http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (4): 672-673, 2000

Effect of Timing of Nitrogen Application on Agronomic Characters and Nutrient Contents of Sugarcane (*Sacharum officinarum* L.)

[1]Maqbool Akhtar, [2]Khurram Bashir, [2]M. Ehsan Akhtar, [2]M. Zameer Khan and [2]Shahid Rafiq Ch.
*Sugar Crops Program, Crop Sciences Institute, **Potash Development Institute,
National Agricultural Research Centre, Park Road, Islamabad-45500, Pakistan

Abstarct: A field experiment was conducted to study the effect of timing of the last dose of split nitrogen application on agronomic traits and nutrient contents of sugarcane. The study was carried out at the National Agricultural Research Centre Islamabad during 1996-97. Application timing of the last dose of nitrogen did not affect early stalk population, millable canes, stalk height, stalk girth and total soluble solids (TSS). Application of last dose of N at early stage (last week of March) produced significantly lower cane yield than other timings of N application. Maximum cane yield of 146 t ha^{-1} was produced when the last dose of N was applied during the first week of June. Cane yield produced with the application of last dose of N either the mid May or the first week of July produced statistically similar cane yield that was produced with the application of last dose of N during first week of June. Sugar recovery was significantly decreased with the late application (July 1st week) of the last dose of N. Maximum sugar yield (15.70 t ha^{-1}) was produced when the last dose of N was applied during the middle of May. P, K, Zn and B contents were not affected with the timing of application of nitrogen. However, Mg contents of the tissue increased significantly as the application of the last dose of nitrogen was delayed.

Key words: Sugarcane, nitrogen, application timing, agronomic characters, productivity, nutrient contents

Introduction

Sugarcane (*Sacharum officinarum* L.) is the main source of sugar production in the world i.e., the main source of income for many countries. In Pakistan, sugarcane is grown on an area of more or less 1.0 million hectares. Punjab, Sindh and NWFP share 62.4, 26.0 and 11.2% area, respectively (Akhtar, 1998, 1999). Pakistan occupies fifth position in cane producing countries of the world and almost 15th position in sugar production (Akhtar, 1998, 1999).

The production of higher cane and sugar depends on the selection of high yielding cultivars and proper management of the crop including application of balanced fertilizer at appropriate rate and time. Nitrogen is essential for the growth of plant. It is well known fact that a proper supply of nitrogen to crop plants is associated with the enhancement of photosynthetic activity, vigour vegetative growth and a dark green colour of plant leaves (Black, 1993). Clements (1980) has regarded nitrogen as the most influential plant element in the regulation of sugarcane growth and production.

Unfortunately the fertilizer costs are very high all over the world. On the other hand the apparant recovery of applied nitrogen by the crop plants seldom exceeds 50% and the rest is lost from the soil plant system one way or the other (Constable *et al*., 1992; Shah *et al*., 1993; Smith and Whitfield, 1990). Better management practices can help improve nitrogen uptake efficiency. Akhtar and Silva (1998) have reported N uptake efficiency of sole sugarcane up to 73.2%, whereas it was 44.3% in intercropped cane.

It is extremely important to manage the application of nitrogen so that maximum cane yield and sugar recovery could be obtained. Early completion of N application may reduce the total tonnage of the cane, whereas, its delayed application will result in delayed maturity and decrease in sugar accumulation. It is, therefore, important to optimize and properly manage the 'N' application for sugarcane in order to exploit maximum yield potential and sugar recovery. Reghenzani *et al*. (1996) have reported that the timing of N application coinciding with conditions optimum for uptake by the plant can beneficially influence N uptake.

The objective of the present study was to find out the effect of timing of nitrogen application on agronomic traits and nutrient contents of sugarcane.

