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Performance of Sugarcane Genotypes Under Different Nitrogen Levels in Sub-Tropical Region of Nepal

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Abstract: A field experiment was conducted during consecutive years of 2014-16 to study the effect of different nutrient levels on performance of sugarcane genotypes on sandy loam soils at National Sugarcane Research Program, Jitpur, Bara, Nepal. The experiment was laid out in split plot design of four nitrogen levels 75%, 100%, 125%, 150% of recommended dose (RD) i.e 112.5, 150, 187.5, 225 kg N/ha for plant crop and 150, 200, 250, 300 kg N/ha for ratoon respectively and four varieties viz. CoLk 94184, BO 147, Co 0233 and BO 141 replicated thrice. The experimental results revealed that significantly increased in number of millable cane and cane yield with increasing nitrogen levels. Application of 150% nitrogen RD (225 and 300 kg N/ha) significantly counted higher number millable canes (115548.43/ha and 100700/ha) in both plant and ratoon crop respectively. High nitrogen levels i.e. 187.5 and 225 kg N/ha showed significant higher cane yield over 150 kg N/ha by 7.22 and 9.36% in plant crop respectively. Reducing nitrogen levels by 25% of RD resulted significantly low yield of 59.78 mt/ha, shortest stalk length (1.87 m) and low single cane weight of 0.65 kg in ratoon crop but not significantly difference in stalk length, cane diameter and single cane weight in plant crop. The data indicated that significantly higher number of millable cane was counted in genotypes CoLk 94184 of 124831.06/ha and 107400/ha in both plant and ratoon crop respectively followed by BO 141 and Co 0233. Higher cane yield was produced by genotypes BO 141 (94.01 and 75.89 mt/ha) and Co 0233 (93.18 and 81.72 mt/ha) in plant crop as well as in ratoon crop respectively. The ratoon performance index (RPI) of genotypes Co 0233 (89.21), CoLk 94181 (84.01) and BO 141 (81.59) were identified as better as compared to BO 147.

Keywords: Nitrogen, Sugarcane Genotypes, Millable Cane, Ratoon Performance Index

1. Introduction

In Nepal, sugarcane (*Saccharum officinarum*) is one of the largest cash and industrial crop that plays a pivotal role in national economy. It is being grown in all agro-ecological zones but intensive commercial production accounts highest in terai region. The high demand for sugarcane-derived products has stimulated the expansion of sugarcane cultivation and sugar factories establishment in recent years. Sugarcane area has been increased by four fold (17,480 to 666,000 hectares) and total production increased by almost eight folds (408,260 to 3,063,000 tons) from 1985 to 2015 [7]. Nepal is also ranked 40th among the sugarcane producing country in the world [3]. However, national productivity is limited to only 46 t/ha [7] as compared to other countries like India, China, and Thailand etc. There might be several factors that contribute to low cane production and productivity such as low yielding varieties, biotic stresses, abiotic stresses, and poor adoption of improve technologies.

The variety plays an important role in boosting cane productivity. However, cane yield and quality in sugarcane are dependent on several quantitatively inherited characters which themselves are also influenced by environment [5]. Varieties behave differently in different soil and agro climatic conditions. In subtropical Nepal, the availability of sugarcane genotypes with higher cane and sugar yield potential is an important strategy to fetch high sugar recovery in the mills. The major agronomic intervention can accelerate the

adoption of genotypes in a particular agro-climatic region of varied soil nutrient status especially nitrogen [13]. Sugarcane genotypes selection under different amount of nutrient status should be done such that it could meet the demand of crop at critical stages for potential cane yield efficiently and minimize nitrogen losses through leaching and volatilization. Except in some part of country, Nepalese soils are universally medium to deficient in nitrogen [2] and being a longer duration and highly exhaustive crop has higher demands for nitrogenous fertilizer. Hence. In this context, the present investigation was thus taken up to assess the performance of new genotypes for different nitrogen status conditions.

