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CANE AND QUALITY POTENTIAL OF NEWLY DEVELOPED SUGARCANE GENOTYPES UNDER AGRO CLIMATIC CONDITIONS OF THATTA, SINDH

By

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ABSTRACT

The experiment was conducted to observe the performance of nine newly developed sugarcane genotypes for cane yield, yield components and quality performance under agro climatic condition of Thatta during 2004-2005. Sugarcane genotypes viz: HoTh-2109, HoTh-307, HoTh-311, HoTh-316, HoTh-318, HoTh-332, HoTh-344, HoTh-348, HoTh-349 and Thatta-10 as a check were planted under RCBD with three replications at NSCRI farm, Thatta during October 2004. The results showed that genotypes HoTh-2109 and HoTh-332 remained on top by producing highest average cane yield of 148.33 and 135.0 t ha^{-1} respectively against check variety Th-10, which produced average cane yield of 130.00 t ha^{-1}. While the genotypes HoTh-348, HoTh-311 and HoTh-316 showed next higher average cane yield of 129.33, 127.66 and 126.66 t ha^{-1}, respectively but could not out yielded check variety in terms of average cane yield. Moreover the average cane yield in rest other genotypes in the trial was also below than that of check variety Th-10. The data regarding quality performance revealed that genotype HoTh-311 showed the trend of superiority by producing highest CCS of 14.64% followed by HoTh-2109, HoTh-344, HoTh-348, HoTh-332 and HoTh-349, with mean CCS of 14.61, 14.50, 14.47, 14.36 and 14.16%, respectively against check variety Th-10 which produced mean CCS of 14.06. In contrast, the genotypes HoTh-316, HoTh-307 and HoTh-318 showed minimum results by producing mean CCS of 13.98, 12.82 and 13.32% respectively against check variety Th-10. Thus on account of maximum average cane yield and quality, it was concluded that genotypes HoTh-2109, HoTh-332 and HoTh-348, HoTh-311 might prove best commercial varieties in future. However the performance of these genotypes needs to be tested in different agro climatic condition and different farmers' field to get substantial results.

INTRODUCTION

Sugarcane is a major cash crop of Pakistan and it is grown on an area of more than one million hectares with total production of 46.33 million tones (Khan *et al.* 2003). National average cane yield in Pakistan is about 47 t ha^{-1}, which is far below the existing potential (Zafar *et al.* 2003). Pakistan occupies 5th position with respect to area under cane cultivation and almost 15th position in cane production but stands far below in sugar production (Anonymous, 2004). Although crop occupies an important place in the cropping pattern of Pakistan but its yield and production has become stagnant for the last two decades due to limited resources and other un-avoidable factors. Main reasons for lower cane yield are lack of high potential varieties, limited irrigation resources and technology (Bahadar *et al.* 2002).

According to (Glaz, 2000) sugarcane production could never be improved until and unless promising varieties and technologies are adopted on large scale and similarly, Nazir *et al.*, (1997) reported that higher cane yield is the function of higher genetic potential of a variety.

Efforts are being made to increase cane production by introducing high yielding varieties and adoption of improved crop production techniques (Gill, 1995).

Besides so many factors, the inherently low cane and sugar yielding varieties are major constraints of cane and sugar production in Pakistan. Therefore it is dire need to evaluate new prodigious sugarcane varieties so as to replace the old existing and exhausted varieties. Evolution of the sugarcane genotypes through crossing is dependent on climatic conditions of tropical and sub-tropical countries. Fortunately, the climatic conditions of coastal areas like District Thatta and Badin of Sindh are favorable for sugarcane flowering and seed setting. Thatta falls at latitude of 24.5^{o} N where profuse flowering has been observed in many sugarcane varieties and the experiments have proved the viability in the locally collected fuzz, which offers a gigantic opportunity for variety development.

The evolution of new sugarcane varieties through fuzz has been a successful practice in different research institutes of Pakistan. The genetic variability of seedlings obtained from fuzz is being exploited through the scientists in making selection (Panhwar and Memon, 2004). Genetic selection for higher yield always plays major role in cane improvement; the agronomic practices just trigger the inherent potential of varieties (Hensely *et al.* 1973). Sherma and Agarwal (1985) reported that good germination and tillering with synchronized millable canes of average thickness are desired selection parameters to evaluate agronomic performance of cane variety. Glaz, (2000) reported that sugar cane production could never be improved until and unless promising varieties and technologies are adopted on large scale. Panhwar and Memon (2004) reported that cane yield per hectare is a product of well coordinated interplay of genetic as well as environmental factors towards the growth and development of the plant. Sugarcane is believed to have functions of various numbers of plant characteristics and population. Clear understanding of the association between yield and yield contributing components is important in crop improvement programme. (Javed *et al.* 2001) reported that cane yield depends upon the number of stalks per hectare and the weight per stalk consequently depends upon the length and girth of stalk.

The main objectives of preliminary study are to identify and evaluate genotypes with better cane yield potential and the yield characters, which contribute directly towards the cane yield. Different parameters are generally used for the selection of genotypes for cane and sugar yield. Breeding and selection strategies depends upon integrated group of the characters, usually determines the acceptance of released varieties at the farmers level. So the type and degree of association between characters also determine the case of breeding and regulate the stages of success.

MATERIALS AND METHODS

The study was conducted to observe the cane yield and quality performance of different sugar cane genotypes under ago-climatic conditions of Thatta, during 2004-2005. The experiment was laid out under randomized complete block design with three replications at National Sugar Crops Institute, experimental Farm, Thatta. The sowing was done in October 2004. Three rows of each genotype were sown in five meters long furrows at one meter row to row space. The fertilizer dose @ 250 kg Nitrogen, 125 kg Phosphorus and 150 kg Potassium per ha^{-1} was applied as, one third of nitrogen with full dose of phosphorus and potassium at the time of sowing and remaining nitrogen was applied in two splits, one in February and other in June. All the cultural practices, insect pest and disease control measures were carried out as and when required. The data for different parameters such as cane girth, number of internodescane^{-1}, cane height, number of millable canes ha^{-1}, cane yield t ha^{-1} and commercial cane sugar percentage (CCS%) were recorded at the time of maturity and analyzed statically by using MSTATC Computer program (Michigan State University, 1992).

RESULTS AND DISCUSSION

The data regarding cane yield and different yield components is presented in table-1 which shows that maximum cane thickness of 26.24 mm was observed in genotype HoTh-311 followed by HoTh-2109, HoTh-307 and HoTh-344 which showed average can thickness of 25.95 25.78 and 25.70 mm respectively, as compared to check variety Th-10 which showed average cane thickness of 25.36 mm. The rest other genotypes in the trial had more than 24 mm average cane thickness and which was slightly lower than that of cane thickness recorded in check variety Th-10. The results are in agreement with the findings of Kaloi *et al* (2005), Panhwar and Memon (2004) Junejo *et al* (2004) and Memon *et al* (2003).

The data regarding internodes plant^{-1} is depicted in table-1, which reveals that maximum 33.22 internodes per plant were recorded in genotype HoTh-307 followed by HoTh-349 and HoTh-344 that gave 29.11 and 27.84 average numbers of internodes plant^{-1}, respectively against 23.77 average number of internodes plant^{-1} recorded from the check variety Th-10. Moreover, the rest other genotypes also showed better performance in terms of average number of internodes plant^{-1} except HoTh-332, which produced minimum 23.66 average number of internodes plant^{-1} against check variety Th-10. The results were coinciding with the findings of Unar *et al* (2004). The data regarding cane height given in table-1 reveals that genotype Hoth-316 produced taller canes of 272.20 cm height followed by Hoth-307 and the check variety Th-10 with canes of 262.40 and 267.1 cm height respectively. The remaining all genotypes showed satisfactory performance with respect to average cane height in the experiment. The results are in agreement with Kaloi, *et al.* 2005 and Memon *et al,* (2003).

The data regarding millable canes, presented in table-1 indicates that genotype HoTh-348 remained on top by producing highest 173.33 average millable canes thousand ha^{-1} followed by HoTh-2109 which produced 166.66 average millable canes thousand ha^{-1} while the genotype HoTh-316, HoTh-332 and check variety Th-10 showed at par results by producing 155.00 average millable canes thousand ha^{-1}, where as the other genotypes HoTh-318, HoTh-311 HoTh-344 and HoTh-307 also gave satisfactory results by producing 151.66, 150.00, 146.66 and 122.66 average millable canes thousand ha^{-1} respectively but remained below than that of average millable canes exhibited in check variety Th-10. The results are in accordance with Kaloi, *et al.* 2005 and Unar *et al.* (2005).

The data regarding cane yield depicted in table-1 shows that maximum cane yield of 148.33 t ha^{-1} was recorded from the genotype HoTh-2109 followed by HoTh-332 and the check variety Th-10 with average cane yield of 135.00 and 130.00 t ha^{-1} respectively. While all other genotypes HoTh-307, HoTh-311, HoTh-316, HoTh-318, HoTh-344, HoTh-348 and HoTh-349 also displayed better performance with respect to cane yield but could not surpass check variety Th-10. The results are in agreement with the finding of Kaloi, *et al.* (2005), who reported 155.70, 134.34 and 132.24 t ha^{-1} cane yield in HoTh-326, HoTh-311 and HoTh-2109 sugarcane genotypes respectively in preliminary yield trial at Thatta. Similarly, Unar *et al.* (2005) reported achievable cane yield up to 120 t ha^{-1} in Thatta varieties under agro-climatic conditions of Thatta.

The data regarding quality analysis of the genotypes presented in table-3 reveals that genotypes HoTh-311 gave maximum mean CCS of 14.64% followed by HoTh-2109, HoTh-344, HoTh-348, HoTh-332 and HoTh-349, with mean CCS of 14.61, 14.50, 14.47, 14.36 and 14.16% respectively against check variety Th-10, which produced mean CCS of 14.06. In contrast, the genotypes HoTh-316, HoTh-307 and HoTh-318 showed minimum results by producing mean CCS of 13.98, 12.82 and 13.32% respectively against check. Kaloi *et al.,* (2005) reported 11.08 to 12.87% CCS in different sugarcane genotypes in preliminary yield trial at Thatta. Similarly, Unar, *et al.,* (2005) reported highest CCS of 13.05 and 12.93% in HoTh-127 and HoTh-348 sugarcane varieties under agro-climatic conditions of Thatta.

In order to determine the contribution of yield components on cane yield; correlation study was done. Coefficient of correlation of yield components with the cane yield (Table-3) showed that the cane thickness, cane height and millable cane were positive and highly significant, showing that the increase in these traits resulted simultaneously increase in cane yield, whereas the number of internodes plant^{-1} were positive but non significant. Mehmood *et al.* (1990), Ramdoyal (1991) Janmisar (1988) and Kaloi, *et al.* (2005) also got the highly significant and positive correlation between dependent and independent characters.

The values of correlation of yield components with the cane yield (Table-3) provided the selection criteria and among these, millable cane had the highest value r=0.701 highly significant and positive correlation with can yield. The coefficient of determination (r^2=0.491) for millable canes revealed that 49% increase in cane yield was due to this character. The coefficient of correlation and coefficient of determination values for the cane thickness and plant height were r=0.363 (r^2=0.313) and r=0.510 (r^2=0.260) respectively showed positive and highly significant relation with cane yield. The results are also in agreement with the findings of Afghan *et al.* (1993), Kaloi *et al.* 2005 and Khan *et al.* (2003).

Table-1 Performance of different sugarcane genotypes for cane yield and yield contributing traits in preliminary yield trial at NSCRI, farm Thatta during 2004-05

Genotypes	Cane thickness (mm)	Cane height (cm)	Internodes Plant^{-1}	Millable canes 000 ha^{-1}	Cane yield (t ha^{-1})
HoTh-307	25.78	262.40	33.22	122.66	114.00
HoTh-311	26.24	234.40	25.77	150.00	127.66
HoTh-316	24.61	272.20	27.00	155.00	126.66
HoTh-318	25.61	245.53	25.09	151.66	104.66
HoTh-332	24.63	245.53	23.66	155.00	135.00
HoTh-344	25.70	257.10	27.84	146.66	118.00
Ho Th-348	25.62	257.43	26.33	173.33	129.33
HoTh-349	24.87	244.40	29.11	146.66	123.33
HoTh-2109	25.95	231.43	24.33	166.66	148.33
Th-10	25.36	267.10	23.77	155.00	130.00
CV %	3.01	10.53	12.30	15.55	19.82
LSD 5%	41.53	4.81	53.11	40.62	42.73
LSD 1 %	1.79	6.59	72.76	55.65	58.55

Table-2 **Quality performance of different sugarcane genotypes in preliminary yield trial at NSCRI, farm Thatta during 2004-05**

Genotypes	Month wise commercial cane sugar percent (CCS%)			Mean
	October	November	December	
HoTh-307	13.49	13.80	14.18	13.82
HoTh-311	13.73	14.51	15.68	14.64
HoTh-316	13.72	13.77	14.47	13.98
HoTh-318	12.80	13.30	13.87	13.32
HoTh-332	13.58	14.48	15.02	14.36
HoTh-344	14.30	14.53	14.69	14.50
Ho Th-348	14.13	14.62	14.68	14.47
HoTh-349	13.90	14.03	14.57	14.16
HoTh-2109	13.94	14.57	15.34	14.61
Th-10	13.56	13.94	14.70	14.06

Table-3 **Correlation coefficients (r) and coefficients of determination (r^2) between cane yield and yield contributing parameters of sugarcane genotypes in Preliminary yield trial during 2004-2005 at NSCRI farm, Thatta**

Parameters	Correlation coefficients (r)	Coefficients of determination (r^2)
Cane thickness	0.363**	0.131
Number of internodes/plant	0.062 NS	0.003
Cane height	0.510**	0.260
Millable canes 000/ha	0.701**	0.491

REFERENCES

1. Afghan, S., N.M. Nasir and S.A. Qureshi, 1993. Performance of SPSG-26 A newly developed variety at Shakargang Sugar Research Institute Jhang. Proc. PSST, 140-53.

