EFFECT OF SOME NEWLY INTRODUCED FERTILIZERS IN SUGARCANE

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ABSTRACT

A field experiment was conducted at Sugarcane Research Institute, Faisalabad to study the effect of different fertilizer forms (solid and liquid) by different application methods (basal, top dressing, spray and fertigations) on yield and quality parameters of sugarcane variety HSF-240. Statistically significant results were obtained with respect to tillers per plant, number of millable canes (000/ha), cane yield (t/ha), sugar yield (t/ha) and juice% cane while non-significant results were obtained regarding germination%, brix% juice, pol% juice, purity%, CCS% and sugar recovery%. Similarly, those treatments received a combination of solid and liquid fertilizers produced results that were mostly statistically at par as compare to that treatment which received solid fertilizers only.

Keywords: Fertilizers, sugarcane, number of millable canes, cane yield, sugar yield

INTRODUCTION

Sugarcane is a major cash crop of Pakistan and it ranks second after textile industry with respect to employment, revenue generation and foreign exchange earning. Its importance can be judged from the facts that it was cultivated on an area of 907 thousand hectares giving an annual production of 44312 thousand tonnes and average cane yield of 48856 kg ha^{-1} during 2005-06 (Anonymous, 2006). But this yield is still low as compare to the potential yield of our varieties as well as average yield of the world. Several reasons may be assigned to this ominous fact like disease infestation, unfavorable arid climatic conditions, low rainfall etc. but poor soil fertility status and unbalanced use of fertilizers occupies the prime reason.

It is an evident fact that for sustainable agriculture, the importance of soil fertility and plant nutrition can never be neglected. A fertile and productive soil is the basic resource for good crop production and fertilizers plays a vital and leading role in this scenario. A healthy and useful combination of good management practices and balanced fertilization is a soul for bumper cane yield. Many researchers in past have investigated fertilizer requirement, time of application, its forms and methods of application in sugarcane crop. The work of some researchers is briefly discussed in coming lines. Bhatti and Khan (1972) reported that significantly higher yields of cane were obtained with the addition of 72, 76 and 54 kg/acre of N, P_2O_5 and K_2O respectively. They also reported that all NK combinations gave higher yields than NP combination. Tabayoyong (1958) studied the increased yield of sugarcane by the combined application of N, P_2O_5 and K_2O but response in terms of cane and sugar yields varied from soil to soil. He also reported the maximum cane yield with 120 Kg/ha each of N, P_2O_5 and K_2O and emphasized that both cane and sugar yields were increased by NP or NK combination but not by PK combination. De Gues (1967) stated the nutrient requirement of sugarcane crop by studying that a crop yielded 30 tonnes of cane per acre extracted on an average 67 Kg N, 28 Kg P_2O_5 and 135 Kg K_2O from soil. Jan (1957) observed an increase in cane yield and decrease in pol% juice by increasing the rate of 50-200 lbs/acre of nitrogen. He also noticed a decreased response when nitrogen application rate per acre exceeded 100 lbs. Kudachikar *et al.,* (1992) studied the role some micro nutrients in the form of liquid spray and observed a clear difference between treated treatments as compare to those treatments where these fertilizers were not used. They found cane yield was 41.22 t/ha in the

untreated crop and highest (68.62 t/ha^{-1}) with 1% $MnSO_4$ spray, while sugar yields were 4.92 t/ha and 10.46 t/ha respectively. Yadav (1993) explored the role of NPKS and micro nutrients on sugarcane crop at eight different places in India. He reported that each Kg of applied N, P, K, NPK, S, Zn, Fe and Mn produced 0.72 to 3.50, 0.62 to 1.34, 0.08 to 2.92, 0.62 to 1.62, 3.48, 21.81, 20.83 and 25.08 to 68.09 quintals millable canes/ha while yield responses were 55.18, 58.00, 23.40 and 23.97 quintals millable canes for each Kg of foliar applied Zn, Fe, Mn, Ca respectively. Similarly in a three years experiment, Ali *et al.,* (1997) applied nitrogen in solid and foliar forms on two broad leaved and narrow leaved cane varieties. They noticed a higher pol% juice and CCS% in those treatments where nitrogen was split into solid and liquid form application.

Therefore, keeping in view these findings and discussion this study was undertaken to evaluate the effect of some newly introduced liquid fertilizers in comparison with solid fertilizers on growth and yield of sugarcane under irrigated conditions of Faisalabad.

