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Research Paper

Effect of fertility levels on productivity and sustainability of sugarcane (*Saccharum* spp. hybrid complex) varieties under various planting seasons in clay loam soil of south-east Rajasthan

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ABSTRACT

A field experiment was conducted from 2008–09 to 2010–11 at Agricultural Research Station, Kota, to find out suitable sugarcane (*Saccharum* spp.) varieties ('CoPK 05191', 'CoPK 05192' and 'Co 05011') for different planting season (spring and summer) under 3 levels of recommended dose of NPK (150:45:30, 200:60:40 and 250:75:50 kg/ha), laid out in randomized block design with 3 replications. The variety 'CoPK 05191' recorded the highest number of millable cane (99,400 and 85,050/ha), cane yield (81.20 and 65.43 t/ha), commercial cane sugar (9.82 and 8.45 t/ha), pol % juice (18.4 and 18.5) across the seasons, hence it could be adopted in the region for optimizing sugar productivity and regulating crushing schedule at factory level. The results also revealed that yield attributes, viz. number of millable cane (95,650 and 83,310/ha), single cane weight (885 and 905.5 g), cane yield (75.90 and 63.90 t/ha), pol % juice (18.1 and 17.7), CCS (10.08 and 8.60 t/ha) and net profit (₹88,680/ha) were significantly influence due to increasing levels of fertilizers up to 200:60:40 kg NPK/ha over 75% RDF of NPK (150:45:30 kg/ha) and at par with 125% RDF of NPK (250:75:50 kg/ha) in spring and summer season respectively. Nutrient uptake followed the similar trend as the yield attributes and cane yield in different fertility levels. Thus, the results indicated that fertility level of 200:60:40 kg NPK/ha was found optimum for improving yield attributes, cane yield and juice quality of sugarcane variety 'CoPK 05191' for spring as well as summer planting.

Key words : Commercial cane sugar, Fertility level, Returns, Sugarcane varieties, Season

Sugarcane (*Saccharum* spp. Hybrid complex) is an important agro industrial crop of India being cultivated on 5.04 million ha, with an average productivity of 71.67 tonnes/ha ((FAO, 2013). It is the most important cash crop of Rajasthan which is grown on 5375 ha area at an average productivity of 73.06 tonnes/ha (Anonymous, 2012). We are also the second largest producer of sugarcane in the world after Brazil. Broadly speaking, in Rajasthan the low sugar recovery as well as cane production is governed by various factors at the farmers' field, out of which, imbalanced nutrient use especially NPK, adoption of old variety, planting time in the prevalent cropping system and agro-climatic conditions is the major reason responsible for this. Sugarcane is an exhaustive crop, which removes about 205, 24, 229, 30, 3.5, 1.2, 0.6 and 0.2 kg/ha of N P K S Fe Mn Zn and Cu, respectively from the soil for the cane yield of 100 t/ha (Singh *et al.* 2007). To produce one tonne of cane from plant crop, 1.270 kg of nitrogen is required, whereas nearly double the quantity of N is required for the first ratoon crop of sugarcane. Application of balanced fertilizers especially NPK is an important management practice for increasing sugarcane yield and sugar production without deterioration soil fertility. Nitrogen and phosphorus are the most important nutrient element in influencing the level of crop yield in sugarcane. Role of nitrogen in increasing tillers and growth is well recognized, while excess N availability during the ripening period reduces the juice quality (Tabayoyong and Robeniol 1962). The application of K fertilizers is very low as compared to its removal from soil. The crop is responding to higher levels of fertilizers than that of recommended doses for its biomass production. Optimum nutrient management for sugarcane plant crop plays key role as it establishes vigorous stubble, which affects the ratoon yield (Shukla, 2007). Fertility levels may influence the tillering pattern and other growth parameters of different varieties to a great extent. Yield potential of different sugarcane varieties may differ under different agro-climatic conditions because of their