2. Anonymous, 2004. Agricultural statistics of Pakistan; Ministry of Agriculture Live Stock and Fisheries.

3. Bahadar, K., M. Jamal., M. Sadiq., M. Suleman., H. Azim and M. S. Balouch, 2002. Genetic variation and ecological suitability of new sugarcane genotypes under the agro-climtic conditions of Bannu (NWFP). Pak. Sugar J. Vol. 17: 15-17.

4. Gill, M.B. 1995. Physio agronomic studies on flat versus pit plantation of autumn and spring sugarcane (*Saccharum officinarum*, L.). Ph.D. Agri. Thesis, Department of Agronomy, University of Agri. Faisalabad (Pakistan). pp-49-89.

5. Glaz, B. 2001. Sugarcane variety census; Sugar Y. Azucar. pp. 23.

6. Hensely, S.D., J. Dean., and W.E. Van Danderen, 1973. FAO Report to Government of Pakistan on sugarcane production. Report No. pp. 22.

7. Janmisar, M., 1988. Punjab development statistics Bureau of Statistics, Government of Punjab, Lahore-Pakistan. pp: 101-103.

8. Javed, M.A., I.A. Khan, S.H. Siddiqui, M. Ahmed, N.A. Dahar, M.H. Khanzada and R.Khan, 2001. Performance of promising sugarcane clone, AEC 81-8415 for yield and quality characters II. Stability studies. Pak. J. Bot., 34 (3): 247-251.

9. Kaloi, G.M., A.F. Soomro, D.B. Panhwar, S.D. Junejo, G.S. Unar, A.H. Mari, M Chohan, and M.A. Bhutto. 2005. Preliminary study on Quality and Cane yield Potential of Some newly developed sugarcane Genotypes Under agro climatic conditions of Thatta, Sindh. Indus J. Plant Sci. 4 (4): 502-506.

10. Khan, M.A., H. K. Keerio, S. Junejo, R.N. Panhwar, M.A. Rajput, Y.M. Memon and B.R. Qazi, 2003. Evaluation of Sugarcane genotypes developed through fuzz. Correlation of cane yield and yield components. Pak. J. Applied Sci. 3 (4): 270-273.

11. Mehmood, T., M. S. Nazir, M. Ashfaq and N.A. Chodhery, 1990. Correlation in sugarcane J. Agri. Res, 28: 359-63.

12. Memon, Y.M., H.K. Keerio, R.N. Panhwar, B.R. Qazi, M. A. Rajput, and G.S. Unar, 2003. Yield response of different sugarcane genotypes under agro-climatic conditions of Thatta. Journal of Applied Sci. 4 (1): 90-92.

13. MSTATC Mannual, 1992. Serial No. 1992. Micro-computer statistical programme, Michigan State University, USA.

14. Nazir, M. S., H. Ali, Saeed, M, A. Ghafar and M. Tariq. 1997. Juice quality of different sugarcane genotypes as affected by pure and blend plantation. Pak. Sugar J. 12:4, 12-14.

15. Panhwar, R.N. and Y.M. Memon, 2004. Differential genetic behavior of some newly developed sugarcane genotypes for yield and yield contributing characters under Thatta conditions. Pak. Sugar J. 19 (6): 47-54.

16. Ramdoyal, K, 1991. Genetic correlation and repeatability for agronomic characters in sugarcane Int. 4: 6-12.

17. Sherma, M.L., and T. Agarwal, 1985. Studies on the cane and sugar yield contributing characters in sugarcane cultivars. Indian Sugar, 35 (2): 91-101.

18. Unar, G.S., M. Chohan, Y.M. Memon, S. Junejo, A.A. Yousuf Zai. A.H. Mari, G.M. Kaloi, and B.A. Abro, 2005. Cane yield and quality performance of some exotic and indigenous sugarcane varieties under agro-climatic conditions of Thatta. Indus J. Plant Sci. 4 (1): 7-10.

19. Zafar, M., M. Umar, A.A. Chatha, M.A. Grawal and F. Ahmed 2003. Comparative performance of elite sugarcane clones and advance nursery stage for growth, quality and disease response. Pakistan Sugar. J., 18: 8-12.

GROWTH AND YIELD OF SUGARCANE AS AFFECTED BY VARIOUS WEED CONTROL METHODS

By

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ABSTRACT

The field experiment was conducted to observe the effect of weed control methods on the growth and cane yield of sugarcane variety BL-4 at Sugarcane Section, Agriculture Research Institute, Tandojam, Pakistan. The weed control methods tested were: Weedy Check, Hand weeding, One weeding with spade, Two weeding with spade, One application of Gezapex combi (3.75 kg ha^{-1}), Two applications of Gezapex combi (3.75 kg ha^{-1}), One application of Gezapex combi (3.75 kg ha^{-1})+ one earthing and Two application of Gezapex combi (3.75 kg ha^{-1})+ two earthings. The results showed that all characters studied were highly significant. All the weed control methods recorded higher values of all crop parameters than weedy check. For controlling weeds in sugarcane crop the two weeding with spade was found efficient by recording taller canes, more internodes, higher cane girth, satisfactory brix and maximum cane yield. Thus, chemical application for weed control be minimized and conventional practice of weed control through spade should be performed.

Keywords: sugarcane, BL-4, Gezapex combi, Girth, Brix, Cane, Yield, Weed, Control, Hand weeding, Earthing.

INTRODUCTION

Sugarcane grows well within the latitudes ranging from 30^{o}N to 35^o. Optimum temperature requirements vary from 27 to 38^{o}C. It flourishes in the soil occurring throughout tropics and sub tropics. Deep rich loam and clay loam having good drainage and aeration free from water logging and salinity with pH from 7.0-8.2 are very conducive to higher cane and sugar production (Yadav, 1991). Sugarcane is planted in wide spaced rows and its germination and rate of growth is very slow in the first sixty days of planting. This is the period of active weed emergence which seriously compete with primary cane shoots for nutrients, water and light. However, weed growth starting 3, 6 or 9 weeks after planting reduce the cane yield and must be controlled for healthy crop stand. The weedicides gave the highest cost benefit ratio than manual and mechanical weed control in sugarcane.

Weeds reduce the economic yield and maintenance on cultivation is increased and soil fertility are degraded due to weed problem (Buriro *et al.,* 2003). The weed control treatments significantly increased the yield over the un-weeded control The percentage of commercial cane sugar improved with the application of weed control treatments (Avtar Singh *et al.,* 2001a;b). The number of plant leaves, the stalk density, nor the plant height, stalk yield and sucrose content were not affected by weed control treatments (Esqueda *et al.,* 2001). Pre and post emergence application of weedicides effectively controlled the weeds and produced the highest cane and sugar yield. The weed control measures did not create any significant effect in juice quality and it remained unchanged (Mathew *et al.,* 2002). The weed control treatments had no effect on number of culms per meter at harvest Quintela *et al.* (2002). None of the weed control methods and N rates significantly affected Brix values, and percentages of sucrose, purity, POL and commercial cane sugar (Mahender *et al.,* 2002). The multiple applications of azafenidin during the plant cane and first ratoon years did not reduce stalk height, population, sugarcane yield, or sugar yield for any of the varieties when compared with the standard herbicide program (Viator *et al.,* 2002).

For agricultural production various methods are being used to control the weeds. Afzal *et al.* (1995) reported that Gesapax comb at 2.50 kg ha^{-1} with Surfactant produced highest cane yield of 90.16 t ha^{-1} and was significantly better than rest of the treatments. Mishra *et al.* (2003) reported that pre-emergence application of ametryn with one hoeing at 60 days after planting recorded lower weed flora and higher average cane yield of 149.8 t ha^{-1} followed by 3 manual hoeings at 30, 60 and 90 DAP recorded 146.2 t ha^{-1} cane yield. Chauhan and Srivastava (2002) revealed that Atrazine + 2,4-D at 60 DAP or manual hoeing 45 DAP reduced the weed biomass significantly and was equivalent in efficacy with 3 hoeing. Highest cane yield (73.2 t ha^{-1}) was obtained with manual hoeing. Deho *et al.* (2002) observed that weed control through wheat straw mulch gave the highest germination percentage (74.88%) and cane yield (62.42 t ha^{-1}). Trash mulch was the most efficient in decreasing weed population and dry matter. Weed dry matter accumulation increased with increasing N rates up to 150 kg N ha^{-1} at 80 days after planting and up to 187.5 kg N ha^{-1} at 120 days after planting. In general, increasing N rates resulted in higher weed control efficiency and lower weed index values. The maximum (748.0q ha^{-1}) and minimum (418.8 q ha^{-1}) cane yields were obtained in weed free and weedy control treatments, respectively Mahender *et al.* (2002). However, Singh *et al.* (2001) encouraged the conventional weed control practices and reported that the net profit was highest with conventional practice was higher (Rs.30310), followed by metribuzin + trash mulching (Rs.28272) and atrazine + trash mulching (Rs.27122). Bilalis et al. (2003) suggested that there is the need to adopt weed control practices that precisely, both for economic and environmental reasons. Looking the previous research, it is observed that weeds are plant which compete for nutrients, space, light and exerts lot of harmful effects by reducing the quality as well as quantity of the crop, if, the weed populations are left uncontrolled (Arnold *et al.,* 1988; Evans *et al.,* 2001; Halford *et al.,* 2001). Keeping in view the importance of weed control methods, the present study was undertaken to assess the effect of different cultural as well as chemical weed control practices on the growth and cane yield of sugarcane.

MATERIALS AND METHODS

The Field study was carried out to evaluate the appropriate weed control method and its effects on the growth and yield of sugarcane variety BL-4 at experimental field of Sugarcane Section, Agriculture Research Institute, Tandojam. The experiment was laid out in randomized complete block design with three replications. The treatments were:

T_1=Weedy check,
T_2=Hand weeding
T_3=One weeding with spade
T_4=Two weeding with spade
T_5=One application of Gezapex combi (3.75 kg ha^{-1})

T_6=Two applications of Gezapex combi (3.75 kg ha^{-1})
T_7=One application of Gezapex combi (3.75 kg ha^{-1})+ one earthing
T_8=Two application of Gezapex combi (3.75 kg ha^{-1})+ two earthings

The experimental area was ploughed and leveled properly to achieve good soil and suitable seedbed. When land came into proper condition for sowing. The setts were planted in furrows at a uniform distance of 90 cm between the furrows by putting the setts end to end method. The recommended fertilizer dose i.e. 250-125-125 NPK kg ha^{-1} was applied in three split doses. The first dose i.e. one third was mixed into soil at the time of sowing. Second dose was applied at tillering stage (at first earthing). The third dose was given at second earthing. The one application of weedicide was applied at 2-3 leaves stage of weeds and two applications were made during 2-3 and 10-12 leaves stage. All normal cultural operations and plant protection measures were carried out. The data collected were subject to the statistical analysis of using analysis of variance method. The comparison of treatment means were tested by L.S.D test following the procedures of Gomez and Gomez (1984).

RESULTS

Germination %age

The maximum germination (77.17%) was recorded in the plots treated with two application of weedicides, followed by one weeding with spade (75.91%). However minimum germination (72.98%) was recorded in weedy check field.

Cane length (m)

The cane length varied highly significantly at 1% level of probability due to different weed control methods. The lengthy canes (2.92m) were obtained with two weeding with spade closely followed by two application of weedicide + one earthing which recorded 2.82m cane length. It was noted that weedy check treatment short (2.46m) canes.

Number of internodes per cane

Weed control treatments showed highly significant differences for number of internodes. The internode number were found more (26.80) under two weeding with spade, followed by Two application of weedicide + two earthings (24.87) and one application of weedicide (24.53). The less number of internodes (20.45) were counted in weedy check.

Cane girth (cm)

The girth of cane is one of the main contributing parameter towards the yield of cane which showed significant differences among the tested treatments. The maximum (2.77, 2.75 and 2.71cm) cane girths were recorded in one application of weedicide + one earthing, two weedings with spade and two application of weedicide + two earthing, respectively. However, weedy check plots recorded thin canes.

Number of tillers $stool^{-1}$

Statistically, the number of tillers $stool^{-1}$ were different under various weed control methods. The tiller production was exhibited superior (4.49) with the application of two application of weedicide + two earthings closely followed by (4.35) two weeding with spade and 4.21 tillers $stool^{-1}$ under one application of weedicide + one earthing, respectively. Weedy check plots recorded the less number of tillers (3.21 $stool^{-1}$).

Brix %age

Higher cane yield of any sugarcane variety is not of consideration, if sugarcane recovery is not up to the economically beneficial level. The results statistically indicated that highly significant effect on brix was observed due to weed control methods.

The brix varied among the treatments and highest (20.61, 20.60 and 20.09%) was produced under one weedicide application + one earthing, two weedicide application and two weedicide application + two earthings, respectively. Whereas, other weed control methods showed significantly less brix in the cane.

Cane yield (t ha^{-1})

Cane yield (t ha^{-1}) showed highly significant differences under tested weed control methods. The highest cane yield (97.20 t ha^{-}1) was obtained from two weeding with spade, closely followed by two weedicide application + two earthings and one weedicide application+ one earthing by recording 88.88 and 86.80 t ha^{-1} cane yield. The lowest cane yield (64.25 t ha^{-1}) was noted in weedy check.

