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Analysis of Economic Aspects of Raising Autumn Sugarcane at Different Planting Patterns and Seeding Densities

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ABSTRACT

The economic analysis of raising sugarcane cv. SPSG-394 at different planting patterns and seeding densities was done. The crop was propagated under the field conditions at Faisalabad during the year 1993 and repeated in year 1994. Planting patterns were 100 cm spaced squarish pits (P_1), 100-cm spaced circular pits (P_2), 90-cm spaced 2-rows strips (P_3) and 60-cm spaced single rows (P_4). Seeding densities included 100, 150, 200 and 250 thousands buds ha^{-1}. Among treatment combination, 1993-94 sugarcane seeded @ 250-thousand buds ha^{-1} in squarish pits (P_1D_4) gave the maximum sugarcane cane yield (144.33 t ha^{-1}) but did not differ significantly from that in P_1D_3, P_2D_3, P_2D_4, P_3D_3 and P_3D_4. Highest net field benefit of Rs. 32420 ha^{-1}. Crop planted @ 250 thousand buds ha^{-1} gave maximum net field benefit of Rs. 29647 among seeding densities. At 90-cm spaced 2-row strip crop planted @ 150,200 and 250 thousand buds ha^{-1} (P_3D_2, P_3D_3 and P_3D_4) exhibited maximum net field benefit of Rs. 32974, 34637 and 33805 per hectare, respectively.

Key Words: Economic analysis; Sugarcane raising; Planting Pattern; Seed density

INTRODUCTION

Unsuitable climate and use of sub-optimal agro-technology are mainly responsible for low sugarcane productivity in Pakistan. Besides, agronomic constraints such as sub-optimal population density and inappropriate plant distribution limit cane productivity. These constraints can be alleviated through the use of optimum seeding density and appropriate planting method/geometric configuration.

There is a positive relationship between the seeding density and plant population of sugarcane (Domini & Plana, 1989). For example, Sugarcane planted @ 200-thousand buds ha^{-1} produced significantly higher cane population than that planted @ 150-thousand buds ha^{-1} (Kathiresan & Narayanasamy, 1991). Pit planting and widely spaced multi-row strip plantation have shown a great promise towards increasing cane yield per unit area (Nazir *et al.,* 1987). However, the technology still needs to be standardized and compared with the conventional method of sugarcane planting. Consequently, the present study was planned to determine the effect of flat and pit plantation technology with different seeding densities on the yield and to analyse the economic aspects involved in different planting methods and seeding densities of sugarcane.

MATERIALS AND METHODS

The experiment was carried out at Students Farm, Department of Agronomy, University of Agriculture, Faisalabad on a sandy clay loam. The experiment was laid out in RCBD with split plot arrangement and with four replications. Net plot size was 4 m x 8 m in pit plantation and 3.6 m x 8 m in flat plantation. Planting patterns were placed in the main and seeding densities in sub plots. Planting patterns were 100 cm spaced square pits, 100 cm spaced circular pits, 90 cm spaced two-row strips (30/90 cm) and 60 cm spaced single rows, while seeding densities comprised 100, 150, 200 and 250 thousand buds ha^{-1}. Sugarcane cv. SPSG-394 was planted on 29 and 30 September in 1993 and 1994, respectively. Double budded sets were used in all the treatments. Fertilizers were @ 168:112:112 kg NPK/ha and 16 irrigation @ 4" to each were applied up to harvesting. In flat plantation, earthing up was done once in the middle of March every year. No earthing up was done in pit plantation. The crop was harvested manually at its physiological maturity on December 10 and 15 in 1994 and 1995, respectively. Stripped cane yield data was only used for economic analysis and analysed statistically by using the Fisher's analysis of variance technique and differences among the treatment means were compared for significance by using the Duncan's New Multiple Range Test (DMR) at P = 0.05 (Steel & Torrie, 1984). For economic analysis partial budgeting technique described by CIMMYT (1988) was followed seeding densities of sugarcane crop were compared with one another and only those costs were included in analysis that varied with the use of alternative planting technique and seeding density.