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inherent capabilities for adaptation. Among the numerous technologies for increasing cane yield and recovery percent, variety is the pivotal and main ingredient. The adoption of high yielding better quality variety is the leaf better technology that the cane grower can easily afford. In subtropical India sugarcane is planted in autumn, spring and summer season under different nutrient levels. However, sugarcane could be grown ideally in February–March, but for improved yield and quality identification of optimum time of planting, which fits well to the local climatic and weather variable is very important. Tillering period in sugarcane is the most important growth phase, which governs the cane yield and number of tillers had positive association with number of millable canes at harvest in subtropical India (Roodagi *et al*. 2001). When sugarcane planting is delayed from February to April/May, it gets lesser time for tillering and reduces productivity (Pandey and Shukla, 2001). Thus, time of planting is a key component for obtaining high sugarcane productivity. Climatic and agronomic practices required for cultivation of sugarcane in subtropical condition is not well-known and have selection of suitable subtropical sugarcane varieties, which is liable to change as per varieties and environment under different planting seasons and nutrient levels needs to be identified in subtropical India. The present experiment was therefore, undertaken with aimed to find out sugarcane varieties suitable for different planting seasons and harvest to extend the crushing season with optimize fertilizer needs for improving productivity and quality of sugarcane under heavy soil of south-east Rajasthan.

MATERIALS AND METHODS

A field experiment was conducted during 2008–09 and 2010–11 at Agricultural Research Station, Ummedganj, Kota, Rajasthan (25°13' N, 75°25' E and 258 m above mean sea-level) to study the effect of different levels of NPK on yield attributes, cane yield and juice quality of sugarcane varieties under various planting seasons. It was laid out in randomized block design with using 3 sugarcane genotypes, viz. ‘CoPK 05191’, ‘CoPK 05192’ and ‘Co 05011’ and three NPK levels 150:45:30, 200:60:40 and 250:75:50 kg/ha with 3 replications. The experiment soil was clay loam having pH 8.0, medium in organic carbon (0.55%), available nitrogen and P_2O_5 (355 and 23.6 kg/ha) and high in available K_2O (287 kg/ha). Separate trials were conducted for spring and summer seasons. Sugarcane was planted in the last week of February (spring planted) and April (summer planted) at 75 cm row spacing using same seed rate of 3 budded sets and harvested in the following years after attaining 11–12 month old crop. Farm yard manure at 10 tonnes/ha was incorporated uniformly over the field before last plouging. Full dose of PK and ¼ N were applied basal as per treatments and remaining N in 3 equal splits were top dressed on 30 and 60 days after planting and earthing up i.e. on onset of monsoon. The NPK fertilizers were applied through urea and DAP and muriate of potash respectively. Seven irrigations to spring and 5 to summer planted crop were given before monsoon. All the agronomic and plant-protections were carried out uniformly as and when required. The experimental location experiences sub tropical climate with dry-summer extending from March to August. A perusal of 50 year weather data of the site reveals that the area received a mean annual rainfall of 772.6 mm distributed in 43.6 rainy days. The mean annual maximum and minimum temperature ranged from 22.3 to 43.96° C and 5.44 to 27.4° C respectively. The mean relative humidity ranged from 38.96 to 80.26%. The mean pan evaporation per day ranged for 1.6 to 16.9 mm (Table 1).

Five canes were randomly selected from each plot for estimation of growth attributes, yield and quality parameters. Cane juice was extracted with power crusher and juice quality was estimated as per method given by Spencer and Meade (1955). Sugar yield was calculated as; Sugar yield (t/ha) = [S- 0.4 (B – S) × 0.73] × cane yield (t/ha)/100; where S and B are sucrose and brix % in cane juice. Millable cane stalk were counted in December for spring and summer crop. Cane growth attributes were measured before harvesting at the time of juice analysis. Whole cane samples were analyzed for N, P and k contents. The uptake of N, P and K were calculated by multiplying their concentration with dry-matter yield. The economics was worked out on prevailing market prices. Variances were subjected to Bartlett’s test for homogeneity of variance. As variances were found to be homogenous pooled data for 3 consecutive years for spring and summer were presented.

Sustainability yield index (SYI) was calculated for different treatments taking yield as dependent variable. Mean yield of each treatment (Yt) and standard deviation (S) over years were calculated using the yield data from 2008 to 2011 (spring and summer) for arriving at SYI using the equation h_1, (Yt–S)/Ymax; where h_1 is sustainability index of h treatment over a period of n years and Ymax is the maximum yield.

