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EDITOR'S NOTE

The first issue of the Bangladesh Journal of Sugarcane 1979 comes out with the blessings of Mr. Delwar Hossain, Chairman and Mr. A. S.M. Kamaluddin, Director (CDR) of the Bangladesh Sugar and Food Industries Corporation. The Young scientists of the Sugarcane Research Institute rejoice the moment and pray to Allah Almighty for its continued success.

The need for regular publication of such Journal of sugarcane was long desired and cherished by those who are actually involved and dedicated to the service of the sugarcane growers and sugar industry in Bangladesh. We are particularly happy to see the dreams come out true.

Even though Bangladesh are in the world map of sugarcane growing region and in the world market of sugar export, it's per acre yield is very low compared to other countries. The reasons are many and there are thousand and one problems in sugarcane production in this country. Hence the Sugarcane Research Institute has set up problem and field oriented experiments to solve these problems. Some results so far obtained are encouraging.

We want to share our knowledge with those who desire for it. The sugarcane growers, the cane development staff, the cane development officer, have to be educated with the recent innovations in sugarcane development technology. The information required to make real breakthrough in increasing sugarcane yield per acre should not be confined within the boundary of the Sugarcane Research Institute Laboratory and allowed to accumulate dustcover the years. Instead, there should be a continuous flow of research results to the grower's fields and feed back of the field problems to the research laboratory ----thus establishing a homeostasis, an appropriate condition that are very much needed to nourish sugarcane growers and flourish Bangladesh sugar Industry.

Therefore the Bangladesh Journal of Sugarcane has taken its birth on such holy day Monday the 16th of April 1979 at the Sugarcane Research Institute, Ishurdi, Pabna. The Journal would continue to grow, nourish and serve the sugarcane growers and sugar industry in the years to come.

It would be my great pleasure to see the Journal reaches the International Standard. There would be left no stone unturned to make it a productive guide for all those involved in practical cane growing and Sugar processing.

M. SHAHJAHAN
DIRECTOR AND EDITOR

CONTENTS

A Quantitative Study of Post Harvest Deterioration of Sugarcane

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SUMMARY

An experiment was conducted at the Sugarcane Research Institute (SRI) to study the quantitative deterioration of Sugarcane after harvest. Chemical analysis of staled cane showed increased brix, but reduced pol, purity and recoverable sugar. A steady loss in cane weight and in total sugar content compared to the cane analyzed immediately after harvest was also observed. The rate and extent of deterioration varied with time and climatic conditions prevailing during the period of the experiment and staleness by one day caused no significant deterioration whereas the same for the subsequent days affected the cane significantly. The total sugar per acre lost over a period of six days of staleness alone during a crushing season, varied from 30% to 54% Canes must be guarded against this factor by all means for economic reason.

INTRODUCTION

The phenomenon of post harvest deterioration of sugarcane is a common problem with sugar industry. Delays by two to three days or even a week between harvesting and milling are common due to distance, transport problems, bad communication systems and/or occasional break down of mills. Such delays result invariably in losses of cane weight and recoverable sugar.

A number of workers in Australia, Hawaii, South Africa, India and in other major sugar producing countries of the world have investigated into the problem and reported loss of cane weight, recoverable Sugar, increase in reducing sugars, changes in juice quality and chemical composition (Lingerfelt *et al.*, 1965; Gupta *et al.*; 1968; Wood *et al.* 1972; Wood, 1973; Bose *et al*. 1974 and Long, 1977)

The post harvest deterioration of sugarcane appears to be a more acute problem in Bangladesh than it is in other countries of the world for seasons mentioned above and still very little work has been done in the line under her agro climatic conditions. The present investigation was undertaken to quantify the extent of damage caused due to different length of staleness over the crushing seasons.

MATERIALS AND METHODS

The experiment was conducted at SRI farm. The cane variety Co 1158 planted on 15th November, 1976 was grown under rainfed conditions from planting to harvest and has all managements, fertilizations and other intercultural practices identical.

The experiment consisted of three independent trials at an interval of 40 days in order to represent early (December), mid (late January) and late (early March) crushing season. Consequently, the age of the crop varied from 388 days to 453 days.

Each of the above mentioned trials followed the same procedures outlined below:-

Random samples in total 126 canes, representing average cane stand of the field, were harvested, detrashed, bound into 21 bundles of 6 canes and weighed. Three such bundles representing 3 replications were reweighed and chemically analyzed fro brix, pol, purity of %

recovery, the same obtained from the samples analyzed on starting day were taken as initials. Loss in total sugar was calculated on the basis of average cane yield/acre of 30 tons.

RESULTS AND DISCUSSION

Both qualitative and quantitative loss that resulted due to staleness was studied in this piece of work. Tables 1-3 show the mean observations on weight loss, brix, pol, purity, recovery as well as on total sugar lost as affected by different lengths of staleness and climatic factors prevailing during the period. Data for early, mid and late part of crushing season representing 3 climatic regions are given in tables 1, 2 and 3 respectively. Except for brix that resulted in an increase from 16.40 to 17.62 fro early from 17.19 to 19.17 for mid from 18.65 to 20.43 for late crushing season, all other parameters have recorded a highly significant (1% level) decrease due to staleness. Perdomo and Ramos (1977) in a 'deterioration of cane after harvesting study' also observed similar increase in brix but a fall in pol, purity etc.

The trend of effect of staleness on all the parameters studied is gradual but cumulative. Initially, the effect for one day staleness is not significant but them the deterioration has become sharp and highly significant. Kapur and Kumar (1977) while studying post harvest deterioration of sugarcane reported that by third day, the effect of staleness in terms of sugar content, purity etc. were significant and they suggested transportation of cane to the factory before this. Gupta *et al*. (1968) also reported that post harvest deterioration after lapse of certain time was very significant.

The weight loss of green cane is one of the parameters studied that fits into the above description The green detrashed cane when left exposed has simply dried up due to staleness through the physiological process and the weight loss has increased upto 8.23%, 8.47% and 11.39% over a period of six days during the different part of the crushing season.

Pol, purity and % recovery have also shown similar significant decrease and % recovery in the parameter that is affected worst. The loss is a colossal one and almost 50% of the total recoverable sugar is lost (48.72 fro early and 47.31 fro late crushing season0. During the cooler period i.e. the mid crushing season of late January when the temperature is lowest, the loss is a little bit lower but none the less it (loss) has reached (35.12%). wood *et al.* recorded about 14% recoverable sugar loss for a staling period of 4-7 days.

The total sugar per acre lost due to staleness is, except for the first day of staleness, highly significant and when our tons sugar production per acre is around 2.35 (even with 30 TCA), already the lowest in the world, the loss due to this factor alone is as high as 50% which is evident when seen dropping it to as low as 1.105 TSA (Figure-1) against the initial of 2.39 TSA. Lingerfelt *et al*. (1965) while studying the rate of deterioration after harvest reported that the loss of cane weight and inversion of sucrose has an extremely important effect on the rates of recoverable sugar to tonnage of fresh cane and they termed these losses as 'hidden losses'. They quantified the daily average loss of 96^{o} sugar slightly greater than 10lbs of sugar per ton of cane per day or approximately 4f% of initially available sugar.

The climatic effect is, as seen from the same figure, once again prominent when we consider the graph for late season. In this cane, the start is at the highest (2.39 TSA) but still the same has the lowest figure of 1.105 TSA indicating a heavy loss. Interestingly, the mid season graph, though started with a lowest figure of 2.289 TSA, has also the lowest slope and consequently, the minimum loss. The early season graph is in between these two extremes and the position is clearly mostly a weather-dependent one. Wood *et al.* (1972) while conducting an experiment to study deterioration losses in whole stalk sugarcane observed that the rate of deterioration varied considerably depending on weather conditions and that the loss was most rapid in the hot summer months.

Because of its so great an economic impact cane should be graphed against staleness by all means and greater attention is needed during drier and warmer periods i.e. during the early and late crushing season.

Table 1. Effect of different lengths of staleness on Weight, Brix, Pol, Purity, % Recovery and Total sugar per acre during the early crushing Season (Data are average of 4 observations)

Staleness	Weight loss (Kg)		Brix	Pol	Purity	% Recovery	TSA lost
	Initial wt.	Final Wt.					
0	6.23	6.23	16.40	14.34	87.43	7.80	0.0000
1	5.30	5.17	16.65	14.39	86.39	7.46	0.025.
2	6.03	5.88	16.60	14.25	85.88	6.85	0.0710
3	5.45	5.27	17.09	13.00	76.09	5.55	0.2228
4	6.50	6.08	17.39	12.31	70.85	4.78	0.6202
5	6.02	5.54	17.62	12.17	69.02	4.44	0.8034
6	6.32	5.80	16.96	11.41	67.26	4.00	0.9382

Table 2. Effect of different lengths of staleness on Weight, Brix, Pol, Purity, % Recovery and Total sugar per acre during the mid crushing Season (Data are average of 4 observations)

Staleness	Weight loss (Kg)		Brix	Pol	Purity	% Recovery	TSA lost
	Initial wt.	Final Wt.					
0	6.10	6.10	18.65	16.46	88.23	7.99	0.0000
1	5.53	5.40	18.43	15.94	86.47	7.40	0.3434
2	5.92	5.68	18.55	14.98	80.74	6.48	0.1835
3	5.70	5.40	18.77	14.87	78.74	6.25	0.2786
4	5.78	5.25	20.43	15.23	74.52	5.47	0.6933
5	5.72	5.15	20.43	14.04	68.71	4.65	0.9990
6	5.62	4.98	20.37	13.63	66.78	4.21	1.2916

Table 3. Effect of different lengths of staleness on Weight, Brix, Pol, Purity, % Recovery and Total sugar per acre during the late crushing Season (Data are average of 4 observations)

Staleness	Weight loss (Kg)		Brix	Pol	Purity	% Recovery	TSA lost
	Initial Wt.	Final Wt.					
0	6.10	6.10	18.65	16.46	88.23	7.99	0.0000
1	5.53	5.40	18.43	15.94	86.47	7.40	0.0434
2	5.92	5.68	18.55	14.98	80.74	6.48	0.1835
3	5.70	5.40	18.77	14.87	78.74	6.25	0.2786
4	5.78	5.25	20.43	15.23	74.52	5.47	0.6933
5	5.72	5.15	20.43	14.04	68.71	4.65	0.9990
6	5.62	4.98	20.37	13.63	66.78	4.21	1.2916

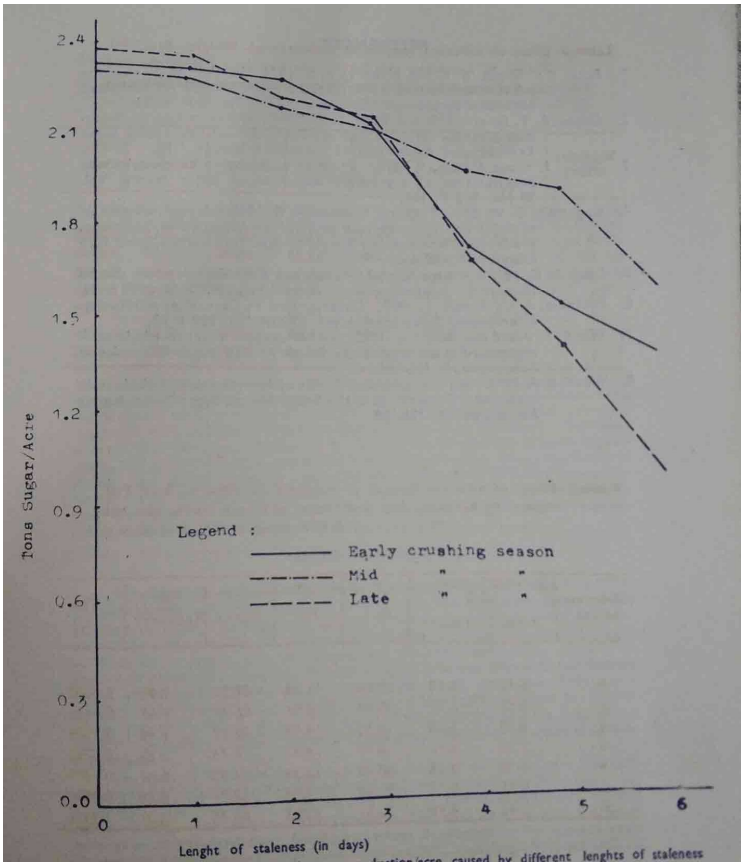

Figure 1. Reduction in total sugar production/acre caused by different lengths of staleness during early, mid and late crushing season.

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Studies on N-Fertilization of Sugarcane under the Tista Flood Plain and the Ganges River Flood Plain Soil Conditions

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SUMMARY

Studies on nitrogen requirement of some sugarcane varieties were made in the Tista flood plain soils of Jaipurhat Sugar Mills (JSM) farm and the Ganges river flood plain soils of Carew and co. farm. Five cane varieties namely Co 1158, Co 975, Bo 17, ISD 9/57 and ISD 2/54 were tested against 50, 100, 150 and 200 lbs N per acre. Control plot received no nitrogen. the experiments were conducted during 1975-1976 crop year under rainfed condition in a split plot design. N-application did not effect germination, but varietal difference in this respect was found to be significant at 0.01 level. Tillers per clump of the cane increased significantly at higher levels of N at JSM farm only though varietal difference in tillers were found significant on both the farms. At Carew & Co., N showed positive influence on cane height and millable cane, varietal differences were also found here in this respect, but such types of manurial or varietal effects were absent on cane height or millable cane at JSM farm. Tons cane per acre increased with increasing N levels and the results were significant at 0.01 level at both the locations. At Carew & Co., 200 lbs N gave significantly among the N-treatments. Varietal difference on cane yield was significant at JSM only. N-application did not affect % sugar recovery at Carew & Co. and brix at JSM farm. At both the locations, 200 lbs N gave highest cane yield indicating higher requirement of N than what is being used now.

INTRODUCTION

Sugarcane is a biennial crop having demand on nutrients like NPK. Bangladesh falls under the monsoon climatic zone it receives heavy rainfall creating shortage of soluble nutrient like N due to leaching and other environmental factors in the soil, for which sugarcane crop needs supplementary nitrogen to meet up its requirement for proper growth and development. This is an important aspect of nitrogen fertilization, since dose and time of its application varies under different agroclimatic conditions (Singh and Singh- 1972). But a very limited research on nutritional aspect of sugarcane was done in the past in our country without covering all types of soils and the present dose of 110 lbs N per acre for plant cane may not be the proper dose for all types of soils in Bangladesh.

