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EFFECT OF NPK FERTILIZERS ON THE GROWTH OF SUGARCANE CLONE AEC86-347 DEVELOPED AT NIA, TANDO JAM, PAKISTAN

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Abstract

A new sugarcane clone AEC86-347, was obtained from seed (fuzz), of a cross combination of NCo 310 x CP57-614, imported from ARS, USDA, Canal Point, Florida, USA. The genotype was evaluated for the response to NPK fertilizers for two consecutive years. Significant ($P \leq 0.05$) differences were observed among the fertilizer treatments. Treatment 3 (200 N kg/ha:120 P_2O_5 kg/ha:150 K_2O kg/ha) showed the best results as compared to the other fertilizer treatments. Six characters i.e., cane yield, plant height, weight/stool, stalks/stool, commercial cane sugar and sugar yield were examined under different fertilizer doses. As per cost: benefit ratio, it was observed that treatment 3 was the suitable fertilizer treatment for clone AEC86-347 to obtain higher cane and sugar yield.

Introduction

Sugarcane is an important cash crop of Pakistan (Ahmed, 1994; Rahman *et al.*, 1992), the average yield of sugarcane in Pakistan is about 48.1 t/ha, which is the lowest among the sugarcane growing countries of the world (Anon., 2002). The average yield of the sugarcane varieties is much lower than their potential yield. For instance, through application of balanced NPK fertilizers, the potential yield have been obtained up to 165.176 t/ha (Sharif & Chaudhry, 1988; Khan *et al*., 2002). Malik (1990), estimated potential cane yields is 150-200 t/ha for Sindh, 100-150 t/ha for Punjab and 75-100 t/ha for NWFP. Imbalanced fertilizer use seems to be one of the factors responsible for the constantly low cane yield in the country. Karstens *et al*., (1992), reported that fertilizer use for sugarcane cultivation in Pakistan is imbalance and inappropriate. According to a survey report, only 4% of the cane growers use NPK and the majority (73%) of them rely only on NP fertilization. Proper fertilization is an important management function in sugarcane production. Nitrogen deficiency may decrease cane yields, while excess N availability during the ripening period reduces juice quality (Tabayoyong & Robeniol, 1962). An average fertilizer nutrient use of 128 kg/ha N, 63 kg/ha P_2O_5 and 7 kg/ha K_2O has been estimated (Anon., 1989). In this context, according to Barnes (1964), doses of 75-90 N kg/ha, 50-60 P_2O_5 kg/ha and 150 K_2O kg/ha are required for good sugarcane growth. Therefore, a study was designed to determine the effect of NPK fertilizers on cane yield, plant height, weight/stool, stalks/stool, commercial cane sugar and sugar yield on clone AEC86-347 developed at the NIA, Tando Jam Sindh, Pakistan.

Materials and Method

True seed (fuzz) of different crosses of sugarcane imported from USDA Canal Point, Florida, USA was grown at the Experimental Farm, Nuclear Institute of Agriculture (NIA), Tando Jam. The clone AEC86-347 was selected on the basis of high cane and sugar yield, from the seedlings of the cross NCo 310 x CP57-614. The yield performance of this clone was tested in agronomic (fertilizer) trials. The experimental layout was RCB design with 3 replications having 5 treatments. The treatments were i) control, 0 N kg/ha, 0 P_2O_5 kg/ha and 0 K_2O kg/ha, ii)150 N kg/ha, 80 P_2O_5 kg/ha and 100 K_2O kg/ha iii) 200 N kg/ha, 120 P_2O_5 kg/ha and 150 K_2O kg/ha iv) 250 N kg/ha, 160 P_2O_5 kg/ha and 200 K_2O kg/ha and v) 300 N kg/ha, 200 P_2O_5 kg/ha and 250 K_2O kg/ha. The plot size was 5 m x 10 m and row to row distance was one meter apart form each other. The sowing was done in the month of September and normal agronomic practices were followed throughout the growth period. Three stools were randomly taken from each plot to determine their sugar contents according to Sugarcane Laboratory Manual for Queensland Sugar Mills (Anon., 1970), while three rows from each plot were harvested to record yield data. The data were analysed according to Steel & Torrie (1960).