RESULTS AND DISCUSSION

Spring planting

Growth and yield attributes: Germination counts were recorded at 40 days after planting of sugarcane. Pooled data of 3 cropping season indicated that percent germination differed among the varieties. Significantly higher germination percentage was recorded with the variety ‘Co 05011’ (41.0 %) over variety ‘CoPK 05191’ and which was almost similar to variety ‘CoPK 05192’ (40.20 %). The remarkable improvement in germination percentage in the variety ‘Co 05011’ of sugarcane was mainly due to higher glucose content at the cellular level, whereas lower germination in variety ‘CoPK 05191’ was due to low conversation of higher amount of sucrose to glucose with low temperature in the subsequent month, which might have led to greater availability of glucose to the germinating buds under prevailing climatic condition vice-versa. Results obtained in the present study are in accordance with those of Singh *et al*. (2011). Varieties differed significantly for observation recorded on tiller, number of millable cane and single cane weight. Maximum number of tillers and millable cane (1,34,810 and 99,400/ha) were recorded with variety ‘CoPK 05191’, which was significantly higher over variety ‘Co 05011’ and variety ‘CoPK 05192’, owing to its higher tillering capacity. Over all mean individual cane weight (892.3 g) of ‘CoPK 05191’ and ‘CoPK 05192’ (871 g) were at par. It showed that although variety ‘CoPK 05191’ produced thicker cane than variety ‘CoPK 05192’, contribution of cane length in cane weight compensated the effect of diameter so ‘CoPK 05192’ was at par with ‘CoPK 05191’. The significant variation in tillers, number of millable cane and single cane weight was due to chemical composition of soluble solids in juice as well as enzymes and hormones present in cell sap, which differs from variety to variety. Kumar *et al*. (2012) also noticed significant variation on aforesaid attributes among different sugarcane varieties.

Fertility levels had significant impact on growth and yield attributes, viz. tillers, number of millable cane and cane weight while, the effect on germination was non-significant (Table 2). The highest tillers (1,31,600/ha), millable cane (95,650/ha) and single cane weight (885 g) were significantly higher in the plot receiving 200:60:40 kg NPK/ha over 150:45:30 kg NPK/ha but on par with 250:75:50 kg NPK/ha. Number of tillers and millable canes increased significantly up to 200:60:40 NPK kg/ha. Moreover, higher dose of NPK also reduced the tiller mortality indicating the besides production of millable canes. Higher nutrition level helped in maintaining retention of tillers. The increase in the rate of physiological process in the plant system leading to increase rate of tiller formation. Navnit Kumar (2012) also reported similar results. Desired NPK level created better nutritional environment in soil system resulting in brought significant improvement in millable cane and cane weight. Positive interaction of nitrogen and phosphorus and nitrogen with potassium is well known. The positive response with NPK on millable cane and cane weight were also reported by Pandey and Shukla (2001) and shukla (2007).

Yield and quality: The cane yield was significantly higher with variety ‘CoPK 05191’ (81.20 t/ha) over rest of the varieties, owing to higher number of millable canes and optimum cane weight. Variety ‘CoPK 05191’ also showed the highest pol (18.4%) reading and commercial cane sugar yield (9.82 t/ha) at 10 month stage in spring cane which was significantly superior to rest of varieties (Table 2). The results indicated that maximum benefit from higher sugar produced variety ‘CoPK 05191’ could be harvested in December under spring planting situation.

Fertility levels causes significant impact on cane yield (Table 2). The cane yield (75.90 t/ha) was significantly higher in the treatment receiving NPK of 200:60:40 kg NPK/ha over 150:45:30 kg NPK/ha and on par with NPK of 250:75:50 kg/ha. This could be attributed to higher of millable canes and average cane weight due to increasing levels of fertilizers. Navnit Kumar (2012) also reported

Table 1. Mean monthly maximum and minimum temperature, relative humidity, evaporation and total rain fall (2008 to 2010).

Month	Temperature °C						Relative humidity (%)			Rainfall (mm)			Evaporation (mm)		
	Maximum			Minimum			2008	2009	2010	2008	2009	2010	2008	2009	2010
	2008	2009	2010	2008	2009	2010									
January	22.1	21.8	22.2	5.03	5.4	5.9	76.1	73.7	68.0	-	6.6	2.6	1.5	1.37	1.7
February	25.1	23.6	25.8	5.23	5.6	10.7	71.6	69.2	68.9	-	3.4	1.4	2.8	2.4	3.2
March	33.7	32.3	33.5	13.1	10.9	10.7	59.8	59.3	55.1	4.2	-	-	5.5	5.2	4.7
April	38.1	35.2	36.9	17.7	14.2	14.85	41.5	42.5	32.9	32.2	-	-	6.2	4.9	6.5
May	40.3	43.6	41.4	18.2	17.5	17.85	43.2	43.6	44.5	-	3.0	-	12.6	10.2	12.5
June	42.5	44.8	44.6	27.2	28.2	8.8	48.8	50.5	50.3	70.0	6.4	23.2	18.5	14.6	17.6
July	36.6	28.6	35.6	28.3	26.5	27.4	64.7	66.9	66.8	160.3	111.7	156.8	4.9	2.8	3.2
August	33.8	29.3	32.7	24.3	23.8	25.1	79.8	80.0	81.0	115.4	70.2	256.2	3.8	3.3	2.8
September	32.3	32.8	33.5	26.6	27.2	25.62	72.7	74.5	74.4	53.0	3.2	104.5	4.2	3.8	4.9
October	34.5	33.4	35.2	28.3	20.5	20.62	64.3	64.8	48.1	4.8	-	-	3.9	3.3	5.3
November	29.0	26.8	28.0	14.8	14.2	15.95	76.2	75.3	74.9	4.5	8.8	37.5	1.1	1.4	2.1
December	22.0	27.3	23.8	7.2	7.5	7.85	64.7	64.7	65.1	-	2.7	2.5	1.3	1.0	1.2