DISCUSSION

Weed management means the careful consideration of all available weed control techniques and subsequent integration of appropriate measures that discourage the development of weeds and keep herbicides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment (Farrell *et al.* 2001). The germination, cane length, internodes, cane girth, tillers, Brix and cane yield were affected highly significantly by various weed control methods. It is reported that all weed control methods have superiority over weedy check. The results indicated that two weeding with spade showed better results compared to other weed control methods by recording taller canes, more internodes, maximum cane girth, and highest cane yield. The results were confirmed with the results of number of researchers (Hadizadeh *et al.,* 2002; Pagar *et al.,* 1995; Giri *et al.,* 1998; Turkhede *et al.,* 2002 and Askew and Wilcut, 2002) all had consolidated experience that hand weeding/manual weeding and interculturing practices proved to be most effective in controlling weeds. Further, Sathyavelu *et al.* (2002) reported that three disc harrowing gave the highest weed control efficiency. Mishra *et al.* (2003) found that higher cane yield was obtained from application of anetryn with one hoeing. Next best treatment was three manual hoeings which also recorded better cane yield. Attalla and Sogheir (2003) revealed that hand hoeing four times was superior for control of weeds and improvement of cane yield. Chauhan and Srivastava (2000) observed the highest cane yield with manual hoeing.

CONCLUSIONS

It is concluded that all characters studied were statistically highly significant under tested weed control methods. The highest cane yield was found with two weeding with spade. The plots left un-weeded exhibited poor growth of the crop which in turns recorded less cane yield.

Table-1 Sugarcane characters under weed control methods

Weed control methods	Germination (%)	Cane Girth (cm)	Tillers ($Stool^{-1}$)	Brix (%)	Cane yield ($t\ ha^{-1}$)
Weedy check	20.45n f	2.44 c	3.21 e	19.66 d	64.25 d
Hand weeding	23.04 e	2.46 c	3.28 ef	19.81 cd	68.30 cd
One weeding with spade	20.99 f	2.35 bc	3.24 f	19.70 d	74.50 c
Two weeding with spade	26.80 a	2.75 a	4.35 ab	20.09 bc	97.20 a
One application of Gezapex combi (3.75 kg ha^{-1})	24.53 c	2.55 bc	3.37 e	19.77 cd	72.50 cd
Two applications of Gezapex combi (3.75 kg ha^{-1})	24.44 c	2.59 b	3.67 d	20.66 a	74.60 c
One application of Gezapex combi (3.75 kg ha^{-1}) + one earthing	23.27 d	2.77 a	4.21 c	20.61 a	86.70 b
Two applications of Gezapex combi (3.75 kg ha^{-1}) + two earthing	24.87 b	2.71 a	4.49 a	20.19 b	88.88 b
SE	0.0616	0.0374	0.0436	0.1269	0.9008
LSD(5%)	0.1812	0.1100	0.1283	0.373	2.6497
LSD (1%)	0.2465	0.1497	0.1746	0.5080	3.6051

REFERENCES

1. Afzal, M., A. Gill, K. B. Malik, M. A. Bajwa and S. Ahmed. 1995. Efficacy of Gezapax combi with surfactant triton for the control of weeds on sugarcane. Weed management for sustainable Agriculture. Proceedings of 4th All Pak. Weed Sci. Conf. March, 27-27, 1994, pp 213-217.

2. Arnold, R. N., M. W. Murray, E. J. Gregory and D. Smeal. 1988. Effects of herbicides on weeds in field corn grown on coarse-textured soils. J. Appl. Agric. Res., 3:121-23.

3. Askew, S. D. and J.W. Wilcut. 2002. Ladysthumb interference and seed production in cotton. Weed Science. 50: 326-332.

4. Avtar Singh, A. S. Svirk, Jayesh Singh, Jasvinder Singh, A. Singh, J. Singh and J. Singh. 2001a. Comparison of pre and post-emergence application of herbicides for the control of weeds in sugarcane. Sugar Tech. 3:109-112.

5. Avtar Singh, A. S. Svirk, Jayesh Singh, Jasvinder Singh, A. Singh, and J. Singh. 2001b. Efficacy of new herbicide for the control of weeds in sugarcane. Cooperative Sugar. 33:315-316.

6. Bilalis, D., N. Sidiras, G. Economou and C. Vakali. 2003. Effect of different levels of wheat straw soil surface coverage on weed flora in Vicia faba crops Journal of Agronomy and Crop Science. 189: 233-241.

7. Buriro, U. A., F. C. Oad, S. K. Agha and G. S. Solangi. 2003. Post emergence weed control in wheat. Pakistan J. Applied Sci., 3: 424-427.

8. Chauhan, R. S., and T. K. Srivastava. 2002. Influence of weed management practices on weed growth and yield of sugarcane. Ind. J. of Weed Sci. 34:318-319.

9. Deho, Z. A., S. D. Tunio, Y. J. Minhas and H. I. Majeedano. 2002. Effect of mulching technique on the growth and yield of sugarcane. Pak. Sug. J. 17:22-26.

10. Esqueda, V. A., L. Altamirano, Y. Hernandez and A. Lopez. 2001. Evaluation of the mixture ametryn + clomazone on sugarcane. Agronomia Mesoamericana. 12:161-167.

11. Evans, J. O., P. Hauderlie and R. W. Williams. 2001. Control of common lambs quarters in Roundup ready corn. W. Soc. Weed Sci., Res. Prog. Rep.

12. Farrell, J.A., G.E. MacDonald and B. J. Brecke. 2001. Weed management in cotton-2006. University of Florida IFAS Extension. Pp. 1-32.

13. Giri, A.N., R.H. Bhosle and D.K. Shelke. 1998. Weed management in cotton *Gossypium hirsutum* groundnut (Arachis hypogaea) sequence. Indian Journal of Agronomy. 43: 50-56.

14. Gomez, K. A. and A. A. Gomez. 1984. Statistical procedures for Agricultural Research (2nd ed.) John Welly and Sons, New York.

15. Hadizadeh, M.H., S. Noroozzadeh and H. Rahimian. 2002. Effect of row spacing and weed free period on yield and yield components of cotton *Gossypium hirsutum* L. Applied Entomology and Phytopathology. 69:171-187.

16. Halford, C., A. S. Hamill, J. Zhang and C. Doucet, 2001. Critical period of weed control in no-till soybean (Glycine max) and corn (*Zea mays*). S.Weed Technol., 15:737-744.

17. Mahender Singh, M. S. N. L. Srivastava, Subhash Cnahder, M. Singh and S. Chander. 2002. Effect of weed control methods and nitrogen levels on density and dry matter accumulation of weeds and yield and quality of spring planted sugarcane. Ind. J. of Weed Sci., 34:146-149.

18. Mathew, T., D. Alexander and G. Jayakumar. 2002. Screening of herbicides for effective weed control in spring planted sugarcane. Cooperative Sugar. 33:741-742.

19. Mishra, P. J., P. K. Mishra, S. Biswal, S. K. Panda and M. K. Mishra. 2003. Studies on integrated weed management practices in spring planted sugarcane of coastal Orissa. Indian Sugar. 52:925-929.

20. Pagar, P.C., H.J. Rajgire, S.O. Darange and V.J. Nikam. 1995. Impact of integrated weed management on yield of rainfed cotton *Gossypium hirsutum* L. Journal of Soils and Crops. 5:650-162.

21. Quintela, A. C. R., L. A. Andrade de B, J. B. D. Correa, P. M. Resende, G. G. Vieira and P. M. Resende. 2002. Control of weeds in sugarcane (cultivar RB835089) in an integrated system of straw, herbicide and vinasse. STAB- Acucar, Alcool-e-Subproudtos. 20:38-42.

22. Turkhede, AB, R.N. Katkar, V.M. Solanke and S.T. Wankhade. 2002. Integrated weed management in cotton. 23:397-401.

23. Viator, B. J., J. L. Griffin and J. M. Ellis. 2002. Sugarcane (*Saccharm* spp.) response to azafenidin applied pre-emergence and post-emergence. Weed. Tech., 16: 444-451.

24. Yadav, J. P. 1991. Sugarcane. Krishna Pub. Bombay, India: 23: 200-206

BIOCONTROL OF INSECT PESTS OF SUGARCANE (*SACCHARUM SP.*)

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ABSTRACT

Sugarcane (*Saccharum* sp.) crop is habitat of more than 1500 species of insects in the sugar world. Amongst these borers like *Scirpophaga excerptalis*, *Chilo infuscatellus*, *Emmalocera depresella*, *Acigona steniellus* and sucking insect pest *Pyrilla perpusilla* are major devastators to cause considerable loss in yield and quality of the crop. In our country primary and secondary insect pests species identified were 11, while parasites and predators species were 14 in cane fields. Studies revealed that with 75 % infestation of borers, sucrose recovery was 52 % lower. Field data on infestation of *Pyrilla perpusilla* showed that decline in cane yield was 18%. Biocontrol of insect pest of sugarcane crop through artificial rearing of *Trichogramma chilonis* was initiated from 1999 and for *Chrysoperla carnea* from 2002 at the institute. Results of the field studies revealed that under unreleased area of *Trichogramma chilonis,* the infestation of borers was 11.65% and in the released area it was 2.74 %. The acreage covered with the released of the parasites was more than 50 thousands from last five years in cane growing areas of Shakarganj Mills. It was observed that under controlled conditions *Chrysoperla carnea* larvae predated 80% eggs of *Pyrilla perpusilla*. Efficiency of biocontrol of the insect pest can be improved only with integrated management practices of the crop identified, these are resistant varieties, alternate planting dates, trash blanketing of ratoon crop, early harvesting, balanced fertigation, pest-free seed cane and field monitoring.

INTRODUCTION

More than 1500 species of insects feed on sugarcane plant recorded throughout the world (Box, 1953). A list of about 800 records of parasitoids, predators and pathogens of the 24 key moth borers in Asia and the Indian Ocean islands was complied, with information on the host stage they attack, host plant or crop and country of record (Sallaman and Allosopp, 2005). It was reported that about 48 species from Indo-Pakistan subcontinent feed on crop (Rehman, 1942). About a dozen of important insects pests have been mentioned from Pakistan (Chaudhry and Ansari, 1988) as well as from province of Sindh (Naqvi, 1975). Amongst them, the borers and leafhoppers are major devastators; those consequently reduce the quality and quantity of cane and cane sugar. Biological control is extensively used in the sugarcane growing regions of South America. In Brazil, the tachinid larval parasitoids, *Metagonistylum minense* (Tns.) and *Paratheresia claripalpis* (Wulp.) and the braconid *Cotesia flavipes* (Cameron) have been routinely released for the control of *D. saccharalis* (IS). Since 1988, parasitoid releases have reduced the infestation intensity from as high as 10% to an average, in 1994 to about 3% (Anon, 1997). Similarly in Venezuela, Diatraea spp. occurring there were no longer considered of consequence because of good biological control. This has been achieved initially by releasing the larval parasitoid *M. minense*. Later, *C. flavipes* was released providing more effective control. It was observed that 16% infestation was recorded in 1947 and in 1996 this infection was only 2% (Salazar, 1997). In Colombia, artificially reared larval parasitoids *M. minense* and *P. claripalpis* have been effective against *D. saccharalis* and *D. indigenella*. Egg parasitoids have also been released. Both *Trichogramma pretiosum* (Riley) and *T. exiguum* have been released; however, no field recoveries have been made of *T. pretiosum*. (Gomez, 1995). In Mexico, biological control is one of several strategies adopted for the control of borer complex, which comprises three species of a Diatraea as well as *E. loftini*. The indigenous parasitoid, *Allorhogas pyralophagus* (Marsh), has limited impact, but releases of *M. minense* have had some influence on damage (Pantoja, 1997). In North America, recent attempts have focused on two species of *Cotesia,* viz: *C. flavipes* and *C. chilonis* (Ishii). Although these parasitoids have not yet become established, levels of parasitism by *C. flavipes* and *C. chilonis* were as high as 15% and 55%, respectively (White and Regan, 1999).

There are many borers of sugarcane in the Far East and Australian region. Releasing the egg parasitoid *T. chilonis* reduced infestations of the borer *Argyroploce schistaceana* (Sn.) in Taiwan. Other examples include> 80% parasitism of late instar larvae of the borer *S. grisescens* in Papua New Guinea by *C. flavipes*, and the effective parasitism of *Chilo infuscatellus* (Sn.) by *Trichogramma* sp. in Indonesia (Conlong, 1994a). An extensive biological control programme has been implemented against *E. saccharina* in South Africa. While in many cases successful laboratory rearing has been achieved and field recoveries made; however, their impact on crop damage has not been clear. Currently, the tachinid parasitoid *Sturmiopsis parasitica* (Curr.) has been released and recoveries have been made (Conlong, 1994b). Similarly, a large programme was developed in Mauritius against *C. sacchariphagus*. Since 1939, 30 egg, larval and pupal parasitoids were introduced into Mauritius against this borers. However, only *Xanthopimpla stemmator* (Thun.) and *Trichospilus diatraeae* became established, and neither had an impact on the borer (Conlong, 1998c). It was reported that in Egypt egg parasitoid *Trichogramma lnescens* (West) contributed significantly to the control of this borers. A reduction in the infestation level of between 50% and 60% was achieved at a release rate of 20 000-30 000 per feddan (1 feddan = 0.42 ha) (Williams, 1983).

Different management practices have been applied to borer control in various regions of sugarcane world. Host plant resistance is an important component of any strategy aimed at reducing the economic impact of crop pests. It is based on three factors: antibiosis, antixenosis, and tolerance (Dent, 1991). Antibiosis is based on the plant inhibiting the development of the feeding insect, while antixenosis acts by influencing adult and / larval behaviour on the surface of the host plant. Most studies have focused on antibiosis, although pubescence in sugarcane can be important (Sosa, 1988). Selecting planting date was to reduce damage to the crop caused by *S. cretica* in the Sudan (Amin, 1988). Moreover, crops planted towards the end of the dry season in Papua New Guinea tended to be more heavily attacked by *Sesamia grisescens*, so this practice is now avoided. The planting of a trap crop of maize was shown to influence infestations of *S. calamistis* in Mauritius (Williams, 1983 and Khan *et al.,* 1997). Early harvesting and balanced fertilization has reduced the impact of *E. saccharina* on sugarcane in South Africa (Carnegie, 1981). However, no clear effect of burning the crop at harvest has been proven, unless the crop is severely infested and has suffered drought stress. Under these conditions, trash-blanketing field can reduce damage in the ratooning crop. Using non-infested seed materials when planting is an important aspect of crop hygiene that can help reduce the possibility of a pest becoming established in a crop (Kuppen and Leslie, 1999). In Guyana, it was reported that flash flooding insect pest of sugarcane crop fields for 48 h 2-3 weeks after harvest is the most common procedure used against *Castniomera licus* (Drury) (Duke and Eastwood, 1997). Whatever the monitoring method used, depend on the level of precision and evaluating the results (Southwood, 1975).