MATERIALS AND METHODS

A field study was conducted at Sugarcane Research Institute, Faisalabad in order to determine the response of growth characteristics of sugarcane crop to the application of solid, liquid and foliar fertilizers. Autumn planted promising commercial sugarcane variety HSF-240 was sown in tri replicated RCBD arrangement with net plot size 45 m^2 during September 2003 and harvested in February 2005. Soil sampling was done from 0-30 cm depth before seed bed preparation and its physical and chemical analysis was made in soil fertility laboratory that was as follows:

Physical properties of soil			Chemical properties of soil		
Sand	=	45%	Organic matter=		0.95%
Silt	=	40%	Nitrogen	=	0.05%
Clay	=	15%	Phosphorus	=	5.8ppm
Texture	=	Loam soil	Potash	=	70ppm
Saturation			pH	=	7.8
Percentage	=	36	EC	=	0.50 dsm^{-1}

All the required agronomic operations and cultural practices were timely performed as and where necessary. While the fertilizers were applied according to different treatments which were as follows:

T_1= 0-0-0 NPK Kg/ha (control)
T_2= 168-112-112 NPK Kg/ha (standard)
T_3= 143-0-32 NPK Kg/ha +259 L/ha H_3PO_4+50kg Nutricalcium +4 sprays of NPK-C +2.50 bags of Nitro-20
T_4= 85-0-32 NPK Kg/ha + 259 L/ha H_3PO_4+ 50Kg Nutricalcium +2.5 bags of Nitro-20
T_5= 143-0-32 NPK Kg/ha + 259 L/ha H_3PO_4 +50Kg Nutricalcium + 2.50 bags of Nitro-20
T_6=143-0-32 NPK Kg/ha +259 L/ha H_3PO_4 +50Kg Nutricalcium+4 sprays of NPK-C
T_7= 168-112-32+50 Kg Nutricalcium+4 sprays of NPK-C +2.50 bags of Nitro-20

The data regarding germination and tillering were recorded after 45 and 90 days of sowing while the other parameters were determined and calculated at the time of harvest. Similarly, a composite sample of ten canes from one randomly selected stool of each replication was brought to laboratory for juice extraction and qualitative analysis as described by Spencer and Meade (1963). The data of physical and chemical characteristics, thus obtained, were

analysed according to analysis of variance (ANOVA) and treatment means were compared with LSD test of significance at 5% probability levels according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

The results from experiment are packed in table. The brief discussion of studied characteristics is given in the coming lines one by one.

Germination

It is the most critical physiological stage in the life cycle of a plant as without germination there is no plant. It should be so sufficient to yield an optimum crop stand. A glance at the data given in the table revealed that the mean germination percentage was statistically non-significant. The highest germination percentage (51.98%) was found in T_1 (control) while the lowest (49.37%) in T_2 (standard). The other treatments revealed results between these two limits. The discussions are in harmony with those elucidated by Majeedano *et al.,* (2003) who also observed non-significant results of germination in their experiment.

Tillers per plant

It is the most important factor that determines the overall crop stand and ultimately affects the cane yield. The data pertaining to tillering are presented in table. The results showed that all treatments differed significantly among each other. The maximum number of tillers per plant ware rescored in T_2 where standard dose of solid fertilizers were applied and it was statistically at par with T_3 where a combination of solid and liquid fertilizers along the liquid fertilizer spray was used. Similarly, the minimum number of tillers per plant were noticed in T_1, having no fertilizer application and it was statistically at par with T_4 and T_6. The work conducted by Majeedano *et al.,* (2003) reveals similar results.

Number of millable canes

The magnitude of final cane yield is mainly determined by the millable cane count and it has the direct effect on cane yield as shown in the table. Statistically significant results were observed regarding the effect of different fertilizers on cane count. The highest value of cane count (154.50 000/ha) was observed in T_2 (standard) while the lowest one (119.70 000/ha) in T_1 (control). The treatments T_5, T_6 and T_7 were statistically at par. The explanation is in accordance with the findings of Korndoreer *et al.,* (1998) who highlighted the comparison of solid and fluid fertilizers for sugarcane.

Cane yield

It is the product of germination, tillering and cane count which attribute substantially towards final cane yield. A perusal of tabulated data indicated significantly variable cane yield produced due to different fertilizer inputs. The maximum cane yield (106.90 t/ha) was produced by T_2 while minimum cane yield (60.57 t/ha) by T_1. The treatments T_4, T_5 and T_6 were statistically at par with each other. A similar experiment with such confirmation was conducted by Subirose *et al.,* (1998).

Sugar yield

It is the product of stripped cane yield and its respective commercial cane sugar. A speculative view to the results obtained in table, it could be observed that the treatments varied significantly with respect to sugar yield. The maximum amount of sugar (14.34 t/ha) was observed in T_2 while the lowest amount (8.44 t/ha) in T_1. Similarly the treatments T_4, T_5, and T_6 were statistically at par. These studies are in confirmation with Subirose *et al.,* (1998) and El-Latif *et al.,* (2000).

Juice % cane
It is a valuable parameter for millers as well as farmers because it increases cane weight on one hand and sugar yield on the other hand. The data given in table indicated the differences among treatments were significant for juice% cane. The maximum (61.18%) juice% cane was extracted from T_2 and minimum (53.59%) from T_1 while all treatments, except T_2 and T_3, were statistically at par with T_1 by producing 55.01, 54.26, 53.93 and 55.76 percent juice extraction respectively.