Materials and Methods

The experiment was conducted at the research area of National Agricultural Research Centre, (NARC), Islamabad during 1996-97. A promising sugarcane cultivar RB 72-454 was planted at a row spacing of 1 m during September. Two budded double setts were planted end to end. The experiment was laid out in a randomized complete block design with three replicates. Phosphorus was applied at 120 kg P_2O_5 ha^{-1}. Potash was applied at 150 kg K_2O ha^{-1}. Nitrogen was applied at 225 kg ha^{-1} in three splits at various timing. The first dose of nitrogen was applied at planting. The second dose of nitrogen was applied during the middle of March. The third and the last dose was applied with the following schedule:

NM1: First week of May NM2: Mid May
NM3: June 1st week NM4: July 1st week

All P and K was applied at the time of planting. Gesapax Combi 80 WP was applied as pre-emergence herbicide to control the weeds. Further weeding was done by cultural operations and earthing up during April and May. Data on tillering was recorded at early growth stages during June and July from an area of 10 m^2. Plant tissue samples were collected during the month of August and these samples were analysed for various nutrients in the tissue. Brix%age (total soluble solids) was also recorded during October and November The crop was harvested during December and the data on stalk height, stalk girth, Brix percent and cane yield were recorded. Final data on cane yield was recorded from an area of 15 m^2. Ten stalks were used to record the stalk height. Stalk girth was measured from 20 cm above ground, from the middle and from 20 cm below the topmost node and then was averaged. Stalks from the harvested samples were used to determine the sugar recovery. The data collected were analysed with PC SAS for analysis of variance using Waller Duncan's LSD at a probability level of 5%.

Results and Discussion

Stalk Population, Stalk height and Girth: The data presented in Table 1 indicated that early stalk population, millable canes at harvest, stalk height and stalk girth were not affected with the application of the last dose of nitrogen at various timings. Although statistically similar with other treatments but the tallest stalks (256 cm) were produced when the last dose of nitrogen was applied during the middle of May. Shortest stalks (235 cm) were produced when the last dose of N was applied during the

Table 1: Mean Tillers (000 ha^{-1}) during crop growth period, Stalk height, Stalk girth and Cane yield at harvest affected by timing of N application

Treatments	Tillers 000 ha^{-1}				Stalk height (cm)	Stalk girth (mm)	Cane yield t $^{-1}$
	June 03	July 04	July 19	At harvest			
NM-1	257.3	273.3	220.0	135.7	248.3	28.9	116 b
NM-2	275.7	287.0	244.3	137.7	256.0	29.4	140 a
NM-3	230.0	251.3	225.0	139.0	240.3	28.6	146 a
NM-4	216.3	227.7	203.3	131.7	235.3	29.2	144 a
p<0.5	N.S	N.S	N.S	N.S	N.S	N.S	26

Table 2: Mean Brix % (Total Soluble Solids) at various maturity stages, Sugar recovery and sugar yield affected by timing of N application

Treatments	Total Soluble Solids (Brix%)					Sugar recovery (%)	Sugar yield (t ha^{-1})
	Oct. 24	Nov. 04	Nov. 12	Nov. 24	At harvest		
NM-1	16.3	17.5	17.8	18.0	20.8	11.5 a	13.34 b
NM-2	15.8	16.5	16.9	18.6	20.6	10.9 a	15.70 a
NM-3	16.1	16.4	17.1	18.7	20.4	10.8 a	15.10 a
NM-4	15.8	16.4	16.7	17.9	19.7	9.2 b	13.00 b
(p<0.5) LSD	N.S	N.S	N.S	N.S	N.S	1.2	1.8

first week of July. Timing of application of the last dose of nitrogen did not affect the total soluble solids (TSS) in the cane juice (Table 2). As the nitrogen was applied according to the requirements of the cane crop hence its application timing did not affect stalk population, stalk height and girth. It is reported that nitrogen improved stalk population, stalk height and girth up to 150 kg Nha^{-1} in sole cane and up to 300 kg N $^{-1}$ in intercropped sugarcane (Akhtar and Silva, 1998).

Table 3: Nutrient concentration of sugarcane plant tissues affected by the timing of Nitrogen application

Treatments	P (%)	K (%)	Zn (mg kg^{-1})	Mg (mg kg^{-1})	B (mg kg^{-1})
NM-1	0.26	2.2	12.0	2823 c	10.2
NM-2	0.27	2.3	12.4	2935 b	10.2
NM-3	0.27	2.4	12.7	2931 b	10.5
NM-4	0.25	2.3	12.8	3367 a	10.5
(p<0.5) LSD	N.S	N.S	N.S	98.7	N.S

Cane yield: Cane yield was the minimum (116 t ha^{-1}) when nitrogen application was completed earlier (last week of March). Other timings of completion of nitrogen application did not affect cane yield. Maximum cane yield of 146 t ha^{-1} was produced when the last dose of nitrogen was applied during the first week of June (Table 1). It seems that completion of N application during the first week of June will result in maximum economic cane yield. Early N application resulted in lower sugar yield due to lower cane yield and late application resulted in early growth loss (Wiedenfeld, 1997). Fertilizer nitrogen uptake by sugarcane was increased by delaying its application after the harvest of potato or maize but it was not accompanied by an increase in cane yield (Kwong *et al.*, 1996).