The insect pests classified as primary and secondary on the basis of infestation are given in table-1. Parasites and predators that could be used successfully against the insect pests of sugarcane crop are given in table-2.

Table-1 Primary and secondary insect pests of sugarcane crop

Sr. No.	Common name	Technical name
	Primary	
1	Sugarcane top borer	*Scirpophaga excerptalis* Wlk. *S. Nivella* Fab.
2	Sugarcane stem borer	*Chilo infuscatellus* Snell.
3	Sugarcane root borer	*Emmalocera depressella* Swin.
4	Sugarcane leaf hopper	*Pyrilla perpusilla* Wlk.
5	Sugarcane white fly	*Aleurolobus barodensis* Mak.
	Secondary	
6	Sugarcane stem borer	*(Sesamia inferens* Wlk. *(Chilo partellus* Swinh).
7	Sugarcane black bug	*Cavelerius excavatus* Dist.
8	Sugarcane mealy bug	*Ripersia sacchari* G.
9	Sugarcane thrips	*Fulmekiola serrata* Kobus. *Haplothrips* sp.
10	Sugarcane (White ants)	*Microtermes obesi* Holmgren
11	Sugarcane mites	*Oligonychus* sp. *Schizotetranychus* sp.

(Khanzada, 1993)

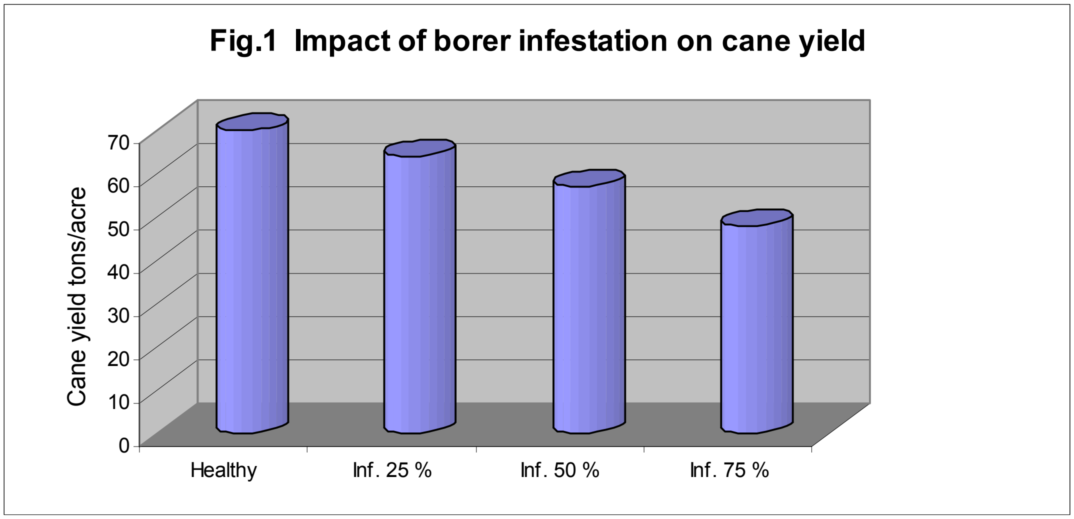
Table-2 Parasites and predators of insect pests of sugarcane crop

Sr. No.	Name of parasite/predator	Name of pest – host	Nature of parasitism
1	*Trichogramma chilonis*	Stem borer	Egg
	"	Root borer	"
2	*Apantles* (Cotesia) *flavipes*	Top, stem & root borers	Larvae
3	*Elasmus zehntneri*	Top borer	"
4	*Telenomus dignus*	Top borer	"
5	*Coccinella septempunctera*	All borers	Eggs
6	*Epiricania melanoleuca*	*Pyrilla*	Nymph and adults
7	*Pyrilloxenos compactus*	"	"
8	*Tetrastichus pyrillae*	"	Eggs
9	Spiders	"	All stages
10	*Chrysopa* sp.		Egg and nymph predator
11	*Coccinella septempunctera*		Egg predators
12	*Azotus sp.*	White fly	Nymph and pupae
13	*Encarsia*		Pupae
14	*Chrysopa* and *Coccinella* species		Predator

(Khanzada, 1993)

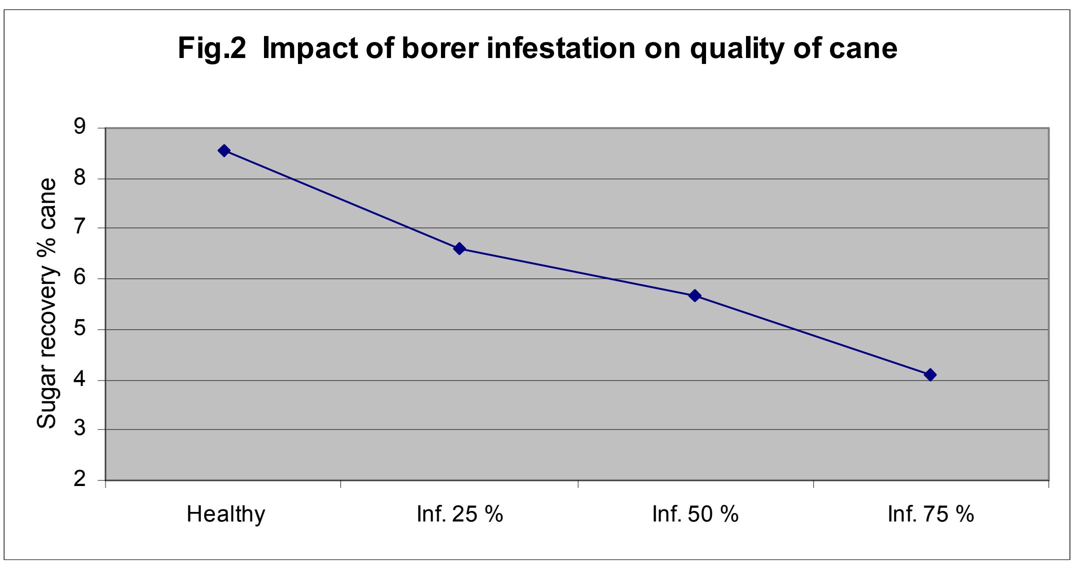
Impact of borers infestation on yield of sugar cane crop

Results of an experiment conducted on impact of borers infestation on cane yield during 2002-2004 are given in Fig.1. It was observed that cane yield of 70 tons per acre was harvested from healthy crop, while losses cane yield was 9, 19 and 31 with borer infestation of 25 %, 50 % and 75 %, respectively.



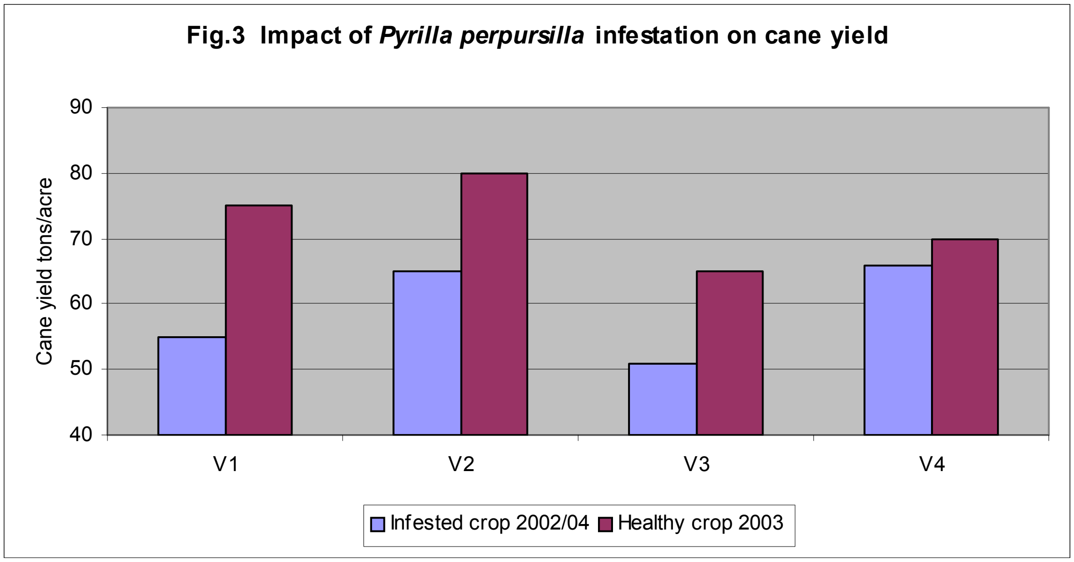
Impact of borers infestation on quality of cane crop

Another experiment was conducted on impact of borers infestation on quality of cane crop (Fig.2). Infestation of borer complex was recorded on internode basis. Quality analysis (sugar recovery % cane) of the crop having infestation of 25 %, 50 %, and 75 % was done from October to April of 2002-04. Results indicated that sugar recovery % cane of healthy crop was 8.56. Decline in sugar recovery was 22, 34, and 52 % with borers infestation of 25, 50, and 75 %, respectively.

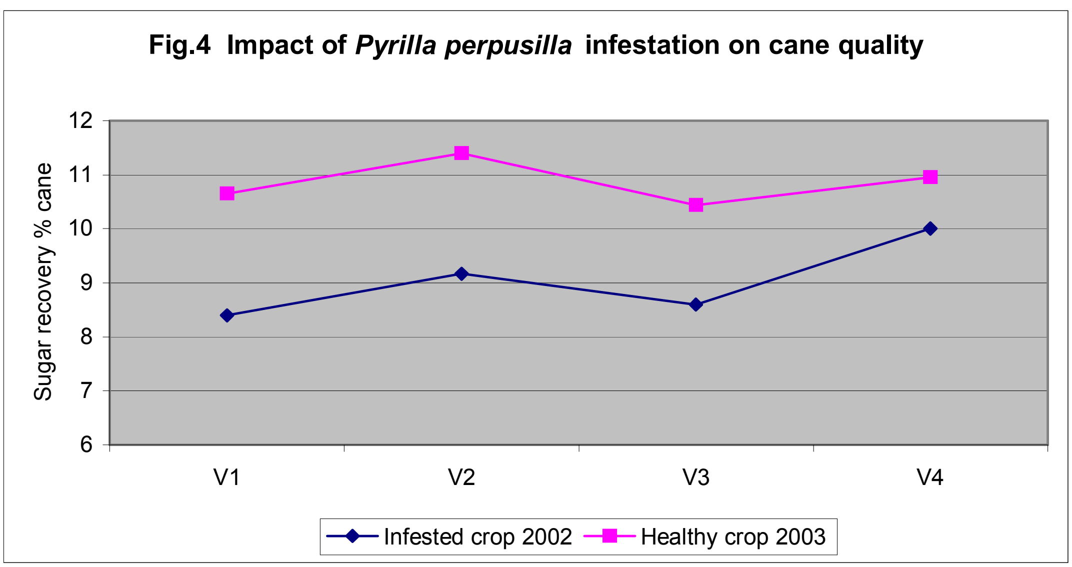


Impact of *Pyrilla perpusilla* infestation on yield of sugar cane crop

Observations on yearly basis were recorded on impact of *Pyrilla perpusilla* infestation on cane yield during 2002, 2003 to 2004 infestation year (Fig. 3). It was observed that all varieties of sugarcane tested, behaved differently during infestation and non-infestation years. The maximum cane yield decline to 20 tons per acre in variety V1 and minimum cane yield decline of 4 tons was recorded in variety V4. An average loss of 13.3 tons per acre yield was recorded due to *Pyrilla perpusilla* infestation.



Impact of *Pyrilla perpusilla* infestation on quality of cane crop
Overall season sugar recovery was recorded during *Pyrilla perpusilla* infestation year (2002) and infestation free year (2003). The results indicated that different varieties behaved differently to loss of sugar recovery % cane. Variety V4 showed stability in its quality during both the years. Maximum loss of sugar recovery % cane was recorded in V1 followed by V2. The variety V4 was relatively resistant to *Pyrilla perpusilla*. Data recorded on impact of *Pyrilla perpusilla* infestation on quality of cane varieties is given in fig.4.



Background
Chemical control of insect pests of sugarcane has given non-significant results and has added higher costs to production. Natural enemies particularly insect parasitoids are important components of control strategies used against borers in most industries of sugar world (Padmanabhan *et al*., 1992). Keeping this in view, biocontrol of insect pest was started, with an aim to develop environment friendly, low cost and efficient control of insect pest of

sugarcane crop. It was observed that infestation of borers was high in humid years and infestation of *Pyrilla perpusilla* was severe during dry years. This variation has provided conditions to establish relationship between infestation of the pest and its impact on cane yield and quality. The evaluation period was 1999 to 2004.

Location

The Biological Pest Control Laboratory of Shakarganj Sugar Research Institute (SSRI) of *Trichogramma chilonis* for control of borer complex was established in 1999 and *Chrysoperla carnea* for control of borers and *Pyrilla perpusilla* was established in 2002. This predator and parasitoids are being released for control of the insect pests of sugarcane crop. The studies on efficacy of the parasitoids and the predators were performed in collaboration with Vice President Agriculture Shakarganj Mills Limited Jhang. Data was collected for five years (1999-04) for infestation % of borers in unreleased and released areas of *Trichogramma chilonis.*

Sampling

Infestation % of borers in both released and unreleased plots with *Trichogramma chilonis* was taken by sampling from March to September each year. Nymph of *Pyrilla perpusilla* per stalk and larvae of borers on internode basis were counted in a randomly selected block of 20 x 20 m. Quality analysis for sugar recovery % cane of healthy and infested samples of borers was done from October-April.