similar findings. As a result of this, the fertility status of the soil might have increased and thus increasing the absorption of plant nutrients. Hence, more tillers were converted into number of millable canes which lead to more yield. The results are in agreement with the finding of Khan *et al.* (2005) and Thakur *et al*. (2007). Fertility levels did not cause significant variation in pol % juice. The results are in accordance with the finding of Singh *et al*. (2008). The effect of NPK fertilization (200:60:40 kg/ha) on sugar yield (10.08 t/ha) was significantly superior over fertility levels of NPK 150:45:30 and 250:75:50 kg/ha. The % increase in sugar yield by application of 200:60:40 kg NPK/ha was 6.44 and 7.23% respectively. Thus cane yield and CCS were also higher at this fertility level. CCS was the function of cane yield and quality. The higher cane yield contributed greater share in improving CCS than cane quality parameters.

Summer planting

Growth and yield attributes: Summer (April) planted crop exhibited lower germination (31.33 %) than spring-planted one (38.33%), variety 'CoPK 05192' maintained its superiority for higher germination during both the seasons. Summer cane produced lesser number of tillers over the period due to less time available for tillering. These results are in close conformity with the results obtained by Pandey and Shukla (2003). However, variety 'CoPK 05191' produced the highest tillers (1,21,540/ha), number of millable canes (85,050/ha) and cane weight (934.8 g), which was significantly higher over rest of the varieties. Cane yields of variety 'CoPK 05191' and 'CoPK 05192' were at par but significantly higher over variety 'Co 05011' during summer planting, indicating better competitive ability of former varieties, when planted in summer season compared to spring season. It may be due to favourable weather condition for the better germination and initial growth of subtropical spring season sugarcane. Sowing under spring season crop growth performance was better than the summer sowing. The total amount of drymatter production in spring season sugarcane is responsible in total amount of radiation intercepted.

Fertility levels could not influence germination of sug-

Table 2. Influence of varieties and fertility levels on growth, yield, quality and nutrients uptake by sugarcane in spring and summer planted crop (Pooled data of 3 cropping seasons)

Treatment	Germination (%)	Tillers at 150 DAP (×10³/ha)	NMC (×10³/ha)	Cane weight (g)	Cane yield (t/ha)	Pol % Juice	CCS (t/ha)	Nutrient uptake (kg/ha)		
								N	P	K
Spring planted crop										
Varieties										
'CoPK 05191'	33.80	134.8	99.4	892.3	81.20	18.4	9.82	263.8	17.9	210.5
'CoPK 05192'	40.20	130.9	94.0	871.0	74.20	17.6	9.55	230.7	16.2	175.3
'Co 05011'	41.00	125.4	90.3	839.3	71.46	17.3	9.58	244.5	15.2	190.8
SEm±	1.40	0.23	0.45	11.46	0.21	0.34	0.08	4.2	0.78	3.6
CD (P=0.05)	4.20	0.69	1.33	33.42	0.63	1.08	0.25	12.6	2.35	10.8
Fertility level (NPK kg/ha)										
150:45:30	37.50	128.2	91.9	849.7	75.23	17.5	9.47	230.4	12.5	153.1
200:60:40	41.30	131.6	95.7	885.0	75.90	18.1	10.08	255.8	18.2	213.3
250:75:50	36.20	131.3	96.1	868.0	75.73	17.6	9.40	253.2	18.6	210.2
SEm±	1.40	0.23	0.45	11.46	0.21	0.34	0.08	4.2	0.78	3.6
CD (P=0.05)	NS	0.69	1.33	33.46	0.64	NS	0.25	12.6	2.35	10.8
Summer planted crop										
Varieties										
'CoPK 05191'	29.40	121.5	85.1	934.8	65.43	18.5	8.45	240.4	15.3	175.8
'CoPK 05192'	35.60	114.8	80.4	897.7	65.00	17.1	8.21	234.8	15.4	163.9
'Co 05011'	29.00	100.5	77.8	855.7	57.70	16.7	8.06	239.5	17.3	174.5
SEm±	0.67	0.81	1.52	6.43	0.85	0.23	0.13	1.5	0.63	2.1
CD (P=0.05)	2.03	2.42	4.55	19.20	2.55	0.70	0.39	4.6	1.9	6.3
Fertility level (NPK kg/ha)										
150:45:30	33.90	106.9	79.1	855.6	61.23	17.3	7.87	230.9	14.9	158.5
200:60:40	32.90	113.4	83.3	905.5	63.90	17.7	8.60	244.8	17.8	165.9
250:75:50	27.20	116.9	80.8	897.0	63.00	17.5	8.25	239.0	15.3	189.8
SEm±	0.67	0.81	1.52	6.43	0.85	0.22	0.13	1.5	0.63	2.1
CD (P=0.05)	NS	2.42	4.55	19.20	2.55	NS	0.39	4.6	1.93	6.3