The soils of JSM farm and Carew & Co. farm fall under the two different physiographic units of the Tista flood plain and the Ganges river flood plain respectively. The soils of the experimental plot at JSM farm contained organic matter 0.69%, N-0.036% and had a pH 6.1. The soils of Carew & Co. farm belongs to the Ganges river flood plain which developed by the Ganges river (Brammer, 1971) and contained organic matter-0.90%, total N-0.048% and pH 7.2. Since the nitrogen level of the two soils is low, it is apprehended that the present dose of nitrogen is not sufficient for proper cane growth in these types of soils. Under the circumstances, two similar types of experiments were conducted to test the response of five commercial cane varieties against 5 different levels of N on the soils of JSM and Carew & Co. farms, and to determine the proper dose of N for plant cane for these soils.

MATERIALS AND METHODS

Two experiments, one at JSM farm and one at Carew & Co. farm, were conducted separately during 1975-1976 crop year. In both the experiments, 5 commercial cane varieties namely Co. 1158, Co. 975, Bo 17 ISD 2/54 and ISD 9/57 were tested against 5 different N levels such as O, 50, 100, 150 and 200 lbs N per acre. The treatments numbering 25 were replicated 4 times in s split plot design. The varieties were placed in the main plot and the N levels in the sub plots. Three budded equal number of assorted setts were planted end to end in each plot at the rate of approximately 60 maunds/acre. Plot size was 28 x 28 with 8 rows/plot. Spacing of cane rows ere 3.5 and the distances from plot to and block to block were 5' and 6' respectively. Present usual doses of 110 lbs p_2o_5 and 97 lbs K2O per acre for JSM were applied in all the plots. At both the locations, the cane was planted in November, 1975 and harvested in January, 1977 and the experiments were carried out under rainfed condition. Before planting sugarcane, soils of the two experimental plots were analyzed for N, organic matter and PH.

From the experiments, data on the following characters were collected and statistically analyzed to determine the response of cane verities to different N-levels : percent germination, tillers per clump, cane height and millable canes at harvest, tons cane per acre and percent recovery of sugar. At JSM farm, due to lack of analytical facilities at the time of the cane harvest, brix readings instead of percent recovery of sugar were taken by Hand refractometer.

RESULTS AND DISCUSSION

At both locations, N-application did not affect germination, but varietal difference in germination was found significant at 0.01 level.

Tillers per clump of cane significantly increased at higher N-levels at JSM. This effect was absent in Carew and Co. farm. Varietal difference in respect of number of tillers per clump was also significant on these factors but such type of manorial and varietal response on height was not observed at JSM farm.

Data on the effect of different levels of nitrogen on tons cane per acre of JSM farm and Carew & Co. farm are presented in table 1 and 2 respectively. Tons cane per acre increased with increasing N levels and in both experiments the results were significant at 0.01 level. The results also showed linear response to the increasing levels of N. In both experiments, the application of 200 lbs N gave highest average yield of cane producing 34.62 and 46.11 TCA at JSM and Carew & Co. farms respectively.

Table 1. Effect of different levels of N on yield of different varieties of cane (tons/acre) at JSM farm. (Tista Flood plain).

N-levels / Varieties	0	50 lbs	100 lbs	150 lbs	200 lbs	Mean
Co 1158	32.50	36.71	36.71	33.71	40.70	36.07 a
Co 975	22.81	25.65	25.41	24.46	20.89	23.84 d
Bo 17	22.76	30.59	32.51	31.91	32.77	30.11 c
ISD 2/54	27.06	30.91	37.88	39.38	42.22	35.49 ab
ISD 9/57	24.39	29.36	33.98	34.70	36.51	31.79 bc
Mean	25.90 b	30.64 a	33.30 a	32.83 a	34.62 a	

Figures bearing same letter do not differ significantly at 5% level.

Table 2. Effect of different levels of N on yield of different varieties of cane (tons/acre) at Carew & Co. farm (Gangatic alluvium)

N-levels / Varieties	0	50 lbs	100 lbs	150 lbs	200 lbs	Mean
Co 1158	35.57	37.31	44.38	38.41	46.66	40.47
Co 975	33.55	42.46	36.95	43.45	49.26	41.13
Bo 17	38.93	39.09	41.68	46.90	46.90	41.94
ISD 2/54	34.70	42.25	42.81	44.30	46.67	42.15
ISD 9/57	33.10	34.49	37.33	43.23	41.04	37.64
Mean	35.17 c	39.12 b	40.36 b	42.30 ab	46.11 a	

Figures bearing similar letters do not differ significantly at 5% level.

Table 3. Effect of different levels of N on % brix of different varieties of cane at JSM farm. (Tista Flood plain)

N-levels / Varieties	0	50 lbs	100 lbs	150 lbs	200 lbs	Mean
Co 1158	18.29	18.47	18.19	17.69	18.70	18.27
Co 975	18.03	20.14	22.54	18.21	19.15	19.62
Bo 17	17.14	18.11	19.13	20.27	20.00	18.93
ISD 2/54	18.98	18.06	18.37	20.14	17.30	18.57
ISD 9/57	18.75	19.94	20.83	20.59	18.76	19.77
Mean	17.24	18.94	19.81	19.38	18.78	

Table 4. Effect of different levels of N on % recovery of sugar of different varieties of cane at Carew & Co. farm (Gangetic alluvium)

N-levels / Varieties	0	50 lbs	100 lbs	150 lbs	200 lbs	Mean
Co 1158	10.50	10.80	9.55	9.84	10.02	10.14
Co 975	10.81	10.59	10.08	10.77	10.59	10.57
Bo 17	10.52	10.57	10.97	10.86	10.46	10.68
ISD 2/54	10.26	10.57	10.35	10.22	10.56	10.39
ISD 9/57	10.64	10.88	10.62	11.03	10.43	10.72
Mean	10.55	10.68	10.31	10.54	10.41	

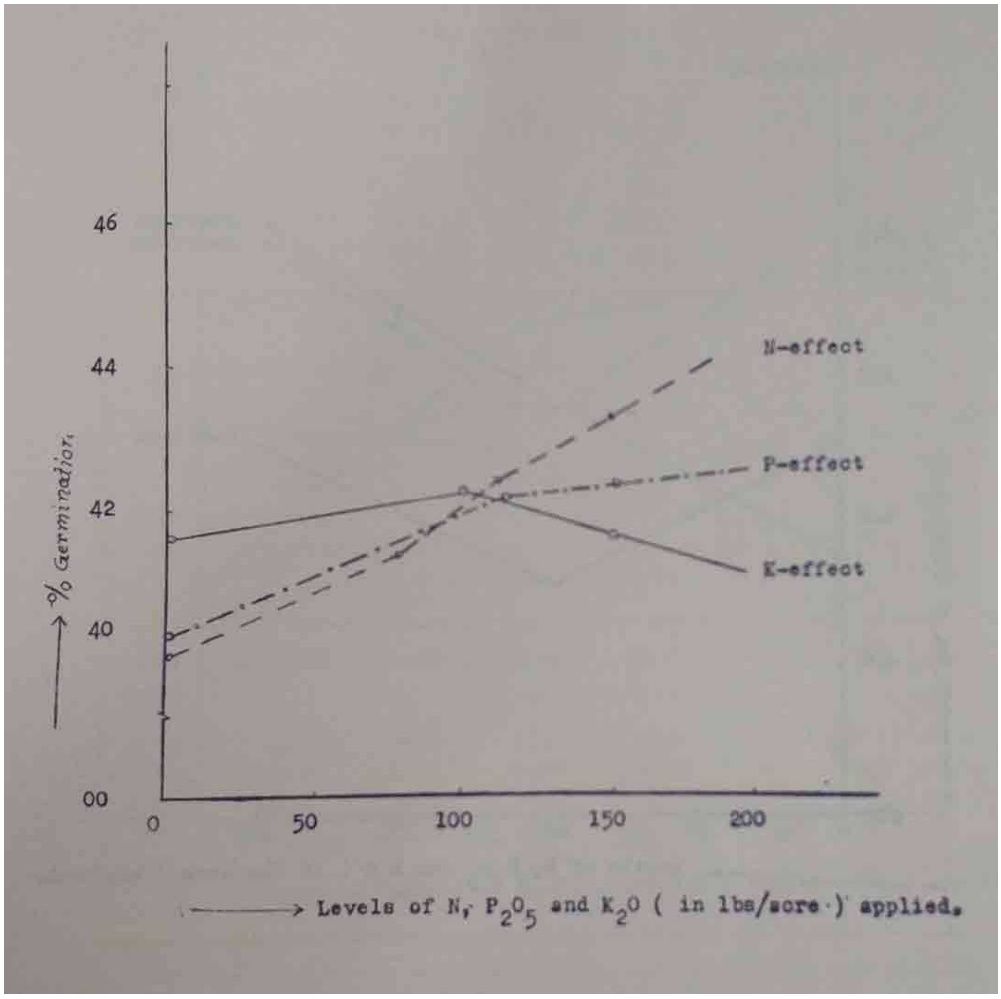

Figure 1. Effects of different levels of N. p & k on % germination of sugarcane.

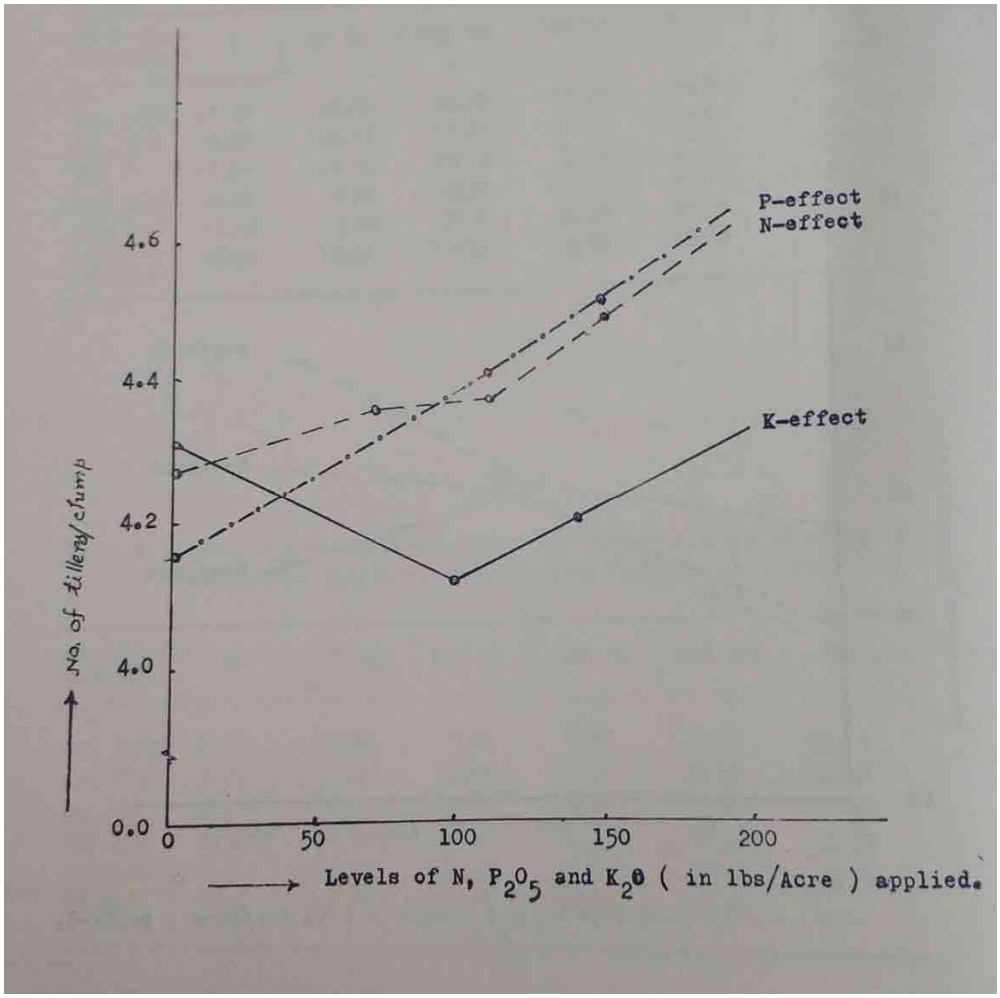

Figure 2. Effects of different levels of N. P & K on tillers/clump

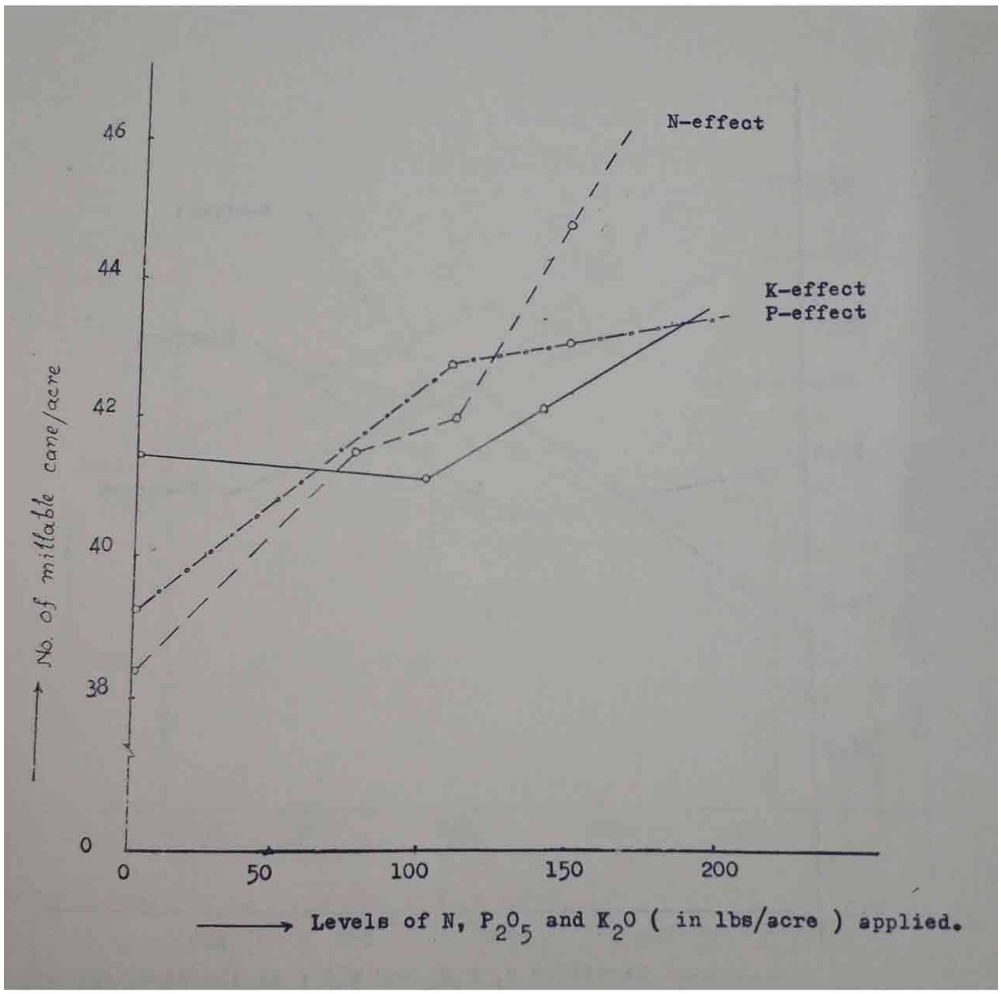

Figure 3. Effects of different levels of N.P & K on millable cane/acre.