Rearing of Host and Parasites

Trichogramma chilonis has proved most effective egg parasite against root, shoot and stem borers. Millions of parasitised eggs were released at different interval in the field. A store grains pest *Sitotroga cerealella* is a good alternate host of *Trichogramma chilonis* and has a capacity to breed a large population in shortest possible time in the laboratory.

Sitotroga is reared of the laboratory, under controlled environment. Its eggs are collected and pasted on cards. *Sitotroga* eggs, act as host of *Trichogramma.* Cards are placed in plastic jars and eggs *of Sitotroga* are parasitized by *Trichogramma chilonis.*

Release of *Trichogramma chilonis* for control of borer complex

As and when required, cards are taken to the field and punched on the under surface of leaves to avoid direct exposure to sunlight. In 2-3 days *Trichogramma chilonis* in infested eggs complete their life cycle and adults come out of eggs. *Trichogramma chilonis* search out the eggs of borers and lays their own eggs through ovipositor. *Trichograma chilonis* has wide chance to spread its generation on sugarcane, maize and rice borer. The eggs of borers are parasitized, and *Trichograma chilonis* complete its life cycle in borer eggs. Parasite has start life cycle of 7-8 days, thus releases must coincide with the presence of host (insect) eggs in the field. A cyclic chain of *Trichograma chilonis* parasitism is developed in cane fields. In favorable environments, 70-80% borer's eggs parasitism is noticed which bring down the pest population to less than 5%. In unfavorable conditions more frequent releases are required to establish parasitism in the cane fields. This is the cheapest, efficient and environmental friendly method of borer control.

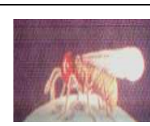
Highly significant control of borers infestation was established through periodic release of *Trichogramma chilonis* in cane growing areas of Shakarganj Mills Limited, Jhang. The results have indicated that the infestation of borers was 11.65 % during 1999-2000 in unreleased area and 2.75 % in released area. Periodic increase in acreage of *Trichogramma chilonis* applications was done in the area. After five years during 2003-2004 infestations of borers was 6.05 % in unreleased area and 1.73 % in released area. The results have indicated that application of *Trichogramma* is useful, efficient and environment friendly. Detail of acreage covered through release of *Trichogramma* for control of borers infestation is given in table-3.

Table-3 Acreage covered and impact of *Trichogramma chilonis* on infestation of borers complex in released and unreleased areas (1999-04)

Year	**Acreage**	**Infestation %**	
		Released area	**Unreleased area**
1999-2000	12131	2.74	11.65
2000-2001	36607	2.13	8.21
2001-2002	41497	1.86	7.86
2002-2003	50998	1.65	7.31
2003-2004	62518	1.73	6.05

(2.47 acres = 1 hectare)

Steps involved in lab rearing of *Trichogramma chilonis*.

Step 1	Rearing of *Sitotroga* (wheat grains)	
Step 2	Rearing condition: Humidity 60-70%. Temperature 28-30°C	
Step 3	28-30 days of emergence Shifted for egg laying in the jars	
Step 4	Collection of Sitotroga eggs	
Step 5	Pasting of 1500 eggs on paper card 3”×2”	
Step 6	Parasitism by *Trichogramma chilonis*	
Step 7	Collection of parasitized *Sitotroga* eggs	
Step 8	*Trichogramma* cards were stored at a Temperature of 6-8C°. Distributed: March to September	
Step 9	Monitoring based field releases of *T. chilonis* for biocontrol of borer complex	

Studies on efficacy of *Chrysoperla carnea*

Chrysoperla carnea commonly known, as *Chrysopa* is the most effective predator. It is utilized for the control of borers complex and *Pyrilla perpusilla* of sugarcane crop. It has the same host (*Sitotroga*) as *Trichogramma chilonis*. *Chrysoperla carnea* has the peculiarity of eating eggs, larvae and nymphs of all types of borers, *Pyrilla*, white fly, bugs and mites. It can be reared and released in all seasons. Rearing of *Chrysopa carnea* is more technical, expensive and time consuming.

Lab. studies conducted at SSRI, has shown that *Chrysoperla* larvae of 7-8 days life period has given 80 % predation to the eggs population of *Pyrilla*. In another study at the lab of the institute indicated that through release of *Chrysoperla* larvae, 65 % mortality of nymph of *Pyrilla perpusilla* was recorded.

The following steps were involved in lab rearing of *Chrysoperla carnea*.

Rearing of *Sitotroga* eggs Temperature 27-30 ^{o}C Humidity 60-70 %	
Freezing of *Sitotroga* eggs	
Filling of 1/3 of capsules by *Sitotroga* eggs + 2 eggs of *Chrysoperla carnea*	
Singling of hatched larva Refilling with *Sitotroga* eggs	
Pupal formation Opening of capsules	
Transfer of *Chrysoperla carnea* adults in glass cages	
Artificial feeding of Adults 150-200 adults per cage	
Egg laying on hard paper sheet Duration24 hours	
Field release Hatching after 3-4 days)	
Attack of the *Chrysoperla* larvae of third instar on target pest of sugar cane borers and *Pyrilla* (all stages)	

RECOMMENDATIONS

- Field applications of *T. chilonis* cards and *C. carnea* sheets should be pest scouting based
- Efficiency of biocontrol could be increased with trash blanketing, balanced fertigation, pest-free seed and appropriate field monitoring
- Efforts are now required to develop transgenic plants of sugarcane for resistance against major infesting insect pests like borers and *Pyrilla perpusilla*
- All the sugar mills should immediately establish *T. chilonis* and *C. carnea* rearing labs. *T. chilonis* cards and *C. carnea* sheets produced should be given on highly subsidized price to cane growers.

REFERENCES

1. Amin, E. M. (1988). Some aspects of the ecology of the stem borer *Sesamia cretica* Led. In sugarcane and sorghum in the Sudan. Beitrage zur tropischen Landmirtschafi und Veterinarmedizin, 26 (1): 33-37.

2. Anon. (1997). Centro de Technologia Copersucar Annual Report for 1996-1997. copersucar, Brazil.

3. Box, H. F. (1953). List of Sugar Cane Insects. London common: Ins. P.101.

4. Carnegie, A. J. M. (1981). Combating *Eldana saccharina* (Lepidoptera: Pyralidae): a progress report. Proceedings of the South African Sugar technologists Association, 55, 116-119.

5. Chaudhry, N. A., and Ansari, M. A. (1988). Insect Pests of Sugar Cane in Pakistan. Progressive Farming, 8(4): 10-18.

6. Conlong, D. E. (1994a). Biological control in sugarcane. In: Proceedings of the Third International Conference on Tropical Entomology (ed R. K. Saini), pp 73-101. ICIPE Science Press, Nairobi, Kenya.

7. Conlong, D. E. (1994b). A review and perspectives for the biological control of the African sugarcane stalk borer *Eldana saccharina* Walker (Lepioptera: Pyralidae). Agriculture Ecosystems Environment, 48, 9-17.

8. Conlong, D. E. (1998c). Field surveys, In: Progress Report of the Entomology Department 1998-1999. SASA Experiment Station Internal Report, Mount Edgecombe, Durban, South Africa.

9. Dent, D. (1991). Host plant resistance. In: Insect Pest Management, pp.213-292.

10. Duke, N. H. and Eastwood D. (1997). Production losses in sugarcane attached by the giant borer *Castniomera licus* (Drury) Lepidoptera: Castniidae in Guyana. Proceedings of the West Indies Sugar Technologists Association, 26: 169-176.

11. Gomez, L. A. (1995). Pre-congress forum discussion papers. Forum A. 1 Plant Health. International Sugar Journal, 97 (1161): 488.

12. Khan, Z. R., Chiliswa, P. and Among-Nyarko, K. (1997). Utilization of wild gramineous plants for management of cereal stem borers in Africa. Insect Science and its Application, 17 (1): 143-450.

13. Khanzada, A. G. (1993). Pest management in sugarcane: an un-abridged review. Pakistan Sugar Journal. 7(2): 11-18.

14. Kuppen, J. P. and Leslie, G. W. (1999). The use of the fumigant methyl bromide in the control of the sugarcane borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae) in seed cane. Proceedings of the Twelfth Entomological congress of the Entomological Society of Southern Africa.

15. Naqvi, K. M. (1975). Important Insect Pests of Sugar Cane Crop in Sindh. Sugar Cane Crop Seminar. Representation and Recommendations, Ciba Geigy: 67-70.

16. Padmanabhan, M. D., John, A. H., Raja, A., Natarajan, S. and Rajashekaran, S. (1992). Bioefficacy of endosulfan for the control of shoot borer of sugarcane, Chilo infuscateleus Snellen, Bharatiya Sugar, 21: 61-64.

17. Pantoja, N. (1997). In: report on the Third International Society of Sugar Cane Technologists Entomology Workshop, Culian, Mexico (eds G. W. Leslie and M. G. Keeping). SASA Experiment Station International Report, Mount Edgecombe, Durban, South Africa.

18. Rehman, K. A. (1942). Parasites of Insect Pests of Sugar Cane in the Punjab. Ind. J. Agric. Sci. II. (1): 119-128, Delhi 1941. RAE (A): 30: 220-221.

19. Salazar, J. (1997). In: Internal SASEX Report on the third International Society of Sugarcane technologists Entomology Workshop, Culian, Mexico (eds G. W. Leslie & M. G. Keeping). Copersucar, Brazil.

20. Sallaman N. M. and Allosopp P. G. (2005). Preparedness for borer incursion: an Australian experience. Proc. ISSCT vol. 25 pp.735-739.

21. Sosa, O. (1988). Pubescence in sugarcane as a plant resistance character affecting oviposition and mobility by the sugarcane borer (Lepidoptera: Pyralidae). Journal of Economic Entomology, 81 (2), 663-667.

22. Southwood, T. R. E. (1975). Ecological Methods. Chapman and Hall, London.

23. Williams, J. R. (1983). The sugar cane stem borer (Chilo sacchariphagus) in Mauritius. Revue Agricole et Sucriere dei'lleMaurice, 62, 5-23.

24. White, W. H. and Regan, T. E. (1999). Biological control of the sugarcane borer with introduced parasites in Louisiana. Sugar Journal, 9, 13-17.

COMPARATIVE STUDY OF SOME PROMISING SUGARCANE VARIETIES AT ARI, D. I. KHAN

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ABSTRACT

The response of total 36 varieties [18 from Mardan selection (NWFP) and 18 from Punjab] was studied at Agricultural Research Institute (ARI), D. I. Khan during 2003-04 for cane yield and sugar recovery %age. A new candidate variety MS92-CP-176 gave significantly higher cane yield of 87 t ha^{-1} followed by MS-91-CP-691, MS92-CP-716 & MS92-CP-434 with the cane yield of 73, 72 and 71 t ha^{-1} respectively from Mardan selection while among the varieties from Punjab, SPF-213 exhibited the highest cane yield of 76 t ha^{-1}, followed by varieties HS-185 and MT-70 with cane yield of 74 and 72 t ha^{-1} respectively. In case of sugar recovery variety BU-1, MS92-CP-434, CP-88/1912 and MS92-CP-727 showed the highest sugar recovery of 11.19, 11.11, 10.96 and 10.94% respectively. While among the varieties from Punjab the highest significant sugar recovery was recorded in BU-1 (11.47%) which was closely followed by HSF-240 (11.02%) and CPF-237 (11.00%).

Keywords: Sugarcane, Cane yield, Sugar recovery, Mardan Selection, Punjab Selection

INTRODUCTION

Sugarcane has occupied the place of major cash crop in Southern zone of NWFP (Khan Bahadar *et al* 2004). It certainly plays a vital role in the economy of such a poor & backward area. Sugarcane being an important cash & industrial crop has occupied a significant position in the economy of Pakistan. The need and importance of sugarcane is increasing day by day due to rapid increase in human population in Pakistan.

Besides sugar manufacturing, it also provides byproducts for several other industries & thus creates employment opportunities in various sectors. Being a major source of sugar production, sugarcane also adds to national economy through foreign exchange. World 65% sugar is produced from sugarcane Deho, *et al* (2002).

Pakistan ranks fifth in sugarcane cultivation & sixth in sugar production. Aslam *et al* (2001) indicated the national average cane yield as 47 t ha^{-1} & assumed that improved yield can be achieved through evaluation of new varieties under various agro climatic conditions. The average cane yield of NWFP is 46.30 t ha^{-1} as against the world average i.e. 63.70 t ha^{-1} with average sugar recovery of 10.60 %. Khisro *et al* (2001). Chatta *et al* (2001) reported the average cane yield of Punjab as 47 t ha^{-1} & compared it with the average cane yield of improved varieties i.e. 90-100 t ha^{-1} & its potential yield of 105-154 t ha^{-1}. This reflects the wide scope & role of new varieties under the exiting resources

Bakhash *et al* (2001) reported conventional planting system as the major cause for lower yield of sugarcane. He reported the overall average yields of 50-70 t ha^{-1} with sugar recovery of 9.5% in Sindh. He also reported the highest yield of above 150 t ha^{-1} with sugar recovery of 11.00% in lower Sindh through the adaptation of new high yielding varieties. Thus through the evolution of new high yielding varieties at the research stations & their adoption by the farmers we can increase the national average yield of sugarcane.

MATERIALS AND METHODS

The performance of total 36 promising varieties of sugarcane (18 from Mardan selection (NWFP) & 18 from Punjab) sown in two separate trials & treated uniformly was studied at Agricultural Research Institute, D. I. Khan during the years 2003-04. The trials were sown in randomized complete block designs with three replications & plot sizes of 5x5x0.75=18.75m^2 in the month of September. The trials were harvested in the month of Feb.2005 & the harvested plot size was 5x5x0.75=18.75m^2. All the recommended cultural practices & inputs level were applied to both the trials uniformly & at appropriate stages.