RESULTS AND DISCUSSION

Stripped-cane yield (SCY) ha^{-1} was lower by 21.31% during the year 1994-95 than 1993-94 (Table I). It was due to less irrigation water availability at different developmental phases of the crop, high incidence of stem borer (*Chiloinfuscatellus snellen*) and pokkah boeng (*Fusarium moniliforme*), and more lodging during the former year. The main effects of planting patterns, seeding density on stripped cane yield were non-significant during both year (Table I).

Among treatment combinations, in 1993-94 sugarcane seeded @ 250-thousand buds ha^{-1} in squarish pits (P_1D_4) gave the maximum SCY (144.33 t ha^{-1}) but did not differ significantly from that in P_1D_3, P_2D_3, P_2D_4, P_3D_3 and P_3D_4 (Table I). On the contrary, crop planted in single rows with 100-thousand buds ha^{-1} (P_4D_1) gave the minimum (90.23 t ha^{-1}). In 1994-95, crop seeded @ 250-thousand buds ha^{-1} in squarish pits (P_1D_4) gave the maximum SCY (115.75 t ha^{-1}) but was statistically on a par with the treatment combinations P_1D_3, P_2D_3, and P_2D_4. While the minimum SCY (86.35 t ha^{-1}) was recorded for P_4D_1 that was statistically equal to P_4D_4. Higher sugarcane yield in pit plantation than in single-rows and double-row strip plantation on flat has also been reported by Shafi *et al.* (1990) and Afghan *et al.* (1996).

Table I. Influence of planting pattern and planting densities on stripped cane yield

Treatment	Stripped cane yield (t ha^{-1})		
	1993-94	1994-95	Mean
Planting pattern (P)			
P_1 100-cm spaced squarish pits	138.16	107.48	122.82
P_2 100- cm spaced circular pits	137.48	107.37	122.43
P_3 90-cm spaced 2-row strips	129.88	103.32	117.85
P_4 60-cm spaced single rows	112.70	89.58	101.15
SX	NS	NS	NS
Seeding density (D) (`000' buds ha^{-1})			
D_1 100	115.93	95.76	105.84
D_2 150	129.93	99.86	114.89
D_3 200	135.89	105.93	122.73
D_4 250	136.48	106.20	120.78
SX	NS	NS	NS
C. P x D			
P_1D_1	134.55 b	99.32 de	116.94
P_1D_2	133.70 b	103.48bcd	118.59
P_1D_3	140.08ab	113.35 a	125.71
P_1D_4	144.33 a	115.75 a	130.04
P_2D_1	134.75 b	99.80 de	117.06
P_2D_2	135.18 b	104.80bcd	119.99
P_2D_3	138.06ab	110.40abc	126.49
P_2D_4	141.93ab	114.90 a	126.16
P_3D_1	104.18 d	97.98 de	101.08
P_3D_2	135.08 b	102.18cde	118.63
P_3D_3	141.53ab	107.50bcd	129.51
P_3D_4	138.73ab	105.65bcd	122.19
P_4D_1	90.23 e	86.35 g	88.29
P_4D_2	115.75 c	88.98 f	102.26
P_4D_3	123.90 c	94.50 ef	109.20
P_4D_4	120.93 c	88.50 gf	107.74
SX	2.77	2.77	NS

ns=Non significant; Values with same letter do not differ

Net field benefits (NFB) of sugarcane as affected by different planting patterns, seeding densities and their combination are given in Table II. NFB were calculated on the basis of average of two years data of 1993-94 and 1994-95). Sugarcane grown in 2 row strips (P_3) gave the maximum NFB of Rs. 32420 ha^{-1}, followed by that in squarish pits (P_1) and circular pits (P_2) with NFB of Rs. 28657 and Rs. 28163 ha^{-1}, respectively (Table II).

Table II. Net field benefits (Rs ha^{-1}) of sugarcane as affected by different planting patterns and seeding densities. Each value is the average of 2-years data.