arcane significantly (Table 2). However, production of tillers, millable canes and cane weight increased significantly upto 200:60:40 kg NPK/ha. Significantly higher millable canes with fertility level of 200:60:40 kg NPK/ha was primarily due to the improved fertility status of the soil created congenial environment for better growth and development of sugarcane plant. The results are in accordance with the findings of Shukla (2007).

Yield and quality: Fertility levels could not influence pol % juice of sugarcane significantly (Table 2).The highest pol % (18.53) and CCS (8.45 t/ha) was obtained with variety 'CoPK 05191', which was significantly higher over varieties 'Co 05011' and at par with variety 'CoPK 05192', owing to higher cane yield and quality of variety 'CoPK 05191'. Planting of various high sugar genotypes in summer exhibited variation in sucrose accumulation pattern over spring cane so through selection of genotypes for high sugar of good quality could be harvested even in the summer season under north Indian conditions.

Significantly higher cane yield (63.90 t/ha) was obtained under the fertility level of 200:60:40 kg NPK/ha because of increased production of millable canes and cane weight and it led to finally higher CCS (8.60 t/ha) at similar fertility level, which was significantly higher over lower fertility level and at par with higher fertility level. Nutrient application beyond 200:60:40 kg NPK/ha could not show significantly impact on cane yield and CCS in summer planted cane. The results are in accordance with the finding of Navnit Kumar (2012).

Correlation coefficient among various major growth and yield contributing indicated highly positive relationship between these character (r=0.75) and millable cane to cane yield (r=0.73), indicating higher contribution of milable cane and cane yield. Millable cane contribution was higher to that of cane weight, which showed importance of earlier formed tiller in increasing cane productivity in north Indians conditions. Cane yield and CCS in spring planting were positively correlated (r=0.808). It was due to increase in cane quality parameters in all the varieties.

Nutrient uptake

Uptake of NP and K was significantly higher with variety 'CoPK 05191' over rest of the varieties in spring planted crop, while the lowest values of N and K uptake were observed with variety 'CoPK 05192'. Whereas uptake of nutrients (NPK) by sugarcane crop significantly increased upto 200:60:40 kg NPK/ha over fertility levels of NPK 150:45:30 kg/ha, being on par with that of 250:75:50 kg NPK/ha in spring planted crop. However, P uptake was increased with each successive increase in fertility levels upto 125% RDF of NPK (Table 2).

In summer planted crop data indicated that the highest uptake of N and K were observed with variety 'CoPK 05191', which significantly higher over variety 'CoPK 05192' and on par with 'Co 05011'. However, significantly the highest P uptake was recorded with variety 'Co 05011' over rest of the varieties. Application of NPK fertilizer upto 200:60:40 kg NPK/ha significantly increased the N and P uptake over rest of the fertility levels, while the lowest values of N and P was recorded with further increasing level of fertility. However, K uptake (189.8 kg/ha) was increased with each successive increase in fertility level in summer planted crop. The results further indicated that among the major nutrients, relatively higher uptake of N was recorded followed by K and P irrespec-