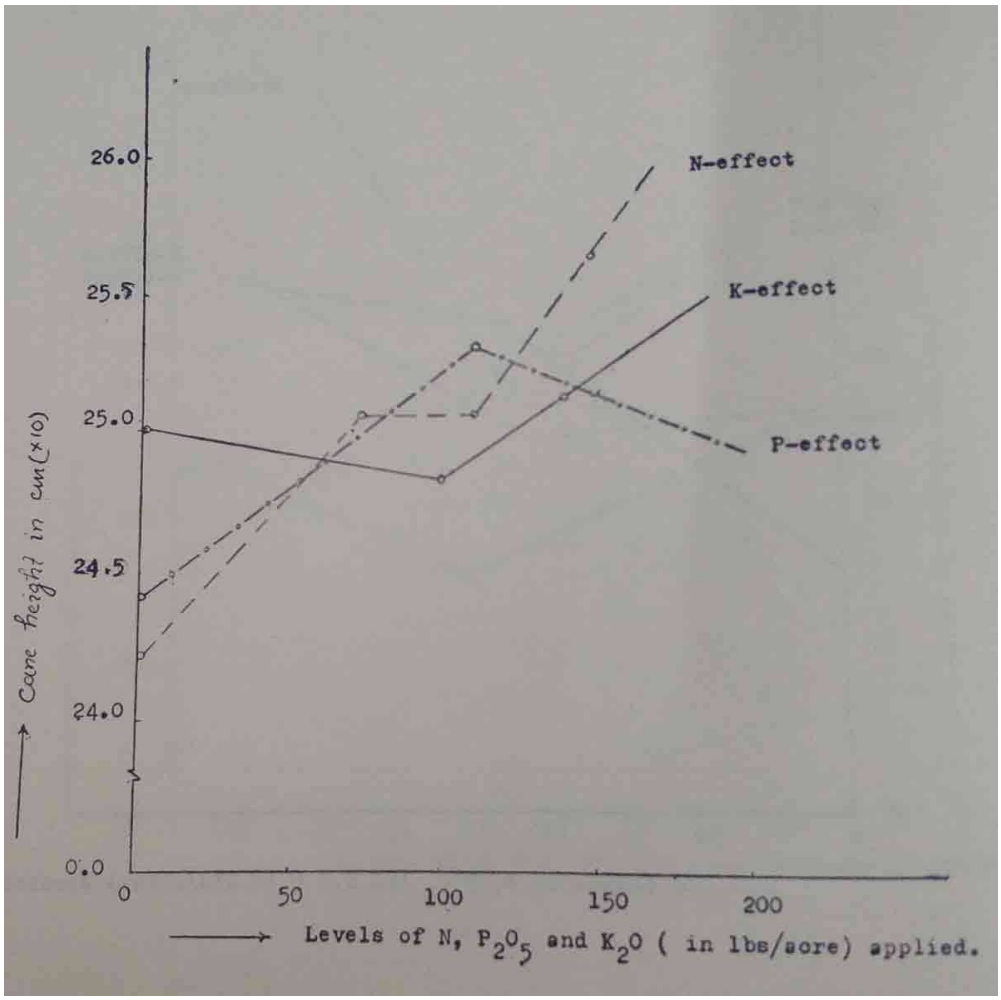

Figure 4. Effect of different levels of N. P & K on cane height.

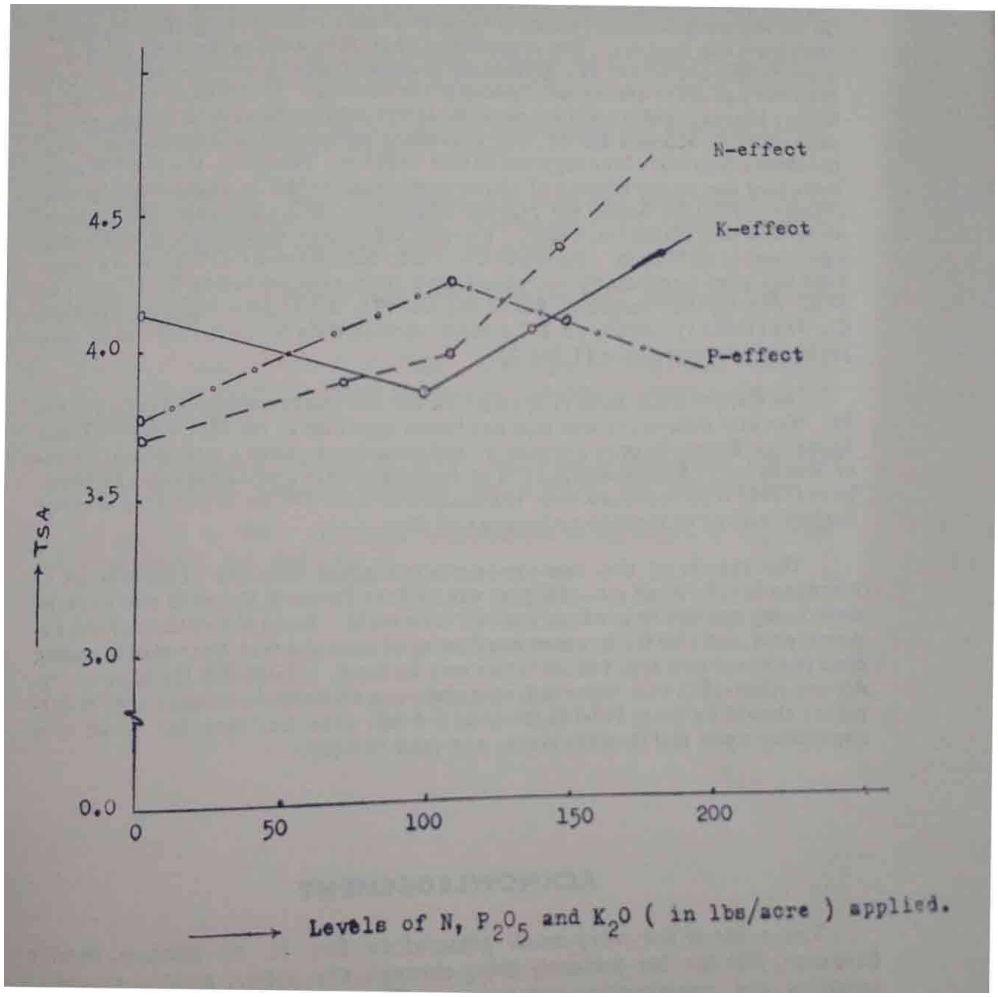

Figure 5. Effects of different levels of N. P & K on tons sugar per acre.

At Carew & Co. 200 lbs N gave highest yield among all the treatments, followed by 150 lbs N., 100 lbs N and 50 lbs N gave identical results in respect of cane yield, but significantly different from the control. The response of N at JSM with respect of yield was a bit erroneous where N significantly increased yield over the control but they did not differ statistically amongst themselves. This lack of response to higher N doses at this location could be attributed to the severe lodging of the varieties Co. 975 and BO 17, the prevailing agroclimatic factors etc. The result needs further investigation in this respect. However, the yield of cane increased due to application of nitrogen was supported by many investigators (Parihar 1971; De Geus-1967l Onkar Singh *et al*., 1972l Samuels, 1967l Iyer, *et al*., 1960 and Humber, 1968). Varietal difference in cane yield was found significant at JSM farm. Varieties Co. 1158, ISD 2/54 and ISD 9/57 were identical but gave significantly increased cane yield over varieties Bo 17 and Co. 975. Among the varieties, BO 17 and Co. 975, BO 17 gave higher yield than Co. 975 (Table 1) At Carew & Co. farm, varietal difference in respect of cane yield was also significant (Table 2).

At Carew & Co. farm N application did not affect sugar recovery (Table 3). Varietal difference was also not found significant. At JSM a farm (Table 4), no significant effect on percent brix of cane due to either nitrogen or variety was found, similar effect of N on sucrose content was observed by Humbert (1968) who reported that application of upto 250 lbs N per acre was not harmful either to sucrose or tonnage of cane.

The results of the two experiments suggest that the requirement of nitrogen for the plant cane is higher specially at Carew & Co. than the present dose being applied to produce desired cane yield. From the results of the experiments, and also from economical point of view the fertilizer rate for plant cane for these two types of soil units may be from 110-lbs -200 lbs N per acre. Ali and Khan-1972 also reported from their experimental evidence that N-fertilizer should be from 110-145 lbs N or 3-4 mds urea per acre for plant cane depending upon soil fertility status and cane variety.

ACKNOWLEDGEMENT

The authors are very much grateful to Dr. M. M. Rahman, former director, SRI for his patiently going through the paper making essential scrutiny and constructive suggestions. The services of Mr. Nasiruddin, ACPS and the Chemical Section of Carew and Co. as well as Mr. Ataur Rahman, ACPS of JSM are gladly acknowledged Mr. Mozammel Haque, Assistant Statistician, SRI did the statistical analysis part of this paper.

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A Study on the Effect of Application of N P K Fertilizer on Growth, Yield and Sucrose Content of Sugarcane

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SUMMARY

An experiment was conducted at Sugarcane Research Institute (SRI) farm during 1976-77 cropping season with different levels of NPK fertilizers using a factorial arrangement, in order to determine a suitable combination of these fertilizers for best growth, yield and % recovery of sugarcane. the levels were 0, 70, 110 lbs N/acre; 0,110, and 150 lbs P_2O_5/acre and 0, 100 and 140 lbs K_2O/acre. Variety Co 1158 was used in the experiment and the treatment combinations numbering 36 were replicated thrice. the cane planted in November, 1976 and harvested in January, 1978 was grown under rainfed conditions. N and P showed significant effects on germination, tillering, number of millable cane and yield of cane. cane height has a significant increase but only due to application of N whereas P or K failed to do so. Application of K did not show any significant influence on any of the parameters studied. The highest yield of cane was obtained at $N_3P_2K_0$ treatment i.e. where 150 lbs N and 150 lbs P_2O_5 per acre with no K were applied. Percent recovery of sugar due to application of any combinations of fertilizers remained statistically identical with the control.

INTRODUCTION

Sugarcane is a biennial crop, and it needs nutrients in greater amount than any other field crops for its proper growth. Judicious use of NPK fertilizers alone can increase both cane yield and total sugar production by many folds.

Applications of N, P or K alone or in combinations have shown significant increase in these parameters (Gumaste and Brave, 1960; Tabayoyong and Rabeniol, 1972; Bumbert, 1968; Parthasarathy, 1972; Singh and Singh, 1972 and Islam and Ali, 1978) though only a few research work were done in the past in these lines for sugarcane crop under Bangladesh agroclimatic conditions. On the other hand, balanced fertilization is the theme of any present-day nutrition schedules (Ali and Khan, 1972) and though response of these elements may vary according to their functions and needs in the plant system or to climate, soil and its fertility status, the best is to use them together in a well suited combination taking into consideration the factors mentioned above.

This work was undertaken to make a systematic study on NPK fertilizers for sugarcane under SRI farm soil conditions to determine the best combination of these for better yield and sugar production.

MATERIALS AND METHODS

The experiment was conducted during 1976-77 cropping season on a typical Gangetic flood plain soil of SRI farm, some characteristics of which are given below:

Texture	pH	% organic matter	%N	Available P in ppm.	Exchangeable K in ppm.	CEC meq/100gm.
Loam	7.8	1.28	0.071	15	123	16.07

Different levels of N, P and K from urea, triple super phosphate and muriate of potash respectively, used in the experiment, were as follows:-

N-0, 70, 110 and 150 lbs N/acre

P-0, 110 and 150 lbs P_2O_5/acre

K- 0, 100 and 140 lbs K_2O/acre

The design of the experiment was randomized complete block with a factorial arrangement of the treatments. The variety used was co 1158 and treatments numbering 36 were replicated thrice.

The size of each plot was 28' x 28' and distance between blocks, plots and rows were 6", 5" and 3.5" respectively. Three budded equal number of assorted setts were planted end to end in each plot at the rate of 60mds/acre.

Total quantity of triple super phosphate and 1/3 of urea and muriate of potash fertilizers, wherever applicable, were applied at planting time in the trenches. The rest 2/3 of urea and muriate of potash were split into two and applied as top-dressed in early April and June. the cane was planted in November, 1976 and harvested in January, 1978. The experiment was conducted under rainfed conditions.

Data on germination, tillering, cane height, millable cane, cane yield, % recovery of sugar as well as total sugar production were collected, statistically analyzed and represented here.

RESULTS AND DISCUSSION

The study undertaken considered effects of different levels of N, P & K and also their interactions but mostly single effect of different elements are presented here to point out the importance of respective fertilizer. Application of N and P fertilizers have shown significant effects on germination and tillering (Figs 1 & 2). Both the factors increased almost in early with N doses per clump at N_{150} for germination and tillering respectively but P had the same effect only on tillering which increased from 4.18 per clump at P_0 to 4.45 at $P_{150.}$ The germination was maximum (42.89%) at PI level i.e. where 110 lbs P_2O_5 per acre was applied. Enhancement of germination and tillering due to N or P applications are not uncommon and have been reported by Van Dillewijin, 1961 and Islam *et al.* 1976. The effect of K on these parameters was not significant and higher levels of K had even a depressing effect on % germination when we consider 41.79% at K_{100}. This could be due to K salt effect as suggested by Tisdale and Nelson, 1975.

Significant positive effect due to N and P application was found on number of mill able cane (fig. 3) though cane height increased only either N (fig. 4) K had, once again, no significance influence on either of these characters.

Data on yield of cane is presented in table-1. Tons cane/acre increased at 1% level due to both N and P application (from 33.82 TCA at N_0 to 39.86 TCA at N_{150} and from 34.03 TCA at P_0 to 38.53 TCA at P_{110}. Very much like germination or tillering, the yield response to increasing N was a linear one but in case of P, it was highest at P_{110} level. Neither the effect of K nor the interaction of N, P or K on cane yield was found significant. Islam and Ali, 1978 conducted experiment on a similar type of soil and reported that Cane yield increased significantly with increasing N levels. The yield increase due to N and P applications is also reported by many investigators (Parihar, 1971; De Geus, 1967; Singh and Singh, 1972; Humbert, 1972 and Islam et at, 1976).