Results and Discussion

Cane yield and its yield component

The NPK treatment differ significantly ($P \leq 0.05$) for cane yield. The highest cane yield (109 t/ha) was obtained in treatment 5 followed by treatments 4(108.80 t/ha) and 3 (107.20 t/ha) (Table 3). Lowest cane yield was recorded in treatment 1 i.e. control. The essence of application of NPK fertilizers in our soil was evident from the lowest cane yield in control (Table 1, 2 & 3) where no fertilization was practiced. Treatments 2, 3, 4, and 5 showed 390.50, 506.37, 513.93 and 518.18% increase over control, respectively (Table 3). The yield difference between the treatments 3, 4 and 5 was less than 5%. Yield differences greater than 10% reflect its impact on the economic benefit (Khan *et al*., 2000, 2002). As per cost benefit ratio, it was observed that treatment 3 was the suitable fertilizer treatment for cane yield. Significant difference in plant height was observed among the treatments, plant height at T3, T4 and T5 differ significantly from T1 and T2. Highest plant height was observed in treatment 4 (235.4 and 251.3 cm), followed by treatment 5 (235.3 and 250.3 cm), Table 1 and 2, respectively. The plant height and cane girth are the major contributing factors for high cane yield (Rehman *et al.*1992). The high cane yield in treatment 3, 4 and 5 may be due to high number of stalks per stool, 7.195, 7.085 and 7.105, respectively (Table 3). Singh *et al*., (1985) and Raman *et al*., (1985) regarded the number of canes (stalks/stool) as the most important character contributing directly to higher yield. Quebedeadux & Martin (1986) proposed that both the stalk number and weight should be assessed to have an accurate yield potential of the variety. Similar findings have also been reported by Khan *et al*., (1997, 2000).

Table 1. Performance of AEC86-347 in fertilizer trial at NIA, Tando Jam during 2001-2002.

Treatment	CCS (%)	Sugar yield (t/ha)	Plant height (cm)	Weight /stool (kg)	Stalks/stool (No.)	Cane yield (t/ha)
0N:0P:0K (T1) Control	12.96a	7.76 d	100.7c	3.30c	5.26b	20.00d
150N: 80P: 100K (T2)	10.40c	8.66 c	132.4b	5.14b	5.00b	83.33c
200N:120P:150K (T3)	11.37b	10.27 a	230.6a	8.81a	7.26a	106.33b
250N:160P:200K (T4)	10.40c	9.22 b	235.4a	8.90a	7.14a	108.67ab
300N:200P:250K (T5)	10.10c	9.43 b	235.3a	8.92a	7.18a	109.33a

DMR test (0.05): Means followed by the same letters are not significantly different from each other

Table 2. Performance of AEC86-347 in fertilizer trial at NIA, Tando Jam during 2002-03.

Treatment	CCS (%)	Sugar yield (t/ha)	Plant height (cm)	Weight /stool (kg)	Stalks/stool (No.)	Cane yield (t/ha)
0N:0P:0K (T1) Control	12.79a	7.59d	97.6c	3.46c	5.17b	22.33 d
150N: 80P: 100K (T2)	10.35c	8.48c	141.1b	5.21b	5.30b	82.00 c
200N:120P:150K (T3)	11.42b	11.08a	245.8a	8.68a	7.13a	108.00b
250N:160P:200K (T4)	10.41c	8.91c	251.3a	8.64a	7.03a	109.00ab
300N:200P:250K (T5)	10.22c	9.60b	250.3a	8.74a	7.03a	110.00a

DMR test (0.05): Means followed by the same letters are not significantly different from each other

Table 3. Pooled performance of AEC86-347 in fertilizer trial at NIA, Tando Jam.