Table 3. Effect of varieties and fertility levels on sustainability yield index, yield and economics and under different planting seasons (pooled data of 3 cropping seasons)

Treatment	Yield of spring and summer pooled (t/ha)	Sustainability yield index (SYI)	Gross returns ($\times10^3$/ha)	Net returns ($\times10^3$/ha)	Benefit: cost ratio
Varieties					
'CoPK 05191'	73.31 (29.92)	0.570	146.6	95.5	2.86
'CoPK 05192'	69.60 (28.40)	0.535	139.2	88.1	2.72
'Co 05011'	64.58 (26.54)	0.453	129.2	78.0	2.52
SEm±	0.55	-	-	-	-
CD (P=0.05)	1.65	-	-	-	-
Fertility levels (N:P:K kg/ha)					
150:45:30	68.23 (27.85)	0.501	136.5	85.3	2.66
200:60:40	69.90 (28.53)	0-536	139.8	88.7	2.73
250:75:50	69.36 (28.29)	0.521	138.7	87.6	2.71
SEm±	0.55	-	-	-	-
CD (P=0.05)	1.65	-	-	-	-

Figures in the parenthesis are SD of mean tive of treatments in spring and summer crop. The results are in close agreement with the findings of Thakur *et al.* (2012). It was due to fact that added nutrients increased the N, P and K concentration in sugarcane, by providing balanced nutritional environment inside the plant and higher photosynthetic efficiency, which favoured higher dry-matter accumulation, resulted in more uptakes of N, P and K by sugarcane.

Mean data of nutrient uptake by spring and summer crops determined (Table 2) at harvest stage showed that variety 'CoPK 05191' removed the maximum NPK from soil during both the cropping seasons. Spring-planted crop analyzed higher mean values (246.4 kg N, 16.43 kg P and 192.2 kg K/ha) of nutrient removal compared to counterpart summer planted cane (238.2, 16.0, and 171.4 kg NPK/ha) due to higher tonnage harvested. Increasing levels of NPK showed increase in nutrient removal through spring and summer cane. However, greater differences were observed in plant cane than in ratoon cane. Nutrient removal through planting spring and summer canes depicted positive balance with N and P in soil and negative balance with K. Spring cane (plant crop) showed higher nutrient uptake than its summer the trend was reversed in summer-planted cane. Singh and Yadav (1992) also reported similar results. The increase in uptake of phosphorus might be due to the complex properties of organic material which prevented the precipitation and fixation of nutrient and kept them in soluble form. These results are in accordance with those of Thakur *et al*. (2013). Plant crop recorded significantly higher potassium uptake than the summer crop. Significant differences were noticed among treatments. The uptake of K was season dependent, being low in cool winter month (Vijaya Shankar Babu *et al.* 2007).

Sustainability yield Index

Sustainability yield index (SYI) was highest (0.570) in variety 'CoPK 05191' followed by 'CoPK 05192' (0.535) and 'Co 05011' (0.453) in the different planting systems (spring and summer). This was followed by recommended dose of fertilizer (200:60:40 kg NPK/ha). SYI was maximum (0.536) in 200:60:40 kg NPK/ha and lowest (0.501) in 150:45:30 NPK kg/ha. Mean pooled data of spring and summer planted crop on yield presented in table 3 indicated that yield of variety 'CoPK 05191' (73.31 t/ha) found significantly superior over rest of varieties. The mean cane yield (69.90 t/ha) of spring and summer planted crop was significantly higher in receiving of 200:60:40 kg NPK/ha over fertility levels of NPK 150:45:30 kg/ha and was on par with NPK of 250:75:50 kg/ha.

Economics

Mean data of three cropping seasons (spring and summer) indicated that the highest net return(₹95,500/ha) and benefit: cost ratio (2.86) was observed with variety 'CoPK 05191' and lowest in variety 'Co 05011', owing to higher cane yield. There was marked improvement in net return with each successive increase in fertilizer level from 75% to 100% of RDF (Table 3). The highest net return (₹88,680/ha) and benefit: cost ratio (2.73) was observed with application of 200:60:40 kg NPK/ha. However, crop did not respond beyond NPK level of 200:60:40 kg/ha during both the planting seasons (spring and summer). The rate of increase in net return was very less by application of NPK 250:75:50 kg/ha, indicating the non-responsiveness for higher doses. Addition of fertilizers beyond the RDF also exhibited comparatively lower benefit: cost ratio indicating the non suitability of this treatment for increasing sugarcane production.

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