Table 1. Effect of NPK fertilizer application on tons cane/acre

(a) Combined effects of NP and Single effect of N and P on yield of Sugarcane (tons cane/acre)

P-levels / N-levels/	P_0	P_{110}	P_{150}	Single effect of N.
N_0	31.58	36.62	33.25	33.82 b
N_{70}	32.93	38.91	36.54	36.13 ab
N_{110}	33.64	37.21	36.56	35.81 ab
N_{150}	37.98	41.36	40.23	39.86 a*
Single effect of P	34.03 b	38.53 a	36.65 ab	

(b) Combined effects of NK and Single effect of K on yield of Sugarcane (tons cane/acre)

K-levels / N-levels/	K_0	K_{100}	K_{140}
N_0	34.38	32.28	34.80
N_{70}	34.30	35.96	37.12
N_{110}	34.17	36.73	36.52
N_{150}	42.53	37.54	37.51
Single effect of K	36.34	35.63	37.24

(c) Combined effects of PK on yield of Sugarcane (tons cane/acre)

K-levels / P-levels/	K_0	K_{100}	K_{140}
P_0	33.76	33.18	35.13
P_{110}	38.83	37.25	39.50
P_{150}	36.42	36.45	37.07

*Letter followed by same letter is not significantly different at 1% level as per DMRT test.

The fact that K failed to increase yield of cane over control whether in presence or in absence of N and P is also not uncommon (anonymous, 1965-1966). Taboyoyong and Robeniol (1962) pointed out that sign cant increase in yields of cane from potash fertilization was found when the soil available K was below 95 ppm. No response was obtained from soils with available K above 120 ppm. and this explains the non-response of K on SRI soil (K-content 123 ppm).

Percent recovery, another importance parameter of sugar production was also studied and application of NPK did not change % recovery over control significantly (table 2). That N application up to 250 lbs per acre does not change sucrose content appreciably was reported by Humbert (1968) and also anonymous (1965-1966). Islam et al (1976) and also Islam et al (1978) reported that P or K did not show any effect on sugar recovery. On the other hand, application of NPK fertilizers enhanced total sugar production significantly and the increase is most prominent in case of N (fig.5) where it reached about 18% (from 3.70 TSA to 4.38 TSA). There is increase with P and K also (fig.5) but not as linear as N effect.

The results of the experiment show that the requirement of nitrogen for plant cane on this type of soil is higher than the present dose. The response of P was rather peculiar. So far single P is concerned, the yield increased at 1% level at 110 lbs P_2O_5/acre but when NPK were applied together, the highest yield was obtained at N_{150} P_{150} K_0. This is highly natural since N & P interaction, though not significant, has raised not only the cane yield but also the need of each other.

Table 2. Effect of NPK fertilizer application on % recovery of Sugarcane.

(a) Combined effects of NP and Single effect of N and P on % recovery of Sugar.

P-levels / N-levels/	P_0	P_{110}	P_{150}	Single effect of N.
N_0	10.89	11.12	10.80	10.94
N_{70}	10.94	10.91	10.74	10.86
N_{110}	10.70	11.05	11.33	11.03
N_{150}	11.03	11.02	10.88	10.98
Single effect of P	10.89	11.03	10.94	

(b) Combined effects of NK and Single effect of K on % recovery of Sugar.

K-levels / N-levels/	K_0	K_{100}	K_{140}
N_0	11.21	10.83	10.77
N_{70}	10.95	10.93	10.70
N_{110}	10.94	10.95	11.20
N_{150}	11.12	10.89	10.92
Single effect of K	11.06	10.90	10.90

(c) Combined effects of PK on % recovery of Sugar

K-levels / P-levels/	K_0	K_{100}	K_{140}
P_0	10.99	10.88	10.79
P_{110}	11.07	10.98	11.03
P_{150}	11.11	10.84	10.87

This is a well known synergistic effect. Since 150 lbs N (4 mds urea) and 150 lbs P2Os (4 mds TSP) per acre have significantly increased both cane and sugar yield, application of these higher dose of N and P fertilizers in comparison to present practice of applying 110 lbs N (3 mds urea) and 110 lbs P2O5 (3 mds TSP)/ acre would result in an increase of cane and sugar yield on this type of soil. The case ok K is a bit different. There was no significant response at any levels of K but altogether stoppage of application of K cannot be advocated. This element has many physiological functions in plant system including protein synthesis, translocation of sugar and entry of water etc. Moreover, to save the soil K from depletion and also to maintain the fertility balance of the soil, the present practice of applying 100 lbs K2o (2 mds MP)/ acre may continue.

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A Study on the Effectiveness of Polaris as a Chemical Ripeners of Sugarcane

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SUMMARY

A field trial was conducted at the experimental farm of the Sugarcane Research institute, Ishurdi, Pabna, in the 1876-77 crop season to asses the effectiveness of Polaris as a chemical ripener of sugarcane. Four doses of Polaris viz., 0, 3, 4 & 5 lbs active ingredient per acre were sprayed on the green forage of Cp, 1158 variety of sugarcane in min-October and the treated crop was subjected to chemical analysis for recovery at 15 days interval. Upto the 30th day following the application, there was no significant increase in recoverable sugar due to the doses tested. The highest dose of 5 lbs a.i. per acre, however, registered a significant increase in recoverable sugar recorded at 45 days of application and the effectiveness of the chemical tended to diminish subsequently. polaris was also found to induce some physiognomic effects like leaf desiccation, yellowing of leaf blades, inhibition of the spindle growth and sprouting of the terminal buds in the treated crop.

INTRODUCTION

The productivity of sugarcane which is conventionally expressed as tons sugar per acre (TSA), is the ultimate outcome of its growth and ripening process. In our country, the milling of sugarcane normally starts by the middle of November. At the beginning of the milling season, the unfavourable soil and climatic factors do not provide good natural ripening of sugarcane (Yang 1967, Alexander, 1973) and as such the recovery of sugar is considerably low. To overcome such unfavourable agro-climatic conditions and to enhance the recovery (and thereby the ultimate productivity0, the use of chemical ripeners like Polaris, Racuza, Ethrel, etc. is being tried in many advanced sugarcane growing areas of the world (Yated and Bates, 1957, Vlitos and Lawrie 1965, Michell and Tanimoto, 1965, Nickell and Takahashi, 1971, Yates, 1972, Tostron, 1973, Yang and Pao, 1974 Selleck *et al*., 1974, Frost, 1975, Yang *et al.*, 1976). The present study was undertaken to assess the effectiveness of different doses of Polaris- a chemical ripener of sugarcane with empirical formula $C_4H_{11}NO_8P_2$ developed by Monsanto Agricultural products Company (U.S.A), in increasing recovery of sugar in Co. 1158 variety of sugarcane at the early milling season.

MATERIALS AND METHODS

The study was conducted during the period from October 15 through December 15, 1977 at the experimental farm of the Sugarcane Research Institute (SRI), Ishurdi, Pabna with Co. 1158 variety of sugarcane planted in December 1976 in 3.5 feet apart rows. Four rates of Polaris viz., 0, 3, 4 and 5 lbs active ingredient (a.i.) per acre diluted in 55 gallons water sprayed on the green foliage of the full grown crop on October 15, 1977 with the help of a handy power sprayer. the plots under the control treatments were sprayed with water only. The experiment was laid out in Randomized Complete Block design with four replication. The area under each unit plot was 350 sq. ft. Normal doses of fertilizers i.e. urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP) at the rates of 3 mds. 3 mds. and 2 mds. per acre respectively were applied. Full quantity of Tsp and one-third quantity each of Urea and MP were applied as basal dressing. The remaining two-thirds were applied later in two equal splits. Other standard cultural practices like weeding, mulching, earthing up, etc. were maintained.

The initial recovery of sugar just prior to the application of Polaris was determined through the conventional Hornes' Lead-Sub-acetate method. The treated crop was subsequently analyzed at 15 days intervals by the same method for brix, pol, purity and recovery. The analyses were continued upto 60 days of application of Polaris and the results of the period analyzed in terms of % recoverable sugar were recorded and statistically analyzed.

RESULTS AND DISCUSSION

The results of the present study have been reported in table 1. Data show that upto the 30th day following the application f Polaris, there was no significant increase in recoverable sugar in the treated crop due to the different doses tested. However, the highest dose of 5 lbs. a.i. per acre registered a significant increase in recoverable sugar recorded at 45 days of application. data further indicated that the effectiveness of the chemical tended to diminish subsequently (Table 1). Similar positive results of polaris were obtained by scientists working on chemical ripening of sugarcane at different countries (Anon. 1971, Samuels *et al*. 1976). Apart from the above, Polaris was found to induce some physiognamic effects like leaf desiccation, yellowing of leaf blades, inhibition of spindle growth and sprouting of the terminal buds (Fig. 1). Side effects of this nature due to Polaris application were also reported in other countries (Anon. 1974).

Table 1. Effects of different doses of Polaris on recoverable sugar at different dates.

Treatment	% recoverable sugar recorded as on				
	Dates of application (Initial level)	15th day of application	30th day of application	45th day of application	60th day of application
T_0-Control	6.99	6.74	8.30	8.97	9.11
T_1-Polaris @ 3 lbs a.i per acre	6.66	6.94	8.41	8.96	9.37
T_2-Polaris @ 4 lbs a.i per acre	6.89	7.11	8.71	9.19	9.88
T_3-Polaris @ 5 lbs a.i per acre	6.88	7.09	8.38	9.58	9.99
LSD at 5% level	-	-	-	0.43	-

Figure 1. Photograph showing the visible side effects of Polaris on the treated crop.

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Studies on the Effectiveness of Soil Insecticide for the Control of Termites Infestation in Sugarcane

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SUMMARY

Two species of termites namely, *Odontotermis parvidens* Holm. and *Odontotermis sp.* are major pest of sugarcane in the sugar mill zones of Bangladesh. An experiment was conducted during 1976-77 crop season at a mill farm of Carew & Co. (Bangladesh) Ltd., Darsana on chemical control or termites in sugarcane by means of soil insecticides. Heptachlor 40 WP @ 2 kg. active ingredient per hectare as powder mixed with fertilizers in trenches before planting of setts, dipping of setts in a suspension containing Heptachlor 40 WP 0.25% active ingredient before planting, Chlordane 40 WP @ 2 kg active ingredient per hectare as water suspension in trenches with 1000 litres of water after placement of setts, Basudin 10G at 4 kg active ingredient per hectare as granules mixed with fertilizers in trenches before planting of setts and Agritox 50 EC @ 10 litres formulation per hectare as water suspension in trenches with 1000 litres of water after placement of setts were used against untreated (Control). At the germination phase, insecticide treatments gave 49.54-89.31% reduction of sugarcane sett damage by termite and increased number of plant population in comparison with those of untreated. Among insecticide treatments Heptachlor treatment s gave highest and Agritox treatment gave lowest reductions of sugarcane sett damage by termite. Heptachlor applied as water suspension in trenches gave highly significant reduction and Heptachlor as powder mixes with fertilizer in trenches gave significant reduction of termite infestations in grown up canes over untreated. All forms of Heptachlor treatments and the Chlordane treatment gave highly significant yield increase of sugarcane over untreated.

INTRODUCTION

Termite is a major pest of sugarcane in almost all cane growing regions of Bangladesh. It damages sugarcane setts after planting, eye buds of planted setts, young shoots on germinating and lower internodes of growing cane (Khanna *et al.*; Rajani, 1964). the germination of cane setts is adversely affected due to destruction of setts and eye buds by the insect. This results in lower plant population, gaps in the field and thus lower crop yield.

The number of species of termites infesting sugarcane in the country are not, however, definitely known. Alam (1965) reported *Microtermes* sp. as the only species infesting sugarcane.

Efforts were undertaken in India for controlling termites by applying chlorinated hydrocarbon insecticides in the soil at various rates and using different methods (Khanna *et al.*,1956 Siddiqi & Singh, 1964; Rajani, 1964; Kalra & Gupta, 1967). Alam and Abbas (1969) conducted trial using post planting application of Heptachlor @ 2 lbs active ingredient per acre and Agritox at 3 and 5 lbs active material per acre just one day after inoculation of sugarcane setts by the nymphs of the collected species of termite. They demonstrated that, the rates of infestation were upto 20.35%, 43.30-54.69% and 85.25% accruing to Heptachlor, Agritox and untreated respectively upto 60 days after application of the treatments.

This paper reports the results of some soil insecticides effecting control of termite infestation in sugarcane.

MATERIALS AND METHODS

The experiment was conducted in 1976-77 at Fulbari farm of Carew & Co. (Bangladesh) Ltd., Darsana, where natural termite infestation on sugarcane had been found to be severe during the preceding years. A randomized completer block design having four replications was used. The size of the plot was 10-meter^2.

Treatments:

Seven treatments listed below were included in the experiment.

1. Dipping of setts before planting for two minutes in a water suspension of 0.25% active ingredient (a.i.) Heptachlor (1, 4, 5, 6, 7, 8,8-Heptachlore- 3a, 4, 7, 7a tetrahydro-4, 7-endo methanoindene) 40% wettable powder (40 WP) and 0.25% Aretan-6.
2. Heptachlor 40 WP @ 2 kg a.i./ha mixed with basal doses of fertilizers and bottom soil of the trenches before planting of setts.
3. Heptachlor 40 WP @ 2 kg a.i. in 1000 litres of water/ha applied by rose can sprinkling in trenches over setts before covering them with soil.
4. Basudin (0,0-diethyl 0-(2-isopropyl 4-methyl-6-pyrimydyl phosphorothioate) 10% granules (10G) at 4 kg a.i./ha mixed with basal doses of fertilizers and the bottom of the trenched soil of the trenches before planting of setts.
5. Agritox (0-ethyl 0-(2,4,5-trichlorophenl)-ethyl monothio phosphonate) 50% emulsifiable concentrate (50 EC) @ 10 litres formulation with 1000 litres of water/ha applied by rose can sprinkling over setts in trenches before covering them with soil.
6. Chlordane (1,2,3,5,6,7,8,8,-octachloro-2.3.3a.4.7.71-hexahydro-4,7-methan-oindene 40 WP @ 2 kg a.i. with 1000 litres of water/ha applied by rose can sprinkling over setts in trenches before covering them with soil.
7. Untreated (Control).

Sugarcane setts of all treatments except those of treatment no. 1 were treated with Areatan-6 for two minutes before planting.