Treatment	CCS (%)	Sugar yield (t/ha)	Plant height (cm)	Weight /stool (kg)	Stalks/stool (No.)	Cane yield (t/ha)
0N:0P:0K (T1) Control	12.88a	7.63d	99.13c	3.38c	5.21b	21.17d
150N: 80P: 100K (T2)	10.38cd	8.57c	136.60b	5.17b	5.15b	82.67c
200N:120P:150K (T3)	11.40b	12.20a	238.20a	8.74a	7.19a	107.20b
250N:160P:200K (T4)	10.40c	11.33b	243.30a	8.77a	7.08a	108.80ab
300N:200P:250K (T5)	10.16d	11.14b	242.80a	8.83a	7.10a	109.70a

DMR test (0.05): Means followed by the same letters are not significantly different from each other

Table 4. Comparative economics of different fertilizer levels on sugarcane.

Treatment	Cost of fertilizer (Rs.)	Cane yield (t/ha)	Additional yield (t/ha)	Gross income (Rs)*	Net income (Rs.)	Value cost ratio
0N:0P:0K (T1) Control	----	21.17	---	---	---	---
150N: 80P: 100K (T2)	6593.0	82.67	61.50	61500	54960	9.32
200N:120P:150K (T3)	8297.0	107.20	86.03	86030	76733	10.36
250N:160P:200K (T4)	12403.0	108.80	87.63	87630	75227	7.06
300N:200P:250K (T5)	15309.0	109.70	88.53	88530	73221	5.78

* Rate: Re. 1.00 per kg

Commercial cane sugar: (CCS% and Sugar yield t/ha)

Significant ($P \leq 0.05$) differences were recorded for CCS% amongst all the treatments and the highest CCS% was observed in control (12.96 and 12.79%), followed by treatment 3 (11.37 and 11.42%) (Table 1 & 2). Minimum CCS% was observed in treatment 5 (10.10 and 10.22%). The data also revealed that increase in NPK has negative effect on CCS%. Tabayoyong & Robeniol, (1962) and Etwali & Gascho (1983) reported that increase in doses of NPK reduces CCS% in cane and similar results were observed in our studies. The maximum sugar (CCS t/ha), was produced in treatment 3 (12.20 t/ha), followed by treatment 4 (11.33 t/ha), whereas, the lowest sugar yield was recorded in control (7.63 t/ha) (Table 3).

Economics of fertilizer practices

Economic feasibility of the fertilizer practices is an essential element of improving crop productivity (Kadian *et al*., 1981). Very often the farming is based on sound economics and the farmers generally adopts only those improved practices or innovations, which are more paying and easily workable. Presently, price is the only index for the farmers to decide about their production plans as no other guidelines or production policies are available to him. If the market prices are higher in a particular year, than there is tendency on the part of the growers to bring more area under sugarcane during the next year which generally results in over production. The sugarcane production is, therefore, marked with serious alternate gluts in the markets and so the profitability aspect of each fertilizer practice was also studied. On the basis of current market prices of fertilizer and the farm gate prices of the sugarcane, the obtainable incomes from the additional yields were worked out. Table 4 reflects the comparative economics of different fertilizer levels used in the present experiment.

Evidently, there could be no additional income from the control plot, which did not receive any fertilizers. The calculated value cost ratio from different fertilizer applications varied between 5.78 to 10.36 which is fully in accordance with the prevailing prices. Treatment 3 (200 N:120 P_2O_5:150 K_2O) significantly out-yielded control and gave comparatively higher value cost ratio than the other treatments (Table 4). All the fertilizer levels were found highly profitable over the control. This shows that the use of fertilizers in balanced amount will always remain profitable for the sugarcane growers. The existing profitability levels can considerably be improved with the use of NPK fertilizers in balanced amount.

Sugar yield per unit area can be increased only, if there is simultaneous increase in the production of sugarcane and the recovery of sugar. There is lack of improved high yielding sugarcane varieties and absence of mechanisms to carry out the package of technology and inputs to the farmers. The share of improved variety in the enhancement of cane yield and sugar recovery is about 20-25%, while rest is contributed by production technology (Javed *et al*., 2001). Since the increase in cane and sugar yield in our country has mainly been due to an increase in the acreage (Hashmi, 1995), therefore, the evolution of high yielding clones and good production technology is urgently needed, which could definitly increase the cane and sugar yield per unit area.

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