Data & observations regarding the cane yield and sugar recovery % were recorded at different intervals. Data on cane yield (t ha^{-1}) and sugar recovery (%) were analyzed statistically using LSD test @ $p<0.05$. The data are given in tables 1, 2 and 3.

RESULTS AND DISCUSSION

Cane Yield (t ha^{-1})

The data revealed significant difference in cane yield (t ha^{-1}) (Table-1 & 2). It is evident from table-1 (Mardan selection) that variety MS92-CP-176 gave significantly highest cane yield of 87 t ha^{-1}, followed by MS91-CP-691, MS92-CP-716, and MS92-CP-434 with cane yield of 73,72,71 t ha^{-1} respectively & were at par with MS92-CP-176. According to table-2, SPF-213 gave the highest cane yield of 76 t ha^{-1} followed by HS-185 & MT-70 with cane yield of 74 & 72 t ha^{-1} respectively, as against the lowest cane yield of 28 tha^{-1} noted in the variety ROC-10 among the varieties from Punjab. Other scientists also recorded the varietal response. Aslam *et al* (2001), determined sugarcane clones AEC82-1026 & AEC86-328 with record yield of 154.75& 133.87 t ha^{-1} for CPF–237 & CP77-400. Aslam *et al* (2001), also observed top cane yield (154.14 & 146.23 t.ha^{-1}) for variety MT70-611, variety S78-US-421 was found with higher yield of 104.43 t ha^{-1} (Anonymous, 2002). Bakhsh (2001) stated that improved variety Thatta-10 produced the highest cane yield of 135.0 t ha^{-1}. Bahadar (2002), recorded higher yield of 90.45 & 83.66 t ha^{-1} for approved varieties Naurang-98 & Bannu-1. Chattha *et al* (2002) obtained 19.21 & 16.46% higher cane yield for varieties CP-77/400 & SPF-162 than standard varieties on farmers field. Anonymous (2003) indicated variety BU-1 with better cane yield of 106.0 t ha^{-1} under farmers conditions. Chattha et al (2003) found cane yield of 101.86 t ha^{-1} for variety HSF-242 in out field trial. Chattha et al (2003) also recorded average higher cane yield (92.0 t.ha^{-1}) for variety CPF-237 at various locations on farmers sites.

Recovery (%)

Data presented in table-1 & 2 indicated statistically significant differences in sugar recovery % of different varieties. Among the varieties from Mardan selection (NWFP) in table-1 varieties BU-1, MS92-CP-434, CP88-1912 & MS92-CP-727 contained significantly higher sugar recovery % of 11.19,11.11,10.96 & 10.94% respectively as against the lowest sugar recovery % noted in MS92-CP-717 (9.287%). While among the varieties from Punjab (Table-2), BU-1 as check showed the highest sugar recovery of 11.46% followed by CPF-237 and

CPF-236 with sugar recovery of 11.02 & 11.00% respectively as against the lowest recovery % recorded in ROC-10 variety (9.427%). Bahadar et al (2000) recorded higher recovery (11.76%) for approved variety Bu-1 on farmer's field in plants stage. Aslam *et al* (2001) detected new clones (AEC86-329 & AEC82-1026) which showed 10 & 6% increased sugar contents. Chatha *et al.,* (2001) found the highest CC % (13.69 & 12.8%) for CPF-237 & CP77-400, respectively.

Bahader *et al* (2002) also reported the higher sugar recovery of 12.12 & 11.54% for varieties S86-US-402 & 422. Chatha *et al* (2002) recorded average sugar recovery of 11.72% for variety SPF-234 on farmer's field. Anonymous (2003) recorded higher brix value (22.3%) for BU-1 in out field trial. Chatha *et al* (2003) noted the maximum CCS%, i.e., 12.78 for SPF-232 on farmers' field. Chatha *et al* (2003) observed higher sugar recovery of 12.03% for variety HSF-242 when tested on farmers' field.

According to Chatha *et al* (2003), variety CPF-237 exhibited better CCS% i.e.12.3% under similar conditions. Sarwar *et al* (2003) found higher sugar recovery of 12.6 & 12.4% in varieties CPF-237 & CPF-236 respectively. According to table-3 four varieties from the trial of Mardan selection, crossed the level of 70 t ha^{-1} while the yield of MS92-CP-716 was 87 t ha^{-1} which was highly significant than all the other varieties. In case of Punjab varieties three varieties crossed the level of 70 t ha^{-1} but these varieties were non significant with each other. In case of recovery% four varieties from Mardan selection exhibited the highest statistically significant recovery% while in case of Punjab varieties BU-1 the check variety gave the highest significant recovery % followed by three other varieties.

REFERENCES

1. Anonymous. 2002. Annual technical report of Sugar Crops Research Institute, Mardan for 2001-02. pp.16.
2. Anonymous.2003.Annual progress report of Agri. Res. Institute, D. I. Khan, 2002-03, 1-86. pp.63.
3. Aslam, M., M .A. Javed & C. A. Ali. 2001. Presown sugar cane varietal response to different seed rates. Pak. Sugar J.16: 6, 115-118.
4. Bahader, K., M. Jamal, M. S. Baloch & A. Hamidullah. 2000. Comparison of sugar cane genotypes on Farmers field. Pak. journal of Biological sciences 3(10): 1547-1549, 2000.
5. Bahader K., M. S.Baloch, A. Hamidullah and K. Aminullah. 2001. Adoption & productivity of sugar cane varieties in Bannu. Pak. Sugar. J.16: 5, 13-15.
6. Bahader K., M. Jamal, M. Sulaman, A. Hamidullah, G. Rasool & B. M. Safdar. 2002. Genetic potential & adaptation of new sugar cane genotypes on farmers fields in Bannu division Pak. Sugar.J.17: 2, 9-13.
7. Chattha, A., M. G. M. Akram., F. G. Ali, & A. Zulfiqar. 2001. Exploitation of cane yield potential of sugar cane varieties. Pak. Sugar. J.16: 6, 51-55.
8. Chattha, A. A., M. A. Bajwa., M. A. Agarwal., S. Hussein & G. Zafrullah. 2002. The quantitative & qualitative performance of cane cultivars in central Punjab (2002). Pak. Sugar. J, 17: 6, 49-51.
9. Chattha. A. A., R. M. Asghar., M. Afzal & A. M. Shafique. 2003. Testing promising sugar cane varieties under Agro-climatic condition of Phalia area District Mandi Baha-ud-Din. Pak. Sugar. J.18: 6, 99-101.
10. Deho, M. A., H. I. Majeedano., S. D. Tunio & J. A. D. 2002. Effect of mulching methods as weed management, growth & yield of sugarcane. Pak. Sugar J. 17:1, 11-14.

Table-1 Final Evaluation of Sugarcane Varieties (Plant) 2003-04 (Mardan Selection)

Sr. No.	Varieties	Cane Yield (t ha^{-1})	Recovery (%)
1.	Thatta-8	36 d	9.407 e
2.	CP-80/1827	35 d	10.23 cd
3.	MS-91-CP-691	73 ab	10.25 cd
4.	MS-91-CP-406	57 c	10.24 cd
5.	CP-85/1491	50 c	10.54 bc
6.	CP-88/1912	38 d	**10.96 a**
7.	CP-87/1248	58 c	9.433 e
8.	CP-87/1628	65 bc	10.04 d
9.	MS-92-CP-716	72 ab	9.437 e
10.	MS-92-CP-176	**87 a**	9.467 e
11.	MS-92-CP-717	67 bc	9.287 e
12.	MS-91-CP-1154	50 c	9.920 d
13.	MS-91-CP-582	38 d	9.387 e
14.	MS-92-CP-434	71 ab	**11.11 a**
15.	MS-91-CP-626	50 c	9.937 d
16	MS-92-CP-727	67 bc	**10.94 a**
17.	BU-1	60 bc	**11.19 a**
18.	BF-162	68 bc	10.85 ab

Table-2 Final Evaluation of Sugarcane Varieties (Plant) 2003-04 (Punjab)

Sr. No.	Varieties	Cane Yield (t ha^{-1})	Recovery (%)
1.	SPF-238	67	10.04 fg
2.	BU-1	69	**11.46 a**
3.	SP-312	58	10.23 defg
4.	HS-229	64	10.13 efg
5.	ROC-10	28	9.427 h
6.	SP-1218	35	10.70 bc
7.	MT-70	72	9.967 g
8.	SPF-213	76	10.50 cde
9.	SP-1058	51	10.42 cdef
10.	HS-185	74	10.45 cde
11.	HSF-240	52	10.14 efg
12.	CPF-237	57	11.02 b
13.	CPF-236	47	11.00 b
14.	NSG-6	55	9.977 g
15.	NSG-39	45	10.45 cde
16	NSG-15	57	10.57 cd
17.	NSG-60	60	9.90 g
18.	Thatta-10	51	9.85 g

Table-3 Comparison Table of Top Varieties from Mardan & Punjab Selection

Mardan Varieties	Cane Yield (t ha^{-1})	Punjab Varieties	Cane Yield (t ha^{-1})
1. MS-92-CP-176	87	1. SPF-213	76
2. MS-91-CP-691	73	2. HS-185	74
3. MS-92-CP-716	72	3. MT-70	72
4. MS-92-CP-434	71		
	Recovery (%)		**Recovery (%)**
1. MS-92-CP-176	9.47	1. SPF-213	10.50
2. MS-91-CP-691	10.24	2. HS-185	10.45
3. MS-92-CP-716	9.43	3. MT-70	9.97
4. MS-92-CP-434	11.11		

CONCLUSION

It is suggested that these seven varieties i.e. 4 from Mardan selection and 3 from Punjab selection should be promoted and approved from Provincial Seed Certification Department NWFP for commercial cultivation of the area (D. I. Khan) after testing them for two more years on farmer's field for rationing capacity, insect and diseases attack/resistant

SUGAR INDUSTRY ABSTRACTS

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BREEDING AND GENETICS

Genetic linkage map of sugarcane *(Saccharum* spp.) based on SRAP and TRAP Markers

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A genetic linkage map is being constructed using two fairly new molecular marker techniques, namely Sequence Related Amplified Polymorphism (SRAP) and Target Region Amplification Polymorphism (TRAP). The SRAP is a two-primer PCR amplification technique wherein primers of about 17 to 18 nucleotides long are designed to target Open-Reading Frames (ORFs). The primers consist of 10 to 11 filler sequences at the 5' end followed by either AATT in the forward or CCGG in the reverse primer which are believed to target introns or exons, respectively. The 3' end consists of three selective nucleotides. TRAP markers, on the other hand, employ EST or gene derived nucleotide sequences for the forward primer but the reverse primer is similar to a SRAP primer. The mapping population consist of 88 individuals from a cross between La Stripe (*S. officinarum*) x SES 147B (*S. spontaneum*). Thus far, 33 SRAP and 12 TRAP primer combinations have resulted in 185 (97 single- and 88 double-dose) and 70 (52 single- and 18 double-dose) polymorphic bands, respectively, which were used for mapping. The map was constructed using the JoinMap software, based on a LOD score of 3.0 to 7.0, a threshold recombination value of 0.4 and the Kosambi mapping function. Of the 255 mapped markers, 117 have grouped into 43 co-segregation groups while the rest remained ungrouped. The genome coverage for these 117 markers is 1311 cM with an average of ~11.0 cM between any two markers. Our long term objective is to saturate the map using additional SRAP and TRAP primer combinations along with EST-derived SSRs and AFLP markers. We are also evaluating the mapping population in field trials with a view of mapping QTLs. These preliminary results show that SRAP and TRAP markers have a potential to be employed in mapping and marker assisted selection in sugarcane breeding programs.

Target Region Amplification Polymorphism (TRAP) for assessing genetic diversity in sugarcane germplasm collections

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Target Region Amplification Polymorphism (TRAP) is a new PCR-based molecular marker technique which uses gene-based information for primer design. A fixed primer of 18 nucleotides designed from an EST or gene of interest is paired with an arbitrary primer, designed with either an AT- or GC-rich motif to anneal with an intron or exon, respectively. The objectives of this study were to evaluate the utility of TRAP markers for assessing genetic diversity and inter-relationships among sugar-cane germplasm accessions and to verify if indeed TRAP markers reveal trait-based polymorphism. Thirty genotypes, representing species of Saccharum, Miscanthus and Erianthus were used in the study. The *Saccharum* species included *S. officinarum, S. barberi, S. sinense, S. spontaneum, S. robustum,* cultivars, cultivar-derived mutants and interspecific hybrids between 5. *officinarum* and *S. spontaneum.* Six fixed primers, designed from sucrose- and cold-tolerance related EST sequences, paired with each of three arbitrary primers, were used to characterize the germplasm. Both the cluster and principle component analysis analyses placed the *Erianthus* and *Miscanthus* genotypes distinctly from each other and from the *Saccharum* species, thus, supporting their taxonomic classification into separate genera. The *S. spontaneum* genotypes clustered into one group while the rest of the sucrose producing *Saccharum* species formed one inter-related cluster with no distinct sub-groups. Sequence analysis of TRAP bands derived from A. S. *spontaneum* clone revealed homology with known gene sequences from other grass species including *Sorghum.* A BLASTn search using one of the homologous sequences from *Sorghum* matched with the *S. officinarum* GenBank accession from which the fixed primer was designed. These results support the use of TRAP markers as a potentially useful technique for genetic diversity studies in sugarcane germplasm collections.