Planting:

The land was well prepared by repeated discing, harrowing and leveling. Equal number of 3 eyed healthy setts of variety Co. 975 were planted on November 12, `976 in trenches at a row spacing of 1 metre. Fertilizers were applied at 123.32 kg N, 123.28 kg P_2O5 and 109.83 kg K2O per hectare . All cultural practices appropriate to sugarcane were followed.

Data Collection:

Five months after planting of sugarcane, the total number of live shoots/plot were recorded. On the day of recording data, the non-germinated setts in the gaps were dug out for examination of termite damages. The setts having clear tunnelling or the eye buds damaged by termite feeding of the both were counted and percent damage of sugarcane setts in relation to the total umber or setts planted were recorded. An area of 8m2 per plot was harvested on January 28,1978. the yield of the area was recorded. the percent infestation on stalk basis war recorded by counting the actual number of stalks in the harvested area. the percent infestation on internode basis (intensity of infestation) was derived by counting the number of bored internodes of 20 termite infested canes selected randomly from each plot or all such infested canes if 20- infested

canes were not available in the cut area of a plot and expressing them as percentage of the total number of internodes of those canes.

Data analysis:

Percentage data were transformed into their angular values following Bliss (19370. Percentage data were analyzed statistically using transformed value. the L.S.D test was used to isolate the desirable treatment.

RESULTS AND DISCUSSION

Two species of termites viz. *Odontotermis parvidens* Holm. and *Odontotermis* sp. were responsible for damaging sugarcane setts and crop.

The greatest damage of 10.94% sugarcane setts causing germination failure was recorded in the untreated plots (Table 1). Compared to untreated, all insecticide treatments exhibited reduction in sett damage by the pest. the highest reduction of 89.31% over untreated was achieved by Heptachlor 2 kg a.i. applied with 1000 litres water /ha sprinkled over setts in trenches before covering with soil. Reduction in sett damage for other treatment viz., dipping of setts in Heptachlor 0.25%a.i. + 0.25% Aretan-6 suspension, heptachlor 2 kg a.i./ha mixed with fertilizers and trench soil before planting., Basudin 4 kg a.i./ha mixed with fertilizers and trench soil before planting, Agritox 50 EC 10 litres water/ha sprinkled over setts in trenches before covering with soil and Chlordane 2 kg a.i.+1000 litres water/ha sprinkled over setts in trenches before covering with soil were 86.38%, 86.38%, 72.12%, 48.54% and 78.52% respectively over untreated (Table 1) The reduction in setts damage by termite due to the application of soil insecticides corroborated the results of Siddiqi and Singh (1964), Rajani (1964), Kalra & Gupta (1967) and Alam & Abbas (1969).

Untreated induced the least number of shoots (70.48×10^3)/ha after 5 months of planting. The application of soil insecticides, in general, induced increased number of shoots/ha (Table 1).

Table 1. Effect of soil insecticides on the sett damage by termites and shoot population/ha observed at 5 months after planting setts.

Treatment	Sett damage	Relative reduction in sett damage (%)	Shoot population per hectare ('000)
Dipping of setts in 0.25% a.i. + 0.25% Aretan-6.	1.49	86.38	138.20
Heptachlor 2 kg a.i./ha mixed with soil in trenches before planting	1.49	86.38	135.60
Heptachlor 2 kg a.i. with water/ha sprinkled over setts in trenches	1.17	86.31	124.90
Basudin 4 kg a.i./ha mixed with soil in trenches before planting	3.05	72.12	124.68
Agritox 50 EC 10 litres formulation with water per ha sprinkled over setts in trenches	5.63	48.53	138.30
Chlordane 2 kg with water/ha sprinkled over setts in	2.35	78.52	133.95

trenches			
Untreated (Control)	10.94	0	70.48

Of the soil insecticides, Agritox 50 EC produced the greatest number of shoots (138.30 × 10^3) per hectare followed by Heptachlor 0.25% a.i.+ 0.25% Aretan-6, Heptachlor 2 kg a.i./ha mixed with fertilizers and trench soil, Chlordane 2 kg a.i.+ 1000 litres of water sprinkled over setts in trenches, Heptachlor 2 kg a.i. + 1000 litres of water sprinkled over setts in trenches and Basudin 4 kg a.i./ha mixed with fertilizers and trench soil. Evidently, soil insecticides inhibited the damage of setts and buds resulting in increased germination and tillering as compared to the untreated. Siddiqi and Singh (1964) and Rajani (1964) demonstrated similar results for heptachlor and Chlordane treatments

Table 2. Effect of soil insecticides on infestation on stalk basis, intensity of infestation and yield/ha

Treatment	Infestation on stalk basis (%)	Intensity of infestation (%)	Yield/ha (Tonnes)
Dipping of setts in 0.25% a.i. + 0.25% Aretan-6.	7.33 (15.18)	9.97 (18.43)	65.59**
Heptachlor 2 kg a.i./ha mixed with soil in trenches before planting	0.85 (4.57)*	9.19 (15.10)	58.03**
Heptachlor 2 kg a.i. with water/ha sprinkled over setts in trenches	0.39 (3.08)**	8.31 (14.48)	62.43**
Basudin 4 kg a.i./ha mixed with soil in trenches before planting	14.56 (22.25)	10.71 (18.62)	42.07
Agritox 50 EC 10 litres formulation with water per ha sprinkled over setts in trenches	7.22 (14.49)	12.71 (20.71)	50.41*
Chlordane 2 kg with water/ha sprinkled over setts in trenches	5.64 (12.73)	8.45 (16.83)	55.21**
Untreated (Control)	12.55 (18.70)	9.78 (18.17)	31.14
LSD 5%	12.50	12.00	14.14
LSD 1%	15.71	15.08	19.37

Figures of parentheses are values of percentages transformed into degree of an angle.

*Indicates significant difference over untreated at 5% level.

** Indicate highly significant difference over untreated at 1% level.

Heptachlor 40 WP at 2 kg a.i. in 1000 litres of water/ha produced the least infestation (0.39%) on stalk basis followed by Heptachlor 40 WP @ 2 kg a.i./ha mixed with fertilizers and trench soil before planting (0.85%) and each on them was significantly different from the untreated (12.55%). None of the other treatment significantly differed from the control. However, Basudin 10 G at 4 kg a.i./ha mixed with fertilizers and trench soil tended to induce a greater

infestation on stalk basis (Table 2). Siddiqi and Singh (1964) and Rajani (1964) also observed a significant reduction of termite infestation in millable canes due to the application of Heptachlor and Chlordane as soil insecticides.

Soil insecticides fail to reduce the intensity of termite infestation as the intensity percentage for none of the treatments was significantly different from the untreated (Table 2).

All forms of Heptachlor treatments and the Chlordane treatment gave highly significant and the Agritox 50 EC treatment gave significant yield differences of the crop as compared to untreated (Table 2). Siddiqi and Singh (1964) and Rajani (1964) also reported significant yield increase of sugarcane at harvest due to Heptachlor and Chlordane treatments of setts at planting time by rose can sprinkling as compared to untreated.

Basudin 10G at 4 kg a.i./ha fail to increase crop yield significantly over untreated probably because of its shorter residual action in soil and greater damage of planted setts and millable canes due to termite infestation (Table 1 & 2). the initial lead of highest plant population in Agritox 50 EC treatment after five months of planting did not give extra advantage in increasing the final crop yield as compared with chlorinated hydrocarbon insecticide treatments (Table 1 & 2). This is also probably due to the shorter residual action of Agritox 50 EC ins soil as compared with chloronated hydrocarbon insecticides.

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Fungicidal Treatments of Sugarcane Setts as a Means of Disease Control

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SUMMARY

Two budded setts of variety Co 1158 were treated with six fungicides namely Areta 6, Agallol, Granosan M, Benlate, Homei and Topsin M. The randomized complete block, design with four replications was used. six hundred eye buds per treatment were dipped in the fungicides for ten minutes and then planted in the field. Dipping in water was served as control. Data on germination, tiller, yield and pathogenic associations were recorded. It was observed that none of the fungicides showed any significant difference on germination, tillering and yield of sugarcane. Three fungi namely Aspergillus, Penicillium and Fusarium were isolated and identified from the non-geminated setts and young dead plants. There was no variation in fungal association due to chemical treatments. No serious sett-or soil borne pathogen could be detected.

INTRODUCTION

A number of diseases which are known to be associated with sugarcane setts (Benda and Ricard, 1977) and those cause poor germination and death of young plants are identified in Bangladesh (Ahmed *et. al*., 1976). These sett of soil-borne pathogens are generally responsible for sett deterioration. Several studies were made to keep setts free of those pathogens (James, 1976; Lewin *et al.*, 1976; Muthusamy and Subbaraja, 1973). Mercuric compounds were generally used but recently hot water and non-mercurial systematic chemicals were advocated (James, 1976; Muthusamy, 1973; Srinivasan and Rao, 1968). In Bangladesh, mercurial fungicides like Aretan 6, Agallol and Granosan M were mostly sued. Due to hazardous nature of mercurial compounds, the present thinking is to replace mercurials by hot water and non-mercurial systemic chemicals (Reddy, 1977; Singh, 1968; Srinivasan and Rao, 1968). Three non-Mercurial systemic sett-treating chemicals were available and as such the present experiment was designed to find out a suitable pre-planting sett-treating chemical under Bangladesh pathogenic environment.

MATERIALS AND METHODS

Six fungicides namely Aretan 6, Agallol, Granosan M, Benlate, Homei and Topsin M, the last three being non-mercuric systemic, were taken in this study. the major commercial sugarcane variety Co. 1158 was used. The following doses of the fungicides were used:

Aretan 6= 0.5 percent
Agallol = 0.25 percent
Granosan M= 0.25 percent
Benlate = 0.05 percent
Homai = 0.1 percent
Topsin = 0.1 percent

The solution was prepared separately for each chemical with the above concentration and three hundred two budded setts per treatment were selected. The setts were then dipped in the solution for ten minutes and planted in the field. Water treatment was considered as control. the design was randomized complete block with four replications. Normal doses of fertilize, general

intercultural operations and pest control measures were taken. Germination count after 100 days of planting, tiller count after 200 days and yield data after 13 months were recorded. Non-germinated setts and young dead plants were collected and studied. the associated fungi in such cases were cultured, isolated and identified in the laboratory.

RESULTS AND DISCUSSION

The experiment results are presented in table 1. It is evident that setts treated with Benlate showed the lowest percentage of germination while the highest record of germination was obtained in case of Aretan6. It was found from the statistically analysis that there were no significant difference among the treatments (Table 2). The germination percentage of systemic fungicides, in general, was lower than the mercurial compounds. Reddy (1977) reported that in Fiji mercurial compounds gave better germination than the systemic chemicals.

The maximum number of tillers were obtained when Aretan 6 was used as pre-planting treatment while setts treated with Topsin M showed minimum number of tillers. however, there was no significant difference among the chemicals (Table 3). Similar in significant difference was obtained in case of yield of sugarcane for different treatments (Table 4), although highest yield was recorded or Homai and lowest yield for Granosan M.

Table 5 summarizes the observations on fungal association on Co 1158 upon treatment with different fungicides. In all, three fungi could be isolated and identified. They were Penicillium, Fusarium and Aspergillus. These fungi except Fusarium, are not pathogenic to sugarcane. Fusarium, on the other hand, could neither produce any disease symptom nor responsible for settling death in this study. The most important sett-rotting pathogens like Ceratocystis, Colletotrichum, Helminthosporium, Pythium, Cephalosporium could not be detected.

The findings of the present investigation indicated that there was no significant difference in germination, tiller and yield of sugarcane for treating setts with different fungicides. generally the failure of germination and death of young tillers which directly contribute on yield are due to the incidence of pineapple and red rot diseases. the pre-planting sett treatment by chemical means is generally done to control such sett-and soil borne diseases. The present experiment was conducted with a resistant variety and disease free setts were taken. Moreover, field-detection of pineapple disease in Bangladesh could not have yet been possible (Ahmed, *et. al.*,1977). There was variation in the findings of the present study and those done by others, but this may be due to disease reaction of the variety and the pathogenic environment of the country. However, further studies are going on to confirm the results.

Table 1. Average germination percentage, total tiller and yield of Co 1158 upon treatment with six fungicides.

Fungicides	Germination (%)	Total tiller	Yield (b)
Aretan 6	58	392	465
Agallol	54	361	431
Granosan M	56	350	419
Benlate	44	354	439
Homai	48	360	493
Topsin M	53	347	425
Water	50	355	477

Table 2. Analysis of variance showing the effect of sett-treating chemicals on germination of Co 1158.

Source of variation	d.f.	S.S.	M.S.	F
Total	27	3740.68	138.54	
Treatment	6	1151.93	191.99	1.48
Block	3	259.25	86.42	0.67
Error	18	2329.50	129.42	

Table 3. Analysis of Variance showing the effect of sett-treating chemicals on tillering of Co 1158

Source of variation	d.f.	S.S.	M.S.	F
Total	27	60859.71		
Treatment	6	5374.71	895.79	0.321
Block	3	5191.42	1730.47	0.619
Error	18	50293.58	2794.09	

Table-4: Analysis of Variance showing the effect of sett-treating chemicals on yield of Co 1158

Source of variation	d.f.	S.S.	M.S.	F
Total	27	311538.68		
Treatment	6	19795.93	3299.32	0.32
Block	3	104334.68	34778.23	3.34
Error	18	187406.07	10411.45	

Table-5: Fungi isolated from non-germinated setts and young dead plants of Co 1158 upon treatment with six fungicides.

Fungicides	Fungal Colonies obtained
Aretan 6	*Penicillium* sp.
Agallol	*Penicillium* sp., *Fusarium* sp.
Granosan M	*Fusarium* sp.
Benlate	*Penicillium* sp., *Fusarium* sp., *Aspergillus* sp.
Homai	*Penicillium* sp., *Fusarium* sp., *Aspergillus* sp.
Topsin M	*Penicillium* sp.
Water	*Penicillium* sp., *Fusarium* sp., *Aspergillus* sp.

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Estimates of Genotypic and Phenotypic Variation, Heritability and Genetic Advance under Selection of Some Characters of Sugarcane Clones

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SUMMARY

An experiment was conducted in the year 1976-77 with 9 promising sugarcane clones form advance selection stage and one standard variety at Sugarcane Research Institute, Ishurdi, Pabna. The genotype and phenotypic variation, co-efficient of variability, heritability and genetic advance under selection were determined for germination percentage, tillering per clump, stalk height, stalk diameter, yield of cane per acre, recoverable sucrose contents and per acre sugar yield. The difference between phenotypic and genotypic variance were very small in all the cases except germination percentage, indicating that the environmental influence on germination was very prominent. Yield of sugar per acre, germination percentage, yield of cane per acre and tillering per clump exhibited high degrees of genotypic and phenotypic co-efficient of variability. High heritability percentage in broad sense was observed in case of sugar yield per acre, recoverable sucrose content, yield of cane per acre and germination percentage. High values of genetic advance expressed as percentage of mean values were observed in case of sugar and cane yield per acre and germination percentage of the clones. Yield of sugar and cane per acre and germination percentage demonstrated high degrees of genetic variability, heritability and genetic advance under selection and were amenable to selection.