2. Materials and Methods

Field experiments were conducted at NSRP Jitpur Bara in 2014-15 (plant crop) and 2015-16 (ratoon crop) to study the performance of sugarcane genotypes under different nitrogen levels. The experiment was laid out in split plot design keeping combinations of four nitrogen levels 75%, 100%, 125%, 150% of recommended dose of Nitrogen fertilizer as main plots i.e. 112.5, 150, 187.5, 225 kg N/ha for plant crop and 150, 200, 250, 300 kg N/ha for ratoon crop and four varieties viz. CoLk 94184, BO 147, Co 0233 and BO 141 as sub plot replicated thrice. The soil of the experimental site was sandy loam with pH 6.5, soil organic matter 1.02%, available N, P, K were 0.06%, 39.19 kg/ha and 126.17 kg/ha, respectively. The plot size was maintained at 3.6 m length of 90 cm spaced four rows in each plot. The fertilizer was used at the rate of 150:60:40 and 200: 60: 40 kg NPK per hectare for plant cane and ratoon crop respectively. Half dose of N and full dose of phosphorus and potassium were applied and mixed with soil as basal at planting. Remaining half dose was applied as two split top dressed each at 60 and 90 days after planting. All the recommended package of practices was adopted for raising a good and healthy crop. The central two row of the plot were harvested and various parameters like yield and number of millable canes were recorded. Five canes were randomly selected for measuring single cane weight and stalk length. Three canes were randomly selected for measuring cane diameter. Data obtained were analyzed using RSTUDIO Program. The ratoon performance index (RPI) was also calculated as per Shaw (1988) [9] by the formula given as below:

$$\text{RPI} = 100\left(1 - \frac{Py - Ry}{Py}\right)$$

Py = Reference plant crop yield (mt/ha)
Ry = Ratoon crop yield (mt/ha)

3. Result and Discussion

3.1. Growth Yield

Number of millable canes and cane yield showed significantly different on sugarcane genotypes with application of graded doses of nitrogen but stalk length, cane diameter and single cane weight could not show any significant improvement in plant crop. The data reported that application of 225 kg/ha N (150% RDF) to sugarcane helped significantly improving number of millable canes (115548.43/ha) thereafter 187.5 kg/ha (125%RDF) application gave 107602.96/ha. Likewise, the response of N application above the recommended dose i.e. 187.5 kg N/ha and 225 kg N/ha produced the cane yield of 90.57 mt/ha and 88.48 mt/ha respectively. The role of nitrogen in chlorophyll formation and carbohydrate metabolism is well known. Hence, improvement in millable cane count and yield at high doses of N application might be due to more availability and absorption of the nutrients nitrogen and in build characterized of genotypes to response high levels of fertilizer N. Continuous uptake of nitrogen led to more spouting of tillers and proper growth and development of cane [4]. Such findings are conformity with the findings of Singh et al (2008) [9] and anonymous (2010) [1].

Table 1. *Yield attributes and cane yield of promising sugarcane genotypes plant cane under different nitrogen levels at NSRP in 2014-15.*

Treatments	No of Millable canes /ha	Stalk length (m)	Cane diameter (mm)	Single cane weight (kg)	Cane yield (mt/ha)
Level of Nitrogen (kg N/ha)					
75% RDN (112.5)	98207.92 c	2.54	20.48	0.92	71.74 c
100% RDN (150)	102156.19 bc	2.49	20.93	0.97	82.09 b
125% RDN (187.5)	107602.96 b	2.57	20.85	1.00	88.48 a
150% RDN (225)	115548.43 a	2.56	21.28	0.98	90.57 a
LSD	6758.93**	NS	NS	NS	5.12**
Sugarcane genotypes					
CoLk94184	124831.06 a	2.38 b	19.97 b	0.79 b	75.91 b
BO 147	68643.88 c	2.56 a	21.91 a	1.03 a	69.79 c
Co 0233	112583.31 b	2.56 a	21.19 ab	1.06 a	93.18 a
BO 141	117457.24 ab	2.65 a	20.47 b	0.98 a	94.01 a
LSD	8933.78**	0.101**	1.19*	0.177**	3.94**
CV	8.2	6.5	6	15.1	5.9
Grand mean	105878.9	2.54	20.88	0.97	83.22

The mean followed by the same letter(s) in a column are not significant different at 5% levels of significance. '*' and '**' indicate statistically different means at 5% and 1% significant level respectively. Means within a column that are not boldface are not significantly different. The figures in parenthesis indicate quantitative amount of nitrogen (kg/ha) applied.