Development of high fiber cane varieties for biofuel production in the Southern United States

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Interest in the production of biofuels has increased considerably within the last decade due in part to rising energy costs. As this interest has grown, research initiatives are underway to examine the potential for increasing biomass in selected row crops and developing efficient processes for the conversion of biomass to biofuels and electricity and perhaps other saleable products. With sugarcane's superior ability to convert solar energy into biomass (sugar and fiber), the use of sugarcane as a biomass feedstock is of interest to producers as they search for alternative sources of revenue. Fiber content in combination with sugar yield was evaluated for six varieties: HoCP 00-961, L 79-1003, TucCP 77-42, US GO-16, US 01-10, and US 01-12 in field studies located at the Sugarcane Research Laboratory in Houma, LA and at the Diamond W Ranch near Welsh, LA. The variety LCP 85-384 was included as a commercial standard. The varieties L 79-1003, US 00-16, US 01-10 and US 01-12 produced the highest fiber content, ranging from 18.5 to 26.9%. The variety L 79-1003 was the most uniform in fiber content in plant-cane, first-ratoon, and second-ratoon crops, at 25.7, 26.1 and 25.6%, respectively. Although this variety had the highest fiber content in each crop, it typically was one of the lowest sucrose yielding varieties, 4.4 to 7.6%, along with US 00-16, US 01-10 and US 01-12. The variety that appears to have the greatest potential for biofuel production among the varieties evaluated was HoCP 00-961. Although this variety did not have the highest fiber percentage, its moderate to high fiber yield, 15.4 to 18.6%, in combination with a moderate production of sucrose, 8.3 to 12.6%, suggest that the total yield of both ethanol and electricity would be greater with this variety.

Characterization of sugarcane populations for disease reactions for use in molecular marker research

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Molecular markers associated with resistance have been used for genotypic selection of individuals in a number of crops and may offer a means of detecting resistance in sugarcane. To initiate research and to associate molecular markers with resistance, several sugarcane populations were characterized for their reaction to yellow leaf, rust and ratoon stunt pathogens. The objective was to find populations with individuals that had extremes in disease reaction for yellow leaf, brown rust and ratoon stunt. Yellow leaf and rust data were taken from clones based on their natural infection. Ratoon stunt data were obtained from inoculated tests based on the number of Colonized Vascular Bundles. The mid-rib tissue immunoassay was used to detect Sugarcane Yellow Leaf Virus (SCYLV) in the phloem cells. Sixty-eight progeny of a cross of Green German x Ind 81-146 had been naturally exposed to SCYLV at Canal Point for 15 years, during a period where almost all other clones at Canal Point became infected within a period of 4-5 years. Thirty-nine clones of this population remained free of SCYLV for over the last three years. However, almost all other clones at Canal Point became infected within a period of 4-5 years. Rust data were taken from individuals from two families: 1) Green German x Ind 81-146 with 23 resistant progeny with no sporulating pustules and 165 susceptible progeny with varying amounts of sporulating pustules and 2) CP 94-1200 x CP 92-1167 with 33 resistant and 72 susceptible progeny. Progeny of six families were evaluated for their ratoon stunt reaction: Green German x Ind 81-146; Green German x SES 208; Green German x Coimbatore; CP80-1827 selfed; SS 57-3 x Yacheng #12 and CP 94-1200 x CP 92-1167. All families exhibited extremes in disease reaction of individuals to ratoon stunt except that of Green German x Ind 81-146 population where all individuals were susceptible. Disease reaction data for the different populations and preliminary marker data will also be presented.

Assessment of sugarcane families in South Texas

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An experiment was conducted in 2004 at the Texas Agricultural Experiment Station Weslaco Center, to assess the yield performance (cane yield and Brix) of 81 families. Statistical design utilized was the randomized incomplete blocks, in two replicates, and two common treatments in each block. Plots were harvested with a weighing wagon and Brix readings were taken on the juice of a random sample from each plot. Another trial had been planted on 2003 with 60 crosses, for cane yield assessment only. Both trials were harvested on the plant cane stage, leaving the first ratoon crop for the selection of individual plants, within each family. Utilization of family assessment in 2003 allowed the increase of selection rate from 5 to 10%, and the identification of "proven crosses" for sowing from remnant seed in 2005. Results from the 2004 trial will be used for within-family selection on the first ratoon stage, to be conducted on the fall of 2005. Genetic analysis showed that good biparental combinations could not be predicted based on the general breeding value of each parent, suggesting that the nonadditive genetic component of variance was more important than the additive one. A strategy, using genomic information, for the prediction of superior biparental combinations will be proposed.

Identification of microsatellite markers associated with yield-traits in sugarcane
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Identification of molecular markers associated with quantitative trait loci (QTL) offers the potential to increase the overall efficiency of sugarcane breeding programs. Co-dominant segregation of 12 microsatellite (SSR) loci was evaluated in the Fl progeny population obtained from an interspecific cross between Saccharum officinarum (cv. Green German) and *S. spontaneum* (cv. IND 81-146). The objectives of this study were to follow the inheritance of these alleles in 162 full-sib families through a linkage analysis and to explore the putative association between the markers and six phenotypic traits (Brix, pol, sucrose content, stalk diameter, stalk height, and stalk weight) measured at two locations and for two crop-years. A total of 107 polymorphic markers were used for linkage analysis in this interspecific cross. Polymorphic profiles generated by single-dose markers that segregated in a Mendelian fashion were subjected to multiple interval mapping. Twice as many markers were specific to the *officinarum* as to the spontaneum parent. The segregation patterns of these markers to different linkage groups and their association with sugarcane yield-component traits will be discussed in the context of this two-location/two-crop year study. The linkage/QTL map developed in this study will be useful for identification of markers linked to genes that control QTL of economic importance in sugarcane and for marker-assisted selection. It also serves as a first step in producing a saturated map of the *Saccharum* genome with more molecular markers used in different pedigrees.

A look at sugarcane variety protection options
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The LSU AgCenter, along with other sugarcane breeding institutions, has initiated efforts to protect sugarcane varieties. As one looks at the history of sugarcane variety releases in the U.S., the predominant means of release was to do so publicly. A notice of release was sent out and subsequently the variety release was publicized through a crop registration manuscript in Crop Science. The new variety would be entered into the National Plant Germplasm System of the USDA-ARS and maintained at the National Germplasm Repository in Miami, Florida. New sugar-cane varieties could be freely accessed upon public release through the USDA-ARS germplasm system. There are many reasons that institutions are beginning to protect newly developed sugarcane varieties. The advent of transgenic varieties in many crops has triggered the use of increased variety protection in the public sector. Also, public sugarcane breeding programs are deriving more of their funding through private sugarcane grower and milling funds derived by various check-off collections. The advantages and disadvantages of sugarcane variety protection will be discussed.

A Comparison of growth and sugar accumulation in sugarcane genotypes adapted to Hawaii or Louisiana
Sarah E. Lingle and Thomas L. Tew
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Louisiana sugarcane breeders are using Hawaiian (HI) genotypes to increase the genetic base of new cultivars. Cultivars developed in Hawaii have high tonnage potential, but are adapted

to two-year crop cycles. We were interested in the growth and sugar accumulation of HI genotypes when grown in the short Louisiana season. We sampled stalks of four HI genotypes (US02-101, US 02-102, US 02-103, and US 02-104) and two Louisiana (LA) cultivars, HoCP 85-845 and LCP 85-384, grown in Schriever, Louisiana. Samples were taken during the grand growth and ripening stages in the plant and first ratoon crops. We determined stalk length and internode number, and then sampled internodes 2, 5, 8 and 11 from the top, from which sugars were extracted. Stalk length was the same in all genotypes except US 02-104, which had longer stalks due to a greater number of above-ground internodes. Internodes of the LA genotypes generally had a higher total sugar concentration than the HI genotypes. The differences in sucrose accumulation were even greater. Internodes of LA genotypes accumulated more sucrose than the HI genotypes, especially during ripening. Only US 02-103 approached the two LA genotypes in sucrose concentration. LA genotypes also had a higher sucrose: total sugar ratio than HI genotypes. The four HI genotypes evaluated in this experiment had reduced sugar accumulation compared to the LA cultivars. While introduction of HI germplasm into the Louisiana breeding program may broaden the genetic base of sugarcane genotypes, it may do so at the cost of sugar accumulation.

Application of high-throughput DMA marker technology in sugarcane breeding: Phase ii - PCR amplification and capillary electrophoresis

Yong-Bao Pan, Brian E. Scheffler, and Edward P. Richard, Jr.

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Each year, only a small portion of the seedlings (approximately 120,000 seedlings from 300 commercial and basic crosses) are transplanted to the field at the SRU's Ardoyne Farm due to space limitations in the greenhouse and field. We are continuing to explore the utilization of high-throughput (HT) DNA marker technology in an effort to maximize the number of hybrid seedlings being transplanted to the greenhouse and field. The HT-DNA extraction method described at this meeting in 2004 and currently being used at our lab, allows the preparation of DNA templates from 600 seedlings per day per technician using 96-well DNA sample microplates and as such is no longer a limiting step. Our goal in further developing this process was to be able to assess cross quality (percentage of seedlings with DNA fragments from both parents) using 22 randomly picked seedlings from each cross. In order to process a minimum of 6,600 HT-DNA samples beginning in early February, we automated the PCR reaction preparation step by using a robot station that set up four 384-well PCR reaction plates in 30 minutes for sixteen 96-well HT-DNA sample plates (1,536 samples in total). PCR amplification reactions were then conducted on a thermal cycler equipped with four 384-well heating blocks for durations not to exceed two hours. Using the same robot system, we automated the capillary electrophoresis sample plate preparation for the same number of samples in 30 minutes by mixing 1μ of amplified DNA products with 9μ HiDye formamide solution containing the RoxTM 500 size standards. Amplified DNA fragments were separated through capillary electrophoresis on ABI3730 Genetic Analyzer for duration of about 22 hours. The separation process was recorded automatically into run files that could be analyzed by the ABI software GeneMapper. Based on the single marker-PCR and single marker capillary electrophoresis just described, we were able to process 6,624 HT DNA samples from sixty-nine 96-well sample plates with two microsatellite markers in 8 days. The breeders were able to obtain microsatellite genotyping data for 1,646 individuals from the *Saccharum spontaneum* cytoplasm project where spont clones were used as the female parents and for 2,304 individuals representing 93 commercial crosses before beginning the transplanting season on April 11, 2005. The output of ABI3730 Genetic Analyzer can be maximized to 9,216 HT-DNA samples per day if up to six PCR amplified microsatellite DNA products with three fluorescence labels were pool-plexed and separated through a single capillary electrophoresis run.

Molecular assessment of the fidelity of sugarcane crosses with high-throughput microsatellite genotyping

Thomas L. Tew and Yong-Bao Pan

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With the recent advent of high-throughput microsatellite genotyping in sugarcane, breeders now have an effective means to assess the fidelity of sugarcane crosses. Cross fidelity was defined as the proportion of progeny within each cross that inherited microsatellite DNA fingerprints from both parents. A total of 76 crosses were assessed, of which 48 had most or all of the following pollen constraints imposed on the designated parents at the time of crossing, namely 1) tassel trimming of designated females, 2) hot-water emasculation of designated females, 3) inclusion of only two parents per cubicle, and 4) use of fully enclosed cubicles (all four sides); while 28 crosses had none. For each cross, 20 randomly sampled seedlings, along with the two parents and positive and negative controls were fingerprinted. Six microsatellite markers were employed in this study; however, within each cross, only two microsatellite markers that best differentiated the parents were used. Among the 48 crosses where pollen constraints were in effect, most had a fidelity rate above 80%. Among the 28 crosses where pollen constraints were not in effect, fidelity ranged from 0 to 95% and the average being below 50%. The results of this study highlight the importance of imposing as many pollen constraints on the female parents as is practical.

Evaluation of resistance to sugarcane red rot in basic germplasm and early generation crosses in Louisiana

John C. Veremis and Jeff W. Hoy

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The susceptibility of current cultivars to red rot disease of planted seed-cane, caused by *Colletotrichum falcatum,* indicates a need to identify and incorporate sources of resistance in commercial breeding programs. The objective of this study was to evaluate the sugarcane basic germplasm collection maintained by the Sugarcane Research Unit and two *S. spontaneum* hybrid progeny populations for genetic diversity of host plant resistance to red rot. The experiment was conducted with detached, inoculated stalks. Eighty basic clones representing species of *Saccharum,* one clone of *Miscanthus* and two clones from *Erianthus* were screened. Among the *Saccharum* species, *S. officinarum* (18), *S. robustum (W), S. barberi* (l5), *S. sinense* (11), *S. spontaneum* (32), and interspecific hybrids (4) were evaluated using a commercial *Saccharum* interspecific hybrid, LCP85-384, as the susceptible control. Also included in this evaluation were Fl hybrids (119) between *S. officinarum* (La Striped, classified as highly susceptible) and *S. spontaneum* (SES147, classified as resistant) and F2 hybrids (178) between two interspecific Fl hybrids of SES 234 (female parent) and LCP85-384. Expression of resistance in these clones and single Fl and F2 progeny populations was assessed as the number of nodes passed (the ability of the infection to move through the node) and the number of and extent of internode rotting. A 1 to 9 rot index, based on the number of nodes passed and rot severity, was developed with 1 representing no rotting and 9 representing all internodes rotted. For our purpose, a clone with a rating of 3 or less was

considered resistant. New sources of resistance were found among *Erianthus* (2), *S. barberi* (5), *S. robustum* (2), *S. sinense* (1), *S. Spontaneum* (4) and the interspecific hybrids (2). Inheritance of resistance to red rot was evaluated using the interspecific Fl hybrids between La Striped and SES147 and the F2 progeny between two interspecific Fl hybrids of SES234 and LCP85-384. The resistance ratings of the *S. spontaneum* cytoplasm parents of the F2 population were 4 and 2, and the susceptible control cultivar LCP85-384 was 9. The S. spontaneum cytoplasmic F2 progeny produced a higher frequency of resistance 47 of 178 than the Fl hybrids 4 of 119. 5. *spontaneum* hybrids were identified as potential sources of resistance to red rot. The results from the progeny populations suggest that the utilization of identified resistance sources in crossing could increase the frequency of red rot resistance in the cultivar selection population.