Brix% juice
It is one of those qualitative parameters used for maturity judgment. The perusal of data embodied in table showed that treatments' differences regarding brix were non-significant. However, the lowest reading of brix was recorded in T_2 where solid fertilizers were applied. It was followed by T_4 (20.68), T_5 (20.76), T_6 (20.99), T_7 (21.04) and T_1 (21.17) in ascending order. These studies are in close confirmation with the findings of Abd-El-Gawad *et al.,* (1992).

Pol% juice
The second important qualitative parameters after brix are pol% juice. It is evident from data table that there was non-significant variation for pol% juice among the seven treatments. However, the highest value (18.49%) for pol% juice was found in T_1 and the lowest (17.87%) in T_2. The remaining five treatments produced intermediate results. These results are identical with the results obtained by Mohammed (1989) who described an inverse relation between the increasing solid fertilizer and decreasing pol% in juice.

Purity
Juice purity is the main factor that is used in maturity and quality judgment. The data pertaining to juice quality are presented in table. The results revealed that all the treatment means varied non-significantly with respect to purity. The lowest purity (86.85) was recorded in T_2 where solid fertilizers were applied while the highest purity (87.34) was observed in control (T_1). The other treatments produced intermediate results. The lower purity value may be due to high level of nitrogen fertilization that accumulated nitrogenous bodies in juice and decreased juice purity. The results are in accordance with the findings of Hussain and Atta (1991) who also reported an inverse relation between purity and nitrogen fertilization.

CCS
It is the major and final qualitative trait that is equally important for miller, farmer and breeder. The tabulated data showed variable effect of different fertilizers and combinations on CCS%. The lowest CCS% (13.42) was observed in T_2 that was followed by T_4 (13.51), T_5 (13.58), T_6 (13.77) T_7 (13.82), T_3 (13.85) and T_1 (13.93) in ascending order.

Sugar recovery
It is obtained from CCS% by multiplying it with a constant factor. The same trend as that of CCS% was observed in sugar recovery. The maximum sugar recovery (13.09) was noted in T_1 while T_3, T_7, T_6, T_5, T_4, and T_2 followed it in descending order by producing 13.02%, 13.00%, 12.94%, 12.77%, 12.70% and 12.61% sugar recovery. These results are similar to the findings of Abd-El-Gawad *et al.,* (1992).

Table-1 Effect of different fertilizer treatments on various physical and chemical characteristic of cane crop

Treatments	Germi-nation (%)	Tillers/ Plant	Millable canes (000/ha)	Cane yield (t/ha)	Sugar yield (t/ha)	Juice % cane	Brix% juice	Pol% juice	Purity (%)	CCS (%)	Sugar Rec. (%)
T_1	51.98	1.76d	119.70e	60.57e	8.44e	53.59c	21.17	18.49	87.34	13.93	13.09
T_2	49.37	2.38a	154.50a	106.90 a	14.34a	61.18a	20.58	17.87	86.85	13.42	12.61
T_3	49.62	2.25ab	146.80b	95.06b	13.17b	57.76b	21.08	18.39	87.24	13.85	13.02
T_4	51.32	1.94cd	130.29d	79.96d	10.26d	55.01c	20.68	17.98	86.95	13.51	12.70
T_5	50.73	2.03bc	135.40c	76.42d	10.38d	54.26c	20.76	18.06	87.00	13.58	12.77
T_6	50.99	2.01bcd	135.10c	74.83d	10.30d	53.93c	20.99	18.30	87.20	13.77	12.94
T_7	50.61	2.09bc	137.80c	84.90c	11.76c	55.76bc	21.04	18.36	87.23	13.82	13.00
LSD at 5%	N.S.	0.2639	4.289	4.629	0.6821	2.543	N.S.	N.S.	N.S.	N.S.	N.S.

LSD = Least Significant Difference
N.S. = Non-Significant
CCS = Commercial Cane Sugar
Sugar Recovery = CCS% x 0.94

CONCLUSIONS

From the results, the following conclusions can be deduced and suggested.

1- Qualitative juice characteristics were non-significantly effected by solid and liquid fertilizers separately as well as by combined applications of both solid and liquid fertilizer forms
2- Quantitative parameters, although significantly effected, but the number of millable canes and cane yield canes were statistically at par in those treatments where solid and liquid fertilizers (newly introduced) were used. This thing also supports first assumption.

However, there are some reservations in case of solid fertilizers in vogue as well as newly introduced fertilizers.

1- Application of newly introduced liquid fertilizers needs more energy and time as compare to the solid fertilizers because solid fertilizers are mostly applied at the time of sowing.
2- An illiterate farmer may face difficultly in application of liquid fertilizers.
3- The solid fertilizers are easy to handle.
4- The efficiency of solid fertilizers may decrease due to volatilization, fixation and unequal application by broad cast. On the other hand, fertigation of newly introduced fertilizers covers all these loopholes.

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