INTRODUCTION

The aim of any plant breeding programme is to develop commercial varieties having greater production potential. This potentiality of the materials may be due to inherent genetic superiority in yield or quality, resistance to pests and diseases, improved agronomic characters or to a combination of such factors. Under plant improvement programme breeders' problem is to breed new variants and to select genetically superior ones for further testing. Genetic variants normally vary due to genetic and environmental factors. Combined variation due to the above two factors of a particular character is the phenotypic variance. Genotypic variance is the effect of the particular assemblance of genes possessed by the individual and environmental deviation is the value of non-genetic circumstances that affect the phenotype. And the proportion of the total phenotypic variance that is to genotypic is measured by heritability.

As cross-pollinated crop, sugarcane has a wide range of variability between clones. In order to select suitable genotypes it is necessary to partition the observed variability into its heritable and non-heritable components with the help of suitable parameters.

The purpose of this investigation was to estimate the genetic and environmental component of variance, heritability, co-efficient of variability and expected progress from selection in some characters of sugarcane clones.

MATERIALS AND METHODS

Field experiment and data collection

The experiment was conducted at Sugarcane Research Institute, Ishurdi, Pabna during the cropping year 1976-77. the experimental materials included 10 sugarcane clones (9 promising strains and 1 standard variety). The experiment was laid out in randomized complete block design with four replications. Each clone was grown in a plot of 30´ × 30´ maintaining 4´ row to row distance. Normal cultural practices were followed:

1. Data on the following characters were recorded.
2. Germination percentage at 75 days of plantation.
3. Tillering per clump at 150 days of plantation.
4. Stalk height (in ft.) and diameter (in cm) at harvest.
5. Yield in TCA (Ton Cane per acre).
6. Recoverable sucrose content (in percentage)
7. Yield in TSA (Ton sugar per acre)

Data on germination percentage, tillering per clump and yield of cane were recorded on the whole plot basis. The rest o the date were noted from 10 randomly selected plants taken from the middle rows.

Statistical Analysis

Analysis of variance as a randomized block design was performed for the characters measured in the form given below:

Source of variation	**Mean sum Square**	**Expectation**
Replication	MS_1	$\delta^2 e + g^{\delta} r$
Genotypes	MS_2-	$\delta^2 e + \delta^2 g$
Error	MS_3	$\delta^2 e$

Components of variance, heritability, co-efficient of variability and expected gain under selection were calculated on the basis o the procedure outlined by Skinder (1972).

Genetic variance $(\delta^2 g) = (MS_2 - MS_3)/r$

Where r= number of replications.

Broad sense heritability $(H) = \delta^2 g / (\delta^2 g + \delta^2 g/r)$

Phenotypic co-efficient of variability $= (\delta^2 ph \times 100) \overline{X}$

Where δph= square root of $\delta^2 ph$

$\overline{X}$ = Mean of the trait under consideration

Genotypic co-efficient of variability $= (\delta g \times 100) \overline{X}$

Where δg = Square root of $\delta^2 g$

$\overline{X}$ = Mean of the trait under consideration

Expected gain under selection $(\Delta G) = K \delta pH$

Where K was selection differential used here was 2.06 on the assumption that the top 5% of the population were chosen (Lush, 1945), δp was the standard deviation and H was the heritability.

RESULTS AND DISCUSSION

Analysis of variance indicated the existence of sufficient genetic variability among the strains for all the characters studied (Table 1). Calculated F values for all the characters studied indicated that the genotypes differed significantly. Similar results have been reported by Allam *et al.* in estimating heritability in sugarcane.

The variability of variances indicated the existence of sufficient genetic variability among the strains for all the characters studied (Table 1). Calculated F values for all the characters studied

indicated that the genotypes differed significantly. Similar results have been reported by allam et al in estimating heritability in sugarcane.

The variability estimated recorded a small difference between genotypic and phenotypic variances in all the characters (Table 2). Only the characters germination percentage-showed comparatively larger difference between phenotypic and genotypic variances. This indicated that the environmental influence upon the various traits studied except termination percentage was low. Table-2 also recorded the low phenotypic and genotypic variances for all the traits except germination percentage and yield of cane. Larger value of genotypic variance of any character is always helpful for effective selection.

Broad sense heritability for all the characters were high (Table-2). Yield of cane & sugar, germination percentage and recoverable sucrose content recorded the highest values with respect to yield of cane and sugar. Tillering per clump showed the lowest heritability value (66.67%) which indicated that maximum environment effect exist on the expression of the genes controlling this trait.

Highest amount of genotypic and phenotypic co-efficient of variability was observed for yield of sugar indicating the wider scope of selection for this trait (Table-3). There was also observed a considerable amount of both genotypic and phenotypic co-efficient of variability for the traits germination percentage, yield of cane, tillering per clump and recoverable sucrose content followed by stalk height and stalk diameter. Low value of variability for any character indicated the difficulty in improving the character by selection as reported by mangelsdori (1959). Large amount of variability in respect of yield of sugar have also been observed by N. Balasundarum and K.V. Bhagyalakshmi (1978) in studying variability and heritability of sugarcane.

Yield of sugar and germination percentage showed high levels of genetic advance i.e. 24.72% and 22.10% respectively, followed by yield of cane (17.48%), tillering per clump (13.78%) and recoverable sucrose content (11.78%). Stalk height and stalk diameter showed the lowest values of genetic advance (Table-3) confirming the low levels of genetic variability in these characters which indicates the difficulty in improving them through selection. Similar results in case of stalk height was also observed by N. Balasundaram and K.V. Babgyalakshimi, (1978).

Table 1. Estimates of phenotypic variation for different characters in sugarcane clones

Characters	Mean	Range	Calculated F.
Germination%	45.97	34.20-50.91	6.40**
Tillering per clump	4.21	3.56-4.8	3.09*
Stalk height	10.01	9.41-10.52	4.71**
Stalk diameter	2.00	1.90-2.13	3.33**
Yield in TCA	39.02	30.35-43.43	7.14**
Recoverable sucrose Content	11.30	10.46-12.58	10.79**
Yield in TSA	4.41	3.56-5.46	14.44**

*Significant at 5% level
**Significant at 1% level

Table 2. Estimates of components of variance and heritability for different characters in sugarcane clones.

Characters	Variances			Heritability%
	Phenotype	Genotype	Error	
Germination%	34.16	28.82	5.34	84.37
Tillering/clump	0.18	0.12	0.06	66.67
Stalk height	0.17	0.13	0.04	76.47
Stalk diameter	0005	0.003	0.002	70.00
Yield in TCA	14.83	12.75	2.08	85.97
Recoverable sucrose Content	0.52	0.47	0.05	90.38
Yield in TSA	0.32	0.30	0.02	93.80

Table 3. Estimates of genotypic and phenotypic co-efficient of variations along with genetic advance for different characters in sugarcane clones.

Characters	Genotypic co-efficient of variation (%)	Phenotypic co-efficient of variation (%)	Genetic advances on % of mean
Germination%	11.70	12.07	22.10
Tillering/clump	8.23	10.08	13.78
Stalk height	3.60	4.10	6.49
Stalk diameter	2.80	3.60	5.00
Yield in TCA	9.20	9.90	17.48
Recoverable sucrose Content	6.10	6.40	11.86
Yield in TSA	12.40	12.80	24.72

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Studies on the Occurrence of Broods in the Sugarcane Top Borer, *Scirpophaga excerptalis* Fabricus (Lepidoptera : Pyrallidae)

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SUMMARY

With a view to ascertaining the number of broods of the top borer, Scirpophagaga excerptails Fab., On sugarcane fields and presumable time of peak emergence of moths, studies were made by observing the larval and populations. The affected canes were sampled and the number of larvae, pupa, pupae and empty shoots were recorded. The data obtained were plotted on a graph and they indicate that there can be 5 peak periods of population of this borer and these were in the months of February, April, June, August and October. As the period succeeding the maximum emergence of the moth will have severe of control at the pre-pupal and egg stages by using them at the above mentioned periods.

INTRODUCTION

Sugarcane crop is affected by many insect pests but the major portion of the damage in caused by top borer, Scirpophaga excerptalis Fab. Alam, 1967 : Gupta, 1962; Rao and Chandy, 1957; Venkatraman, 1961). Its larvae bore into the top shoot causing a characteristic dead heart and making a tunnel through in which they feed on the internal tissue of the growing portion of the sugarcane and remain there for a considerable period till maturity of the adult (Fletcher and Ghosh, 1920 ; Hazelhoff 1932; Patel, 1963). Thus it causes a major loss in yield in tonnage and sugar recovery percentage by (i) killing the young tillers, (ii) by the stunted growth (iii) by deteriorating the quality of the Sugarcane, and (iv) by causing the favorable conditions for the pathogens `Gupta et. al., 1965; Kalra and Chaudhury, 1964; Rajani, 1961; Siddiqi, 1961).

The studies on the broods of the sugarcane top borer were carried put in India by Gupta, (1959), Husain (1955), Huque and Agarwala (1955), Patel and Bagal (1957), Kalra and Sidhu (1965) and Venkatraman (1963). In Bangladesh, Rahman (1970) observed the number of generations by studying the adult moths and egg laying of this pest in the northern districts.

The trial for controlling the pests needs the information regarding the broods to evolve an effective method of insecticidal control of the borer in the initial stages by right timing and frequency of the application, as the failure of an otherwise efficient insecticide may be entirely due to faults in the timing or the frequency of its application. So, an experiment was conducted to study the broods of the sugarcane top borer, S. exceerptalis on the basis of the determination of the populations of the larvae and pupae in the fields.

MATERIALS AND METHODS

Among the three techniques to determine the number of broods of a borer pest as mentioned by Patel and Bagal (1957), the 3rd technique i.e. by determination of the relative proportion of larvae to pupae in randomized samples of populations was followed in the present investigation.

The samples of the top borer infested canes were taken from the sugarcane plots of the Rajshahi University Rural and Agricultural Development Project. The infested shoots were identified by their characteristic `dead-hearts'. 20 sizeable samples were collected in a month (for 10 plots at 15 days intervals) and were carried to the laboratory. They were then cleaned and split open with a sharp knife for examination and the number of larvae, pupae and empty shoots were noted. Such examinations of infested shoots were made from December, 1977 to December, 1978. In January and February, there were no plants in the fields because old plants were harvested by them and young plants did not contain much infestation. So, the sampling in those two months was avoided.

RESULTS AND DISCUSSION

The number of infested canes, number of larvae, pupae and the number of empty shoots found are shown in Table-1. The percentage of larvae and pupae found at different months are also shown in figure-1.

It was found that in newly grown sugarcane plants, percentage of larvae was higher than pupae in the month of March. In April, percentage of pupae increased and it became higher than that of larvae and a further fall was noticed in May with a rise again in June. There was also a fall in July and it rose in August, again a fall was observed in September. The population became higher in October but declined in November.

The pupal population observed in December was very low as compared with the number of larvae. This explainable as the larvae during this month went into hibernation, which also was observed by Patel (1963), Kalra and Kalra and Sidhu (1965), and Patel and Begal (1957). Therefore, if seems form the experiment that there was another peak of pupal population during the months of January and February. Because in March, the number of pupae was very low in comparison with the number of larvae observed in the month of December of the previous year.

The number of broods of S. excerptails recorded by different workers varied form 3 to 7 with the variation of the locality. Venkatraman (1963) observed 3 broods in Madras of India, but in Bihar, it was recorded 5 broods by Huque and Agarwala (1955) and 5 to 7 broods at different states of India by Gupta (1959). Kalra and Sidhu (1965) observed 5 generations of top borer in the Punjab and Patel (1963) studied 6 generations in laboratory while 5 generations in fields at South Gujarat. Patel and Bagal (1957) studied 5 peaks of pupal populations at Walchandnagar in India.

The present findings are similar with the observations made by Rahman (1970) as there were 5 generations of S. excerptalis in Bangladesh. Thus it is evident that there would be at the most 5 peaks of emergence of moths corresponding to rises of pupal abundance. As the period succeeding the maximum emergence of moth will have severe infestation to sugarcane, it is therefore, possible to use the natural enemies and chemicals to control top borer at their pre-pupal and egg stages at suitable periods.

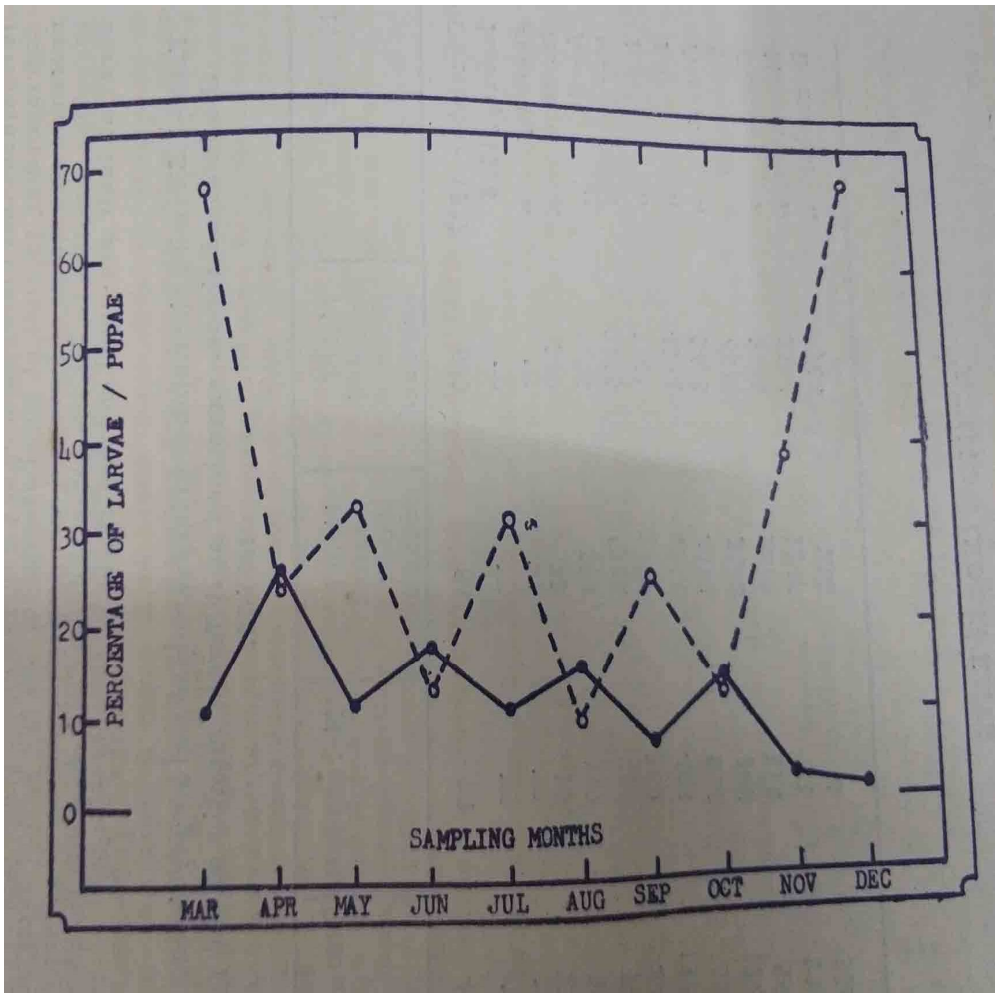

Figure 1. Showing the percentages of larvae (broken line) and pupae (solid line) of S. nivella among the infested shoots examined at different months of the year 1978.