The number of millable canes counted significantly higher in CoLk 94184 (124831.06/ha) which was at par with BO 141 (117457.24/ha) followed by C0 0233 (112583.31/ha) over BO 147. Individual stalk length, cane diameter and single cane weight were significantly different among the genotypes tested. In the contrary, genotype BO 147 gave significantly the thickest cane diameter (21.91 mm) followed by Co 023 of 21.19 mm. But, only genotype CoLk 94184 recorded significantly shortest cane length (2.38 m) and less single cane weight (0.79 kg) among tested genotypes and this may be attributed to higher number of millable canes in genotypes CoLk 94194 [4] Yield is a major parameter to find out the economic potential of the variety. Among the tested genotypes, the data indicated that BO 141, Co 0233 had highest cane yield of 94.01 and 93.18 mt/ha respectively where genotype BO 147 recorded significantly lowest cane yield. The inherent capacity of genotypes might have favored the growth of BO 141 and Co 0233 over the other genotypes. Similar finding were also reported by Shukla (2007) [11] and Singh and Uppal (2013) [13].

3.2. Performance of Ratoon

The ratoon crop fertilized with higher dose of nitrogen (300 kg N/ha) significantly the more number of millable cane (100700/ha) which was 17.46% higher than 150 kg N/ha. Likewise, application of nitrogen above the recommended doses (250 and 300 kg N/ha) showed significant differences on stalk length (1.97 and 2.0 m) and cane yield (72.37 mt/ha and 69.37 mt/ha) as compare to below recommended dose which might be due to continuous uptake of nutrient under different nitrogen led more sprouting of tillers and proper growth and development of cane [10] But, the increase in nitrogen application above the recommended dose up to 300 kg N/ha in ratoon crop showed non-significant responses on single cane weight. The result showed that application of different N application reported insignificant effect on cane diameter and ratoon performance index (table 2).

The data on performance of ratoon CoLk 94184 gave 43.14% higher number of millable cane (107400/ha) followed by Co 0233 of 96220/ha (37.14%) over BO 147. In contrast, significantly the lowest single cane weight was recorded in CoLk 94184 (0.60 kg) than other genotypes. But superiority of genotypes Co 0233 (81.72 mt/ha) and BO 141 (75.89 mt/ha) cane yield was recorded over other genotypes It might to due to higher millable canes and individual cane yields. Similarly, ratoon performance index was found higher in three genotypes Co 0233 (89.21), CoLk 94184 (84.01) and BO 141 (81.59) than genotype BO 147. The inherent capacity of genotypes might have favored proper ratoon initiations (Shukla, 2007) [12].

Table 2. *Yield attributes and cane yield of promising sugarcane genotypes ratoon crop under different nitrogen levels at NSRP in 2015-16.*

Treatments	No of Millable canes /ha	Stalk length (m)	Cane diameter (mm)	Single cane weight (kg)	Cane yield (mt/ha)	Ratoon performance index
Level of Nitrogen (kg N/ha)						
75% RDN (150)	83110 b	1.87 b	20.25	0.65 b	59.78 b	82.41
100% RDN (200)	86640 b	1.93 ab	22.13	0.76 a	65.87 ab	79.32
125% RDN (250)	89050 b	1.97 a	20.43	0.74 a	69.57 a	78.45
150% RDN (300)	100700 a	2.0 a	20.55	0.76 a	72.37 a	80.29
LSD	9950.94 *	0.08 *	NS	0.047 **	8.22*	NS
Sugarcane genotypes						
CoLk 94184	107400 a	1.91	20.48	0.60 b	64.16 b	84.01 a
BO 147	60480 c	1.95	20.83	0.81 a	45.81 c	65.67 b
Co 0233	96220 ab	1.96	20.97	0.77 a	81.72 a	89.21 a
BO 141	95390 b	1.95	21.06	0.74 a	75.89 a	81.59 a
LSD	11219.9**	NS	NS	0.104 **	8.81**	14.47**
CV	12.95	4.1	12.1	6.4	12.3	17.40
Grand mean	89879.61	1.94	20.84	0.73	66.89	80.12

The mean followed by the same letter(s) in a column are not significant different at 5% levels of significance. '*' and '**' indicate statistically different means at 5% and 1% significant level respectively. Means within a column that are not boldface are not significantly different. The figures in parenthesis indicate quantitative amount of nitrogen (kg/ha) applied.

4. Conclusion

On the basis of above discussion it may be concluded that although having more number of millable canes in higher dose of N application (150% of recommended dose), the sugarcane yield was similar to 125% recommended dose of nitrogen in plant cane (88.48 mt/ha) as well as in ratoon crop (81.72mt/ha). With considering resource saving and economical prospect, application of 187.5 kg N/ha (125% RD) for plant crop and 250 kg N/ha (125% RD) for ratoon crop were recommended for sustainable sugarcane production. Similarly the genotype Co 0233 and BO 141 had superior in cane yield in both crops and CoLk 94184 also performed well in ratoon crop.

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