Total soulble soilds (Brix%), sugar recovery and sugar yield: Data on total soluble solids taken at various maturity stages was not affected with the application timing of the last dose of nitrogen (Table 2). The results of the study indicated that the sugar recovery was significantly decreased with the delayed application of (July 1st week) the last dose of nitrogen. Sugar recovery was maximum (11.5%) when the last dose of N was completed during the first week of May, however, with this treatment cane yield was minimum. Sugar recovery was statistically similar with the application of the last dose of N either during the 1st week of May, mid May or 1st week of June. Sugar yield was significantly affected with the application of the last dose of N either too early (May 1st week) or too late (July 1st week). Maximum sugar yield 15.70 (t ha^{-1}) was produced when the last dose of N was applied during middle of May (Table 2). Late application of nitrogen resulted in poor juice quality, whereas, early application improved juice quality and decreased cane yield (Wiedenfeld, 1997).

Nutrient contents of plant tissues: Data presented in Table 3 shows that application timing of last dose of nitrogen did not affect P, K, Zn and B contents of sugarcane tissues. However Mg contents of the tissues were affected with the application timing of the last dose of nitrogen. Concentration of Mg in plant tissue increased as the application timing of the last dose of nitrogen was delayed (Table 3).

The present study shows that the management of nitrogen is extremely important in order to obtain maximum cane and sugar yield. It is suggested that nitrogen should be applied at least in three to four splits to September planted cane and in three splits to Feb-Mar. planted cane crop. The last dose of nitrogen must be applied during the first week of June so that the maturity of the cane may not be delayed and there may be the maximum sugar accumulation.

References

Akhtar, M. and J.A. Silva, 1998. Nitrogen requirements and growth characters of sugarcane in various cropping systems. Pak. J. Soil Sci., 15: 126-129.

Akhtar, M., 1998. Status of sugarcane research and development in Pakistan. Daily Business Recorder. August 14, 1998.

Akhtar, M., 1999. Sugarcane research and development in Pakistan. Sci. Technol. Dev., 18: 15-21.

Black, C.A., 1993. Soil Fertility Evaluation and Control. Lewis Pub., Boca Raton, pp: 171-175.

Clements, H.F., 1980. Sugarcane Crop Logging and Crop Control. The University Press of Hawaii, Honolulu, pp: 272-313.

Constable, G.A., I.J. Rochester and I.G. Daniel's, 1992. Cotton yield and nitrogen requirement is modified by crop rotation and tillage method. Soil Till Res., 23: 41-59.

Kwong, K.F.N.K., G. Umrit and J. Deville, 1996. Nitrogen fertilization of sugarcane in an intercropping system with maize and potato in the humid tropical climate of Mauritius. Exp. Agric., 32: 213-218.

Reghenzani J.R., J.D. Armour, B.G. Prove, P.W. Moody and T.J. McShane, 1996. Nitrogen Balances for Sugarcane Plant and First Ratoon Crops in the Wet Tropics. In: Sugarcane: Research Towards Efficient and Sustainable Production, Wilson, J.R., D.M. Hogarth, J.A. Campbell and A.L. Garside (Eds.). CSIRO Division of Tropical Crops and Pastures, Brisbane, pp: 275-277.

Shah, Z., J.K. Khattak and R. Ali, 1993. Fate of applied nitrogen in soil plant system and its effect on yield of maize [(*Zea mays* L.)]. Sarhad. J. Agric., 9: 435-455.

Smith, C.J. and D.M. Whitfield, 1990. Nitrogen accumulation and redistribution of late applications of ^{15}N-labelled fertilizer by wheat. Field Crops Res., 24: 211-226.

Wiedenfeld, R., 1997. Sugarcane responses to N fertilizer application on clay soils. J. Amer. Soc. Sugar Cane Technol., 17: 14-27.