Table 1. Showing the number of larvae, pupae and empty shoots among the infested shoots examined at different months of the year.

Months	No. of infested shoots examined	No. of infested shoots found empty	No. of pupae	No. of larvae
December, 1977	603	86	28	489
January, 1978	-	-	-	-
February, 1978	-	-	-	-
March, 1978	349	73	38	238
April, 1978	1205	598	317	290
May, 1978	2216	1232	260	724
June, 1978	3241	2219	580	442
July, 1978	4392	2547	468	1377
August, 1978	5405	4014	864	57
September, 1978	4832	3258	348	1226
October, 1978	3875	2810	515	550
November, 1978	2314	1347	73	894
December, 1978	788	226	6	556

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Potential of Spaced Transplanting of Sugarcane

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SUMMARY

An experiment was undertaken at the experimental farm of the Sugarcane Research Institute, Ishurdi, Pabna in the 1976-1977 crop season to assess the potential of Spaced Transplanting (STP) of single-budded settlings of sugarcane as compared to the direct normal planting of three-budded setts. The study was further extended to see the effects of row-orientation with part culler reference to sunlight utilization, on the ultimate productivity of sugarcane. Planting of three-budded setts was done in mid December while the transplanting of the single-budded settlings from the nursery be to main field was done 70 days later. It was observed that the conventional planting with the three-budded setts produces significantly higher number of tillers at the early tillering stage (April) while the single-budded settlings under STP outnumbered them at the late tillering (June) and produced significantly higher number of millable canes at harvest. STP registered higher productivity in terms of both TCA (tons cane/acre) and TSA (tons sugar/acre) although the yield increases were not statistically significant. Row-direction was found to exert no significant effect on the ultimate cane yield.

INTRODUCTION

The yield of sugarcane in term of both TCA and TSA, is miserably poor in our country. The reasons for such poor productivity could be attributed to the dearth of high yielding or high sugar varieties on the one hand and the inefficient exploitation of the yielding potential of the existing varieties on the other. Scientist working on the physiological aspects of sugarcane are of opinion that there is considerable scope for increasing the cane yield beyond the apparent yield limits of the existing varieties by providing adequate nutrient, water and sunlight (Rostron 1971, Gloves 1972). The present day agriculture is the harvesting of the solar energy and this is most true for sugarcane. The production of sugar or sucrose is directly related to the process of photosynthesis which in turn is greatly influenced by sunlight factor provided water and nutrients are non-limiting. The net gain in the photosynthetic ultimately depends on the amount of light energy available and the proportion of this light intercepted and used by the leaves. In recent years, the use of spaced transplanting/planting and row-orientation which restricts mutual shading and provides for efficient utilization of sunlight, has received considerable attention of cane scientists for obtaining higher productivity of sugarcane (Kosaka 1961, Nickell 1967, Silva 1969, Buren 1972). A closer look to our existing situation might reveal that the present level of cane yield be considerably increased if optimum number of millable healthy stalks per unit area could be ensured. Here again sunlight stands as one of the most important factors for obtaining adequate millable tiller (Buren 1972, Mac Coll 1976). Although a number of research work have been carried out in different countries on spaced transplanting of sugarcane but practically no attempt had yet been made to investigate into the merit of this technique in our country.

The present study was therefore, undertaken to access the potential of spaced transplanting of single budded germinated settlings as compared to the conventional planting of three-budded setts with particular reference to millability of tillers and the ultimate productivity of Sugarcane.

MATERIALS AND METHODS

The experiment was conducted at the experimental farm of the Sugarcane Research Institute, Ishurdi, Pabna during the period from December 15, 1976 through February 5, 1978 with the newly evolved variety of sugarcane, BS-96. The experiment comprised of the following four treatments:

1. Conventional planting of 3 budded setts planted in $3^1/_2$ ft. apart rows with South-North row direction.
2. Same as treatment No. 1 above but with East-West row direction.
3. Transplanting of single budded settlings with the spacing of 3 ft. between rows and 2 ft. between settlings and placed rectangularly.
4. Same as treatment No. 3 above but placed triangularly.

The above treatments have been denoted, here in the text, by T0, T1, T2 & T3 respectively. The planting of the 3-budded setts was done on December 15, 1976 while the transplanting of the single-budded settling was effected on February 25, 1977. Normal doses of fertilizer viz., Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP) at the rates of 3 mds. 3 mds. and 2 mds per acre respectively were applied. Full dose of TSP and one-third quantities each of Urea & MP were applied as the basal dressing while the remaining two-thirds each of Urea & MP were applied later on in two equal splits. Intercultural operation like weeding, irrigation, mulching, earthing up, plant protection measures, etc. were maintained as per normal practice. Data on % germination of buds (in the case of planted-cane as under treatments T0 & T1) and % survival of settlings (in the case of treatments T2 & T3) were recorded. Counts on tillers at monthly intervals starting from 1st April, 1977 through 1st June 1977 were taken. The crop was harvested on February 5, 1978 and data on millable cane per acre, recovery % sugar, yield of cane in terms of both TCA and TSA were recorded at the time of harvest. The chemical analysis of cane samples for determining % recoverable sugar was done according to the conventional Horne's Lead Sub-acetate method. The data on various parameters were statistically analyzed.

RESULTS AND DISCUSSION

Some salient aspects of the experimental results are presented in table 1 & 2. Data show that the scent per cent settlings transplanted survived as compared to about 39 & germination of buds obtained in the case of STP is about 24% of the conventional planting (Table 1).

Table 1. Dates of planting/transplanting, % germination, % survival of buds/settlings, and quantities of seed material used under different treatments.

Treatment	Date of		%germination of planted cane	%Survival of transplanted settlings	Quantities of seed material used/acre
	Planting	Transplanting			
T_0	Dec. 15-1976	-	39.68%	-	50 mds.
T_1	Dec. 15-1976	-	39.09%	-	50 mds.
T_2	-	Feb. 25, 1977	-	100%	12 mds.
T_3	-	Feb. 25, 1977	-	100%	12 mds.

Table 2. Production of tillers, millable cane, % recovery, TCA and TSA as influenced by different treatments.

Treatments	Tillers produced per acre as no (fig. in thousands)			Millable cane per acre (,000)	% recovery	TCA	TSA
	April 1, 77	May 1, 77	June 1, 77				
T_0	35.39	56.30	63.26	38.81	9.51	41.33	3.93
T_1	35.47	55.28	64.15	39.48	9.41	41.97	3.95
T_2	25.64	51.35	72.90	49.93	9.77	42.19	4.12
T_3	25.93	53.73	73.52	50.58	10.33	42.19	4.38
L.S.D. at 1% level	1.04	-	5.61	3.15	-	-	-

As it can be seen from Table 2, conventionally planted cane with 3-budded setts produced significantly higher number of tillers at the early tillering stage (April) while at the late tillering stage (June), the single-budded settlings under STP out numbered them by producing significantly higher number of tillers. As regards mill ability of tillers, STP promoted higher rates of millability of tillers by producing significantly higher number of millable canes at harvest. Results showed that STP registered higher productivity in terms of both TCA and TSA although the corresponding yield increase were not significant due to the production of comparatively thinner cane. Results further showed that row- direction had no significant effect on the yield and yield contributing characters of sugarcane. That STP promotes higher number of millable cane giving higher fields has been supported by some relevant works of scientists working in the line (Pearson 1950. Rao & Prashad) 1962, Hum bert 1968, Loh and Tseng 1956, Russel 1959, Buren 1972).

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Notes on the Mechanical Sugarcane Pest Control Operations and Practices in Bangladesh

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INTRODUCTION

The Sugarcane Plants are attached by a variety of pests and about 1500 species have so far been recorded in this crop all over the world (Long and Hensley, 1972). In Bangladesh, the seem borer, Chilo tumidicostalis, top shoot borer, Scirpophaga escerptalis and the root borer, Emmalocera dipresella have been reported to be very damaging (Alam, 1967; Shahjahan, 1974a 1974b, 1976). Other insects like termites, Odontoterms spp ; white grubs, Holotrichia spp., Leaf-hopper, Pyrilla perpusilla pusana, wooly aphis, Ceratovacuna lanigera, and scale insects, Melanaspis glomerata also attacks sugarcanes and cause considerable loss in yield.

The chemical control of borers of sugarcanes is not satisfactory despite considerable development in the field of pesticides (Long and Hensley, 1972). Hence this method of control is not extensively used in any region of the world except in Louisiana (Singh et al, 1956; Siddique et al, 1959; Long, 1969; Long at al, 1969; Hensley, 1971; Hensley and Concienne, 1968).

Therefore, more emphasis is given on the Mechanical, biological and Cultural methods of borer control in different parts of the world.

Charpentier and Mathes (1969) reviewed the cultural practices for sugarcane pest control in various countries and recommended this method as an adjunct to other control measures. The planting of uninfected cane seeds and the use of light traps in combination with manual collecting of adult moths and egg-masses would greatly minimize the level of borer population (Gupta and Avsthy, 1959).

MATERIALS AND METHODS

The following materials and the methods are in practices in this country for carrying out mechanical operations for borers and other pest control in sugarcane.

Removal and Destruction of Borer-Infested Plants:- The borer-infested plants, especially by the top shoot and stem borer, are removed and destroyed. During the initial stage of attacks, the infested settlings are cut 2 inches below the soil level, removed and the larvae are immediately destroyed.

Spike-thrusting method:- Mere cutting of the infested plants, during early stage, and their destruction does not guarantee the killing of the insects inside especially in case of attacks by the early shoot borers and the root borers. In such cases, the spike-thrusting practices are extensively carried out after cutting the plants at soil level.

Hand and Hand-net Collection of insects:- The adult moths of the top shoot borers and the adult beetles of the white grubs are usually collected by hands or hand-nets. The sugarcane leaf-hoppers (Pyrilla) are conveniently collected and destroyed by sweeping in hand-nets. The young boys are employed to collect and destroy termite-queens.

Light Trapping:- The adult moths of the top shoot borers, stem borers, adult beetles of white grubs, the winged termites and the adult hoppers are collected by light trapping method and destroyed. This practice is carried out, especially at peak period for 2 hours after evening.

Hand collection of Egg-Masses:-The egg-masses of the adult of the top shoot borers and the sugarcane pyrilla are very prominent and laid on the leaves. The young boys are economically employed to collect and destroy these masses.

Leaf-Clipping:- The infestation of the sugarcane thrips and the wooly aphis on the sugarcane leaves are very prominent and easily detected from a considerable distance. Such thrips- and wooly aphis-infested leaves are usually clipped in the morning and the pests are destroyed by dipping the leaves in the kerosinized water (1 chattak kerosine in 1 seer of water).

Spading Method:- As soon as the symptoms of damage of the termite and white-grubs are observed in the fields, the soils around and under the infested setts, shoot or plants are spaded up along with the insects and immediately killed by crushing or dipping them in an emulsion of pesticide (4 ounce pesticide in 20 seers of water).

Water-Proof Mud Barrier:- A water-proof mud-barrier are usually created around the white-grubs are observed white-grubs-infested field during July or August to hold natural rain water at least for a week, and then drain out the water to avoid bad effect of water-logging. The accumulated rain water are usually treated with pesticides (1 lb/acre)

Flooding Method:- This has been recognized as a very effective method of controlling all kinds of soil-inhabiting insects. Where irrigation facilities are available, the irrigation water is treated with pesticide to control termites, white-grubs and root borers.

Detrashing and Stripping:- Detrashing and stripping of the old and dry sugarcane leaves during July and August are sometimes practiced to help achieve a great success in controlling the stem borers, scale-insects and pyrilla. This not only control the insects but also increase the sugar content in sugarcanes.

Stem Cutting Method:- Cutting and destruction of both the primarily and secondarily infested stems by the stem borers and scale insects have been practiced and proved to be very successful in controlling these 2 insect-pests.

Bamboo-Tower:- This method works well especially during July and August when it is very hard to search for the stem borer-infested plants in the heavily tillered sugarcane fields. A bamboo-tower of 10-12 feet high are usually made somewhere in the field which enable a pest control operator to have a bird-eye view of the entire field. He locates the presence of the stem-borer-damaged plants from the tower and guides the worker/workers near to such borer-damaged plants by simple direction. Such plants are cut and destroyed. A thorough search around 5 feet diameter of such stem-borer-damaged plants is made to detect the newly stem borer-infested plants. These plants are then cut at the base, removed and destroyed along with the larvae inside.

Surgical Operation:- This technique works well in case of the top shoot borer-attacks during June, July or August when the growers are quite reluctant to cut and destroy the entire infested plants. At about 5-6 inches down from the neck of the top shoot borer-infested plants, (or at the upper base of the top most node), a small slit (about 3 inches long) is usually made with a pointed knife to detect the position of the larvae and kill it by pinching or crushing. Such practice do not usually cause any remarkable damage to the plants. This method is conveniently carried out in the 4-8 feet tall sugarcane plants.

Mechanical Manipulation of Local Parasites:- The complete destruction of the collected egg-masses and pest-infested stems would not only kill the target pests, but would also destroy a large number of parasites which could have otherwise been utilized to kill a large number of harmful insects in nature. Therefore, the collected egg-masses of the top shoot borers and the pyrilla are kept confined in a small container, covered with very finely meshed thin cloth, for sometimes only to let the parasites out. But the newly hatched pest-larvae or nymphs immediately killed.

Similar actions are also taken with the stem borer and scale insect-infested stems. The egg-masses are also kept in a small container which are made to float in the middle of a large container having water. The later is kept in some high place near the new sugarcane fields.

