clones evaluated. Of 175 *Saccharum* hybrid clones 70.9% were infected. Several clones (Bandejarmain Hitan, Chunnee, Co213, Co285, POJ 100, POJ 213, and POJ 2878) that were used early in breeding programs were SCYLV infected; whereas clones Kassoer, Co206, Co281 and POJ 1499 were putatively virus-free. Both NCo310 and NCo376, two widely grown cultivars, were infected. Ratings for the individual clones will be posted on the website: http://www.ars-grin.gov/ars/SoAtlantic/Miami/ngr/gallry0l.htm. The low SCYLV infection found in the S. *spontaneum* clones suggests this group is putatively the most resistant. The high incidence of SCYLV in the hybrid clones is consistent because a number of clones in their early pedigrees were susceptible.

Entomology

Sugarcane woolly aphid, *Ceratovacuna lanigera* zehntner (Hemiptera: Apiddidae) and its natural enemies in Thailand

Wiwat Suasa-Ard, Oraphan Kern-Asa and Pruetthiphat Punyawattoe
Proc. Int. Soc. Sugar Cane Technol., 25: 774-779

The sugarcane woolly aphid, *Ceratovacuna lanigera,* is one of the important insect pests of sugarcane in Asia. To improve management options, we investigated the pests biology and ecology in Thailand. There are four nymphal instars with average durations of 3.64, 4.64, 5.65 and 6.05 days, respectively. An apterous viviparous adult can produce an average of 30.53 nymphs over its life of 12.9 days. Life-table analysis shows a net reproductive rate of increase of 11.58, a capacity for increase of 0.0939, a finite rate of increase of 1.098 and a cohort generation time of 26.09 days. Natural enemies comprise one hymenopterous parasite, *Encarsia flavoscutellum* Zehntner, and three predators, *Thiallela* sp., *Chrysoperla basalis* Walker and *Hemerobius* sp. of these, the first two are the most important.

Infestation and damage to commercial sugarcane varieties from *Sesamia* spp. Stem borers in Iran

A. Sayad Mansour, A. Shlrali, G. H. Fathi and N. Sardarzadeh
Proc. Int. Soc. Sugar Cane Technol., 25: 780-783

Sesmia stem borers are important constraints on production of sugarcane in Iran and management is difficult because most activity is hidden inside stems. We determined the impact of stem borers on recoverable sugar and juice contents for six cultivars grown commercially at Karoun Agro-Industrial Company, southwestern Iran, and calculated the impacts for the whole estate. The highest proportion of infested stems was in CP48-103, while the lowest was in ratoon crops of SP71-6163. The highest and the lowest reductions in recoverable sugar content due to stem borer activity were in CP70-321 and SP71-6163, respectively; this translated to the highest loss from reductions in recoverable sugar of 363.2 kg of white sugar per hectare in CP70-321 and the greatest yield loss over the entire estate in CP48-103. The highest and lowest reductions in juice content due to stem borer activity were in SP71-6163 and CP69-315, respectively; this translated to the highest loss from reductions in juice contents of 195.0 kg of white sugar per hectare in SP71-6163 and the greatest yield loss over the entire estate in CP48-103. Changing the varietal composition grown on the estate could have considerable impact on sugar production.

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