AGRONOMY

The effect of planting date and planting method on Louisiana sugarcane varieties

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Sugarcane in Louisiana is propagated from either whole-stalks or billets in late summer through early fall. Research was conducted to determine if yields of sugarcane varieties currently grown in Louisiana are affected by planting date and/or planting method. Billet planting was compared to whole-stalk planting at three planting dates (August 15, September 15, and October 15) with three varieties (LCP 85-384, HoCP 85-845, and HoCP 91-555) in 2002 and 2003. Yields of sugar per ton of cane, cane per acre, and sugar per acre were compared in the plant-cane and first-ratoon crops. Yields in plant-cane from billet planting were inconsistent when compared to whole-stalk planting. The August planting date had higher yields of cane (40.0 to 43.1 t/A) and sugar (11,000 to 11,800 Ibs/A) than the September and October plantings (30.0 to 36.1 t/A and 7,200 to 9,900 Ibs/A) when varieties and planting methods were combined and averaged for each planting date. Varieties did not differ in response to planting method. In 2003, the first-stubble crop also benefited from an early planting as yields in the August-planted cane were 2.5 t/A and 600 Ibs/A higher than in the September and October-planted cane. Billet planting did not affect yields of the first-ratoon crop. Data suggests that farmers should plant as much as possible in August to obtain maximum yields. Also, farmers should be aware that by planting billets, they may get inconsistent yields compared to planting whole-stalks. [A = acre]

Establishment and management of sugarcane on organic-amended vs. non-amended mineral soils

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Low organic matter (OM) and associated poor soil condition limit sugarcane production and sustenance of ratoon yields on sandy soils. Organic amendments can improve sugarcane production by improving water and nutrient holding capacities. Data are presented on the establishment phase of an ongoing study on the effect of long-term application of organic amendments on sugarcane production on Immokalee fine sand (sandy, siliceous, hyperthermic Arenic Alaquods) at Immokalee (26° 27' N; 81° 26' W), south Florida. The site was used yearly for fall and spring vegetable production from 1993 to 2003, and sorghum x sudangrass *(Sorghum bicolor L* 'Sxl7') as cover crop in 2004. The organic-amended plots received 7 to 180 Mg/ha/year of composted municipal solid waste (biosolids), yard trimmings, and/or cow manure, depending on availability. The non-amended plots received no amendments. On 13 January 2005, two sugarcane (interspecific hybrids of *Saccharum* spp.) cultivars, CP 78-1628 and CP 80-1743 (sub-sub plot) were planted at 1.5 m row spacing, and randomly assigned to four N-rates (subplots). Organic amendment (with or without) constituted the whole plot and were randomly assigned to four blocks. At planting, P, K, Mg, and micronutrients were applied in the furrows at recommended rates. Water table was maintained with perimeter ditch irrigation and shallow field ditches (20-cm deep) constructed between each soil amendment whole plots. Data were collected before plots received N fertilizer. Average soil OM contents at 0-15 and 15-30-cm depths were 24.0 and 11.0 g/kg soil on amended and 9.0 and 6.8 g/kg soil on non-amended soil, respectively. Higher soil water matrix potential was recorded in amended soil than in non-organic-amended soil in the morning (07:00 h) and afternoon (15:00 h) and at both 15- and 30-cm depths. At 10 weeks after planting, CP 78-1628 (17,579 shoots/ha) had a significantly greater ($P<0.0001$) shoot count than CP 80-1743 (8,436 shoots/ha), and organic-amended soil (20,371 shoots/ha) had greater shoot count than non-amended soil (9,714 shoots/ha). There was no soil amendment x cultivar interaction on stand count. There was significantly greater weed incidence on amended than non-amended soil, with weed (mainly nutsedge *[Cyperus* spp.]) ground cover, reaching 62.5% on amended plot vs. 6.5% on non-amended plots. Therefore, agronomic management programs that utilize organic amendments to improve OM of sandy soils in south Florida will need to address potential problems associated with achieving proper soil moisture for seed piece germination and establishment, and weed control.

No-till sugarcane: Agronomic and economic implications

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In Louisiana, tillage is used extensively to control weeds, eliminate ruts caused by harvest, destroy residue from the previous crop, and incorporate fertilizer. Sugarcane growers strongly feel that tillage also stimulates sugarcane regrowth in the spring by warming the seedbeds. The effect of tillage and weed control programs on 'LCP 85-384' sugarcane *(Saccharum* spp. hybrids) growth and yield and on economics was evaluated over two growing seasons. Residue remaining from harvest of the previous crop was not a factor affecting sugarcane regrowth. When row shoulders and middles were not tilled in March soil temperature in the sugarcane drill early in the growing season was equal to that where March tillage was performed. Weeds were effectively controlled with a March application of hexazinone at 0.53 Ib ai/A plus diuron at 1.88 Ib ai/A. Sugarcane and sugar yield were each equivalent for the full season tillage (off-bar tillage in March plus layby tillage in May) and the no-till programs. Elimination of a single tillage operation reduced cost $6.59/A and herbicide applied on a band rather than broadcast reduced cost $12.34/A. For the no-till program with herbicide banded in March compared with full season tillage, net return was increased $13.18/A. In a subsequent study conducted at five locations sugar yield was increased 8.6% and net return was increased $61.79/A when sugarcane was not tilled in March. Sugar yield was increased 8.0% and net return was increased $58.23/A when lay by tillage in May was eliminated. Crop residue deposited on the soil surface as a consequence of using chopper harvesters can affect regrowth of the ratoon crop following the winter dormant period and efficiency of spring tillage. Mechanical removal of crop residue using a Sunco Trash Tiger® three weeks after harvest of LCP 85-384 with a chopper harvester was compared with burning. Tillage efficiency in March was not reduced when the residue was mechanically removed from the row top and placed in the row middle. Sugar yield was reduced an average of 7.9% when sugar-cane residue was not removed compared with mechanical removal or burning in December. Research was also conducted to compare mechanical removal of sugarcane residue with the Trash Tiger® in January, February, or March. Allowing crop residue to remain on the soil surface until March reduced both early season sugarcane height and shoot population when compared with December residue removal. Sugar yield was equivalent when crop residue was removed in December by burning or mechanically and averaged 7,740 Ib/A. Delaying mechanical removal of residue until February or March decreased sugar yields an average of around 13% compared with December burn or mechanical removal. [A = acre]

Ripening sugarcane for early factory starts

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In recent years, the Louisiana sugar industry has expanded its area planted to sugarcane to approximately 500,000 acres. Along with this expansion, came the release of a new, high yielding sugarcane variety, LCP 85-384, in 1993 which produced as much as 30 percent more cane per acre than the varieties it replaced. Another change occurred when the industry switched from the whole-stalk or "soldier" to the combine harvesting system which meant that more total biomass had to be processed by the mills especially when recumbent cane was harvested. Although milling capacity was increased at most mills, the harvest season was extended to 100 days or more which meant that the starting date for the harvest season was advanced into September. Then with the current Farm Bill, mills that did not meet their allotment during the normal crop were forced to begin the next crop in September prior to the start of the Federal fiscal year in order to market all sugar allocated to them. In 1980, glyphosate was labeled as a chemical ripener to enhance the yield of sugar per ton of cane especially in cane that was harvested early in the season. However, at that time, the average startup date for the mills was the first or second week of October; now that date is about September 20. In the past, it was a general recommendation that glyphosate be applied 35-49 days prior to the harvest; however, it was known that this product generally reduced cane yield while increasing sugar yield. With the earlier startup dates necessitated an earlier application of glyphosate in August which is still during the grand growth phase of the crop, further impacting the yield of cane tonnage. In 2004, glyphosate (Polado-L®, RoundUp WeatherMax® or Touchdown iQ®) was applied at three equivalent rates on two dates, August 18 and September 14. The results showed that glyphosate can be applied on or about mid-August without loss of sugar per acre if the crop is harvested within 28 days of harvest. However, if the harvest is delayed beyond 42 days, the increase in yield of sugar per ton is generally offset by the reduction in tons of cane per acre. For cane harvested later in the harvest season, these studies showed a significant increase in sugar per acre when compared to harvesting earlier in the season. These studies also showed that a significant increase in sugar per acre can be obtained with longer treatment-to-harvest intervals when glyphosate is applied in mid-September and presumably later. The results of these studies show conclusively that ripening of sugarcane for early factory starts is attainable without sacrificing the yield of sugar per acre.

Evaluation of trinexapac-ethyl for use as a ripener in Florida sugarcane
Curtis R. Rainbolt, Gerald Powell, German Montes, Ronald W. Rice, and James M. Shine
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Trinexapac-methyl is currently labeled for use as a growth regulator in perennial ryegrass seed production and turf grass. Preliminary studies have indicated that trinexapac has potential for use as a ripening agent in sugarcane. Currently, glyphosate is the only compound labeled for use as a ripener in Florida sugarcane. In Florida, glyphosate can only be used in the final harvest of sugarcane because of stand and growth reductions in subsequent ratoons. Trinexapac is reported to have potential for safe use in each year of the crop. Plots were established in 2004 at the Okeelanta Corporation and the University of Florida Everglades Research and Education Center (EREC) to evaluate and compare trinexapac to glyphosate for use as a sugarcane ripener. Plots were established at Okeelanta in a field of CP89-2143 plant cane and in a field of CP72-2086 plant cane at the EREC. Several rates of trinexapac and glyphosate were applied using a 20 ft overhead spray boom calibrated to deliver 5 gallons per acre and simulate aerial application. Ten stalk samples were collected immediately following treatment application and at 2, 4, 6, 8, and 10 weeks after treatment (WAT). Harvest samples were ground, crushed, and the juice was analyzed for Brix and apparent sucrose and theoretical yields were calculated. Stalk counts following harvest are being conducted to evaluate the effect of ripener treatment on stalk emergence in the subsequent ratoon crop. At Okeelanta, Brix and apparent sucrose were not significantly affected by treatment, except at the 6 WAT sampling. Although not significantly different, the glyphosate treatments tended to result in higher Brix and apparent sucrose 2 and 4 WAT. By 6 WAT, Brix and apparent sucrose were similar with the low rate of trinexapac and the glyphosate treatments. Theoretical yield was not significantly affected by treatment, and the overall response to treatment followed a trend similar to that for Brix and apparent sucrose. At the EREC, Brix, apparent sucrose, and theoretical yield were not significantly affected by treatment. The data tended to be highly variable, thus making trends difficult to distinguish. Trinexapac treatments typically ranked higher than the untreated control, but were often lower than the glyphosate treatments. Preliminary results suggest that in some situations trinexapac can perform similarly to glyphosate, but response to glyphosate tends to be more consistent. Complete results including data on regrowth in the ratoon crop will be presented at the meetings.

Variable-rate nitrogen management of sugarcane
H.P. Viator and R.G. Downer
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Site-specific management of sugarcane has lagged behind other commodities because of the unavailability of commercial yield monitors. Measures of spatially variable soil attributes associated with sugar cane yield have been both inconvenient and limited. The principal objective of this study was to determine the response of plant cane to the application of variable rates of fertilizer nitrogen. An ancillary objective was to investigate the relationship of yield to measured soil attributes. Four N rates (0, 90, 179 or 269 kg/ha^{-1}) were superimposed in a randomized block design on a 10-hectare field on which apparent soil electrical conductivity (ECa) and soil nutrient levels were measured. The soil (Vertic Haplaquolls) had a silty clay loam surface layer and a clayey subsoil. Absent a workable yield monitor, plot weights were measured using a field wagon equipped with electronic load cells. The growing season was characterized by moisture extremes, with excessive rainfall occurring in the spring, followed by a moisture deficit during the grand growth stage of summer. A multi-source regression was fit to the plot data. The three applied N rates were statistically equivalent and significantly higher in sugar per acre than the 0 kg/ha^{-1} rate. Blocks (approximate surrogate for clay content), N application rates, average ECa of the plots, soil sodium and the interaction of average ECa and soil sodium were all significant in a model that explained 92 percent of the variability in sugar per hectare. This significant interaction is consistent with visual displays of ECa and soil sodium for the experimental region and consistent with our understanding of the typical effect of these variables on yield This model will be used in the upcoming growing season as a prescription for a variable N rate investigation. As is typical of seasons with exceedingly uneven moisture regimes, sugarcane under-performed on areas of the field with higher clay content (% clay ranged from 20.8 to 60.8 within the experimental area). Management options useful for mitigation of this dilemma are limited. The results suggest that the ability to predict the response of sugar cane yield on clay soil to nitrogen fertilizer is undermined by the inability to predict growing season climate. The data also suggest, as others have observed with different crops, that ECa alone cannot be used to predict variation in sugarcane yield. Collateral observations and information must be included in the development of fertilizer prescriptions.

Irrigation and nitrogen application effects on sugarcane production in the ower Rio Grande valley of Texas
Bob Wiedenfeld and Juan Enciso
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Water for agricultural production is becoming increasingly limited in semiarid South Texas. Optimum irrigation scheduling based on knowledge of crop water use is necessary in order to maintain production while conserving water. Methods of N application also have to be modified when more efficient irrigation practices are adopted compared to conventional furrow irrigation. A 4-year study was conducted to evaluate sugarcane growth and yield at different irrigation levels based on different crop coefficient curves applied to Penman-Monteith reference evapotranspiration. Broadcast, thru-the-drip and stool-splitter methods of N application were also compared, along with different rates of N application. Optimum irrigation levels varied annually, with no differences being found in the first two years while optimum yields were obtained at lower irrigation levels in the later years. Substantial reductions in crop irrigation applications were obtained when using drip compared to furrow irrigation. Sugarcane yields showed a somewhat diminished response to N application than expected. Both thru-the-drip and broadcast applications gave best results, while the stool-splitter resulted in slightly lower yields.

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