Burning Stubs and Trashes:- After harvest of the sugarcanes, the left-over cane stubs and dry trashes are piled up and burnt to ashes. The fields are immediately tractor-ploughed and harrowed. This process helps destroy a large number of damaging sugarcane pests including insects, root borers, mealy bug, termite, stem borers, etc. etc.

Adjustments Method:- The plantation and harvesting time of sugarcanes, if adjusted accurately, would help control the top shoot borer-attacks in the new plantation by stopping their migration from the old standing canes to the newly emerged shoots. By the time the new shoots of the newly planted sugarcane emerge, the harvesting of the nearby old standing sugarcanes are completed and transported to the mills. The left over cane stubs and dry trashes are immediately piled up and burnt.

DISCUSSION

The strong mechanical control operations should continue until the key regulating or the key controlling factors are identified and an effective control programme is evolved. In Bangladesh, this method was proved to be very useful in preventing the sugarcane pests from inflicting heavy crop damage.

For this method to be effective, the operations should timely and simultaneously be started in all the infested areas and be completed within a week from the date of commencement.

The appropriate time of application of this control measure can be determined through field sampling and the operation should be carried out at least 2 times during the season for complete success.

This method is economic and easily integrated with any other pest control operations. It works well at all stags of insect development (e.g. eggs, larva, pupa and adult). There is no danger of developing “insect-resistance” to control measures as is expected with pesticide with pesticide application.

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A Note on Mosaic Disease of Sugarcane in Bangladesh

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Mosaic was first reported s a disease of sugarcane by Nusschenbroek in Java in the year 1892. Since then the disease was recorded in 71 cane-growing countries of the world. Although recorded in large number of countries, serious crop damage due to mosaic was reported only in Puerto Rico, Cuba and Lousiana (Martin *et. al.*, 1961). In most of the countries the common green type mosaic was prevalent.

Two distinct types of mosaic infections were reported. They are (1). the common, "mild" or "green" type and (2). the "severe" or "yellow" type. Economically the severe or yellow type of infection is important. In this case the affected plants show leaf yellowing and severe stunting. the other type of infection known as mild or green shows the symptoms like chlorotic or light coloured, elongated, irregular streaks on the leaves surrounded by normal green areas. This green type infection, so far reported, does not affect the crop very much Edgerton (1955) reported that the mild or green mosaic was more virulent and on susceptible varieties spread with extreme rapidity. On the other hand, severe or yellow mosaic was more destructive to the plants when affected, but the spread of infection in the field was slow. He studied in detail the relationship between green or yellow type infection and the strain of the virus through artificial inoculation on different varieties and found that the strain for these two types of symptoms might produce yellow mosaic on other varieties. He further stated that the variations in symptom expressions were mainly sue to variety and environment. So far 13 strains of the virus were identified (Kolke, 1976) and they are denoted by A, B, C, D, E, F, G, H, I, J, K, L, and M.

In Bangladesh, no report is available when the disease was first detected, but Ahmed *et. al.* (1976) recorded the disease in the year 1974. Mosaic was noticed n all cane-growing areas of the country and most of the varieties were found to be affected by the disease. Both green and yellow types of infections were observed. The most common and widely spread mosaic is the mid or green type. In this case the infected plants dis not show any outward visible symptom, apparently both healthy and diseased plants showed the similar growth and tillering. But on close observation to the leaves , the symptom of mosaic could be detected on affected plants. On the other hand, the severe or yellow type of infection occurred seldomly and so far such symptom expressions were noted on three varieties namely Bo 67, Bo 70 and Isd 5/55. This type of infection is not widespread, but found only in few plots. In case of yellow type infection, the affected plants could easily be identified through its visual symptoms like severe stunting and yellowing of leaves.

A preliminary survey on the occurrence of mosaic was conducted in the farm of the Sugarcane Research Institute and a total of 229 varieties were observed. Of them, 148 varieties showed mosaic symptom while 81 varieties showed no symptoms of the disease.

Under natural field conditions mosaic could be seen in all the months of the year. The growing settlings of November planting cane show the symptoms at the end of February and as the plants grow further, the symptom expression were clear and definite. In the months of May-June, pronounced and very clear symptoms were easily observed. During this time leaf yellowing and stunting growth were also noticed.

Seed materials are the main source of new infection. Whether yellow or green mosaic, the use of affected setts generally produce diseases settlings. In case of seed materials from yellow mosaic affected plants, the germinated settlings show thin and stunted growth, while seed materials from green mosaic affected plants, the germination and growth were similar to the healthy plants. But on close observations, mosaic symptoms could be seen on the healthy plants. But on close observations, mosaic symptoms could be seed on the leaves. Nakata and Hidaka (1975) reported that in Japan mosaic was spread mainly through planting diseased setts. In addition to the seed materials, insect vectors like aphids were found to be responsible for the spread of mosaic (David *et. al*. 1972; Ohtsu and Manabe, 1974: Bhargava *et. al.,* 1978). Several weeds and some members of the grass family were also reported to be the alternative hosts of mosaic virus (Anzalone, 1965: Nolla, 1965: Singh, 1976). Not much work has been done in this line in our country. However, studies on varietal screening, virus stain position in Bangladesh, possible transmission of mosaic by insect vectors and also on the alternative hosts will be taken up soon. The future programme also include to establish a mosaic field nursery in order to screen the sugarcane clones under natural field conditions.

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Studies on the Sugarcane Weeds: Weeds of Sugarcane Research Institute Farm

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SUMMARY

Weeds are serious problem to sugarcane. For effective seed control, thorough study of the weeds are needed. Hence, during 196-77, the weeds found in Sugarcane Research Institute farm were surveyed and 32 weeds were collected, identified and described. Most of the weeds were annuals but some were perennials. The climax infestation period was found to range between November and April. One parasitic Kharif annual, *Striga densiflora* was also identified.

INTRODUCTION

Weeds are serious problem wherever they occur on sugarcane field and the competition between weed and crop is often in favour of the weed due to poor crop condition. The loss of crop due to weed infestations in India has been reported to vary from 5 to 50% depending upon the level of crop and soil management (Anon, 1970 and Ethirajan *et. al.*, 1976). Under labour intensive cropping system, the most common weed control methods is hand weeding. Chemical weed control has been found suitable under labour constraint conditions and in plantation crops like sugarcane (Arakri *et. al.* 1962; Muzik, 1970: Crafts, 1967 and parker and Frayer, 1975). For successful weed control programme either cultural, mechanical or chemical, a thorough knowledge on the life cycle, taxonomy, crop association and other relevant factors are quite obvious as particular method of weed control is effective only at a definite stage of growth and environmental conditions surrounding the weeds.

To acquire a comprehensive idea on various aspects of weeds that are found to grow in association with sugarcane, a survey was carried out during 1976-77 in the Sugarcane Research Institute farm, Ishurdi.

MATERIALS AND METHODS

During the survey, the weeds found in sugarcane fields were collected and identified following the standard taxonomic classification. In addition, life cycle-time of emergence, reproduction and senescence, leaf type-broad or narrow, weed infestation in relation to cropping season were also studied.

RESULTS AND DISCUSSION

During the survey 32 weeds were collected and described (Table 1). Most of them were annuals although some perennials also did exist. Both broad and narrow leaf weeds could be identified indicating a diverse scope of chemical control. The annuals appeared during both kharif and rabi seasons but the rabi annuals were more prevalent than the kharif ones. The perennials existed all throughout the year. The annuals reproduced through seeds but the perennials mostly through vegetative parts. The climax infestation period ranged between November and April suggesting that the sugarcane seedlings are most vulnerable to weed attack.

Beside the non-parasitic weeds described above, parasitic weed, *Striga densiflora* L., has been identified. This weed was found to establish parasitic relationship with sugarcane by

ramification of its roots into those of sugarcane and forming houstoria. This is a narrow leaf weed found to infest during kharif season when sugarcane starts boom growth period.

The identified weeds are listed in Table 1 giving their agronomic attributes

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Table1 List of weeds found in sugarcane field and their agronomic attributes

Sl. No.	Name	Family	Life Cycle				Leafs type & Character	Climax infestation	Cropping season index
			Emergence	Reproduction	Senescence	Type			
1	*Chrysopogoa aciculatus* (Retz) Trin. Premkata (B)** Love Thorn (E)***	Gramineae	February-March	June-July	-	Perennial	Narrow; Leaves alternate, Leaf blade linear, spikelets sessile harmphorodite, Root fibrous	March-April	KR*
2	*Imperata cylindrica* Ulu (B)	Gramineae	November-December	-	-	Perennial	Narrow; Stems erect, slender and 8-16 inch tall with creeping rhizome.	January-April	KR
3	*Saccharum spontaneum* Lin. Kansh (B)	Gramineae	October-November	-	-	Perennial	Narrow	December-March	KR
4	*Cynodon dactylon* (L) Pers. Bermuda grass (E) Durba Ghas (B)	Gramineae	All seasons	-	-	Perennial	Narrow; It is widely spreading by stolon and rhizomes and forming mats. There are 3-5 spikes radiating from the top of the culm	November-April	KR
5	*Eleusine indica* Goose grass (E) Chapra (B)	Gramineae	November-December	-	-	Annual	Narrow; Leaf-sheath flattened. Leaf-blade smooth. Stems prostrate and grow in tufts	January-March	R
6	*Cyperus rotundus* Nut grass (E) Mutha (B)	Gramineae	All seasons	-	-	Perennial	Narrow; stem triangular and erect Numerous small tubers came out from the rhizome. Inflorescence umber and composed of 3-7 rap.	November-April	RK
7	*Colocasia esculenta* Kachu (B)	Cyperaceae	March-April	-	-	Perennial	Broad	May-July	K
8	*Chenopodium album* Lamb's-quarter (E) Bathua (B)	Chenopodiaceae	November-December	February-March	April	Annual	Narrow; alternate, simple, ovate to lanceolate, Stem erect and branched. Seeds lens-shaped shinny black & smooth.	January-February	R
9	*Mimosa pudica* L. Lajjabati (B)	Leguminoceae	-	-	-	Annual	Narrow	February-March	RK
10	*Vicia hirsuta* Mashur Chana (B)	Leguminoceae	-	February-March	March-April	Annual	Narrow	January-February	R
11	*Cassia tora* Sickle Pod (E)	Leguminoceae	October-November	March-April	April	Annual	Broad pinnately compound usually with six opposite, smooth & paired leaflets. Flowers are yellow in colour. The seeds are rhomboidal and shin brown.	December-March	R
12	*Crotalaria striata* Stripped rotolaria (E)	Leguminoceae	October-November	March-April	-	Annual	Broad; the leaves are trifoliate with ovate oblong leaflets. Stem erect. Root is a tap root	December-March	R
13	*Jussiaea decurrens* Panimorich (B)	Onagraceae	-	-	-	Annual	Narrow; simple alternate, stem erect, gibrous, 4 angled 10-40 inch high.	January-March	R
14	*Hydrocotyl asiatica* Thankuni (B)	Umbelliferae	-	-	-	Perennial	Broad; stem prostrate, creeping and slender having nodes and internodes and about 30 inch long	Monsoon	RK
15	*Ipomoea aquatica* Kalmishak (B)	Convolvulaceae	-	-	-	Annual	Broad; alternate, simple, elliptic oblong and acute. Stem hollow having nodes and internodes Flower funnel shaped	Monsoon	RK
16	*Gnaphalium lutea-album* Shwete Lumi (B)	Compositae	-	November-February	-	Annual	Broad; Leaves entire, oblong, spatulate and sessile	November-December	R
17	*Solanum torvum* Titabegun (B)	Solanaceae	-	-	-	Annual	Broad; simple, alternate petiolate. Fruit a many seeded black-berry	November-March	R

* K-Kharif **B- Bengali synonym
R- Rabi ***E- English synonym

18	*Physalis angulata* Futki (B)	Solanaceae	-	-	-	Annual	Broad; leaves alternate, smooth and ovate with irregular margin.	November-March	R
19	*Solanum nigrum* Gurki (B)	Solanaceae	-	-	-	Annual	Leaves Broad and irregularly toothed alternate simple and ovate.	February-May	RK
20	*Xanthium itlicum* Gyara (B)	Solanaceae	-	-	-	Annual	Broad leaved, fruit spinoks	February-April	RK
21	*Leucas aspera* Setodrone (B)	Solanaceae	-	-	-	Annual	Narrow	November-March	R
22	*Solanum mauritianum* Wild Tobacco (E)	Solanaceae	-	-	-	Annual	Broad	November-March	R
23	*Amaranthus spinosus* Katanotey (B)	Amaranthaceae	-	-	-	Annual	Broad; leaves alternate & petiolate Stem erect glabrous and branches above. Flowers in a long slender spikes. crowded in a close terminal, panicle seeds small, lens shaped glabrous and black	November-February	R
24	*Amaranthus viridis* Shaknotey (B)	Amaranthaceae	-	-	-	Annual herb.	Broad; leaves alternate with long petioles, broadly ovate or rhombic ovate. Stem erect branches above	November-February	R
25	*Marsilea quadrifolia* Shushnishak (B)	Marsileaceae	-	-	-	Annual	Broad; leaves petiolate and projecting above. Leaflets 4, sessile, obdeltoid and glabrous. It propagates by vegetative means.	November-February	R
26	*Borreria laevis* Dudhia (B)	Rubiaceae	-	-	-	Annual herb.	The leaves are oblong to oval lanceolate, sessile, opposite and 2-4 cm. long.	Rabi season	R
27	*Portulaca oleracea* Nunia (B)	Portulaceae	-	-	-	Annual	Narrow; it bears alternate to nearly opposite leaves which are often found in clusters at the end branches. Leaves are thick, sessile and ovate with broad-rounded tips and smooth margins and are 2-4 cm. long	Rabi	R
28	*Curcumic melo* Telkucha (B)	Cucurbitaceae	-	-	-	Annual	Broad; leaves are kidney shaped, alternate and petiolate. Stem is a pubescent and spiny vines	Rabi	R
29	*Argemone mexicane* Prickly poppy (E) Shial Kantha (B)	Papaveraceae	-	-	-	Annual herbaceous plant	Broad; leaves are coarse, deeply loabed, irregularly toothed and prickly. The terminal flowers are bright yellow in colour. It has a characteristic yellow sap	Rabi	R
30	*Striga densiflora* Bijlee ghas (B) ,Witch weed (E)	Scorphulariaceae	-	-	-	Annual	Narrow	May-October	K
31	*Convolvusus arvensis*	Convolvulaceae	-	-	-	Annual	Broad	May-December	RK
32	*Ipomoea plebeia* Bell vine (E)	Convolvulaceae	-	-	-	Annual	Broad	May-December	RK