Treatment	Net field benefit (Rs ha^{-1})
Planting pattern (P)	
P_1 100-cm spaced squarish pits	28657
P_2 100-cm spaced circular pits	28163
P_3 90-cm spaced 2-row strips	32420
P_4 60-cm spaced single rows	23995
Seeding density (D) (`000' buds ha^{-1})	
D_1 100	25790
D_2 150	28158
D_3 200	29629
D_4 250	29647
C. P x D	
P_1D_1	27259
P_1D_2	27725
P_1D_3	29756
P_1D_4	30288
P_2D_1	27009
P_2D_2	27701
P_2D_3	28625
P_2D_4	29548
P_3D_1	27986
P_3D_2	32974
P_3D_3	34637
P_3D_4	33805
P_4D_1	20907
P_4D_2	24233
P_4D_3	25896
P_4D_4	24945

Table III. Dominance analysis combinations of different planting patterns and seeding densities. Each value is the average of 2-years data

Treatment combinations	TC (Rs. ha^{-1})	NFB (Rs. ha^{-1})
P_4D_1 (60-cm spaced single rows with 100-thousand buds ha^{-1})	31893	20907 (D)
P_3D_1 (90-cm spaced 2-row strips with 100-thousand buds ha^{-1})	32614	27986
P_4D_2 (60-cm spaced single rows with 150-thousand buds ha^{-1})	36967	24233 (D)
P_4D_4 (60-cm spaced 2-rows strips with 250-thousand buds ha^{-1})	38055	24945 (D)
P_3D_2 (90-cm spaced single rows with 150-thousand buds ha^{-1})	38426	32974
P_4D_3 (60-cm spaced single rows with 200-thousand buds ha^{-1})	39504	25896 (D)
P_3D_4 (90-cm spaced 2-row strips with 250-thousand buds ha^{-1})	39425	33805
P_3D_3 (90-cm spaced 2-row strips with 200-thousand buds ha^{-1})	40413	34637
P_1D_1 (Squarish pit plantation with 100-thousand buds ha^{-1})	42941	27259 (D)
P_2D_1 (Circular pit plantation with 100-thousand buds ha^{-1})	43193	27009 (D)
P_1D_2 (Squarish pit plantation with 150-thousand buds ha^{-1})	43675	27725 (D)
P_2D_2 (Circular pit plantation with 150-thousand buds ha^{-1})	44299	27701 (D)
P_2D_3 (Circular pit plantation with 200-thousand buds ha^{-1})	45775	28625 (D)
P_1D_3 (Squarish pit plantation with 200-thousand buds ha^{-1})	46244	29356 (D)
P_2D_4 (Circular pit plantation with 250-thousand buds ha^{-1})	47252	29548 (D)
P_1D_4 (Squarish pit plantation with 250-thousand buds ha^{-1})	47712	30288 (D)

TC= Total costs that vary; NFB= Net field benefit; PD=Planting pattern x seeding density; D='Dominated' treatment combination

On the contrary, crop grown in single rows (P_4) resulted in the minimum NFB of Rs. 23995 ha^{-1}. More NFB in 2-row strips were due to less cost of production than that in pit plantations (P_1, P_2), though the stripped-cane yield ha^{-1} was substantially more in the latter planting patterns. As regards seeding density, crop seeded @ 250-thousand buds ha^{-1} gave the maximum NFB of Rs. 29647 ha^{-1}, followed by that seeded @ 200 and 150-thousand buds ha^{-1} with NFB of Rs. 29629 and 28158 ha^{-1}, respectively (Table II). On the contrary, crop seeded @ 100-thousand buds ha^{-1} resulted in the minimum NFB of Rs. 25790 ha^{-1}. Slight differences in NFB among seeding densities of 150, 200 and 250-thousand buds ha^{-1} are ascribed to the small differences in stripped-cane yield and increasing cost of seed materials with each increment in the seeding density.

Different treatment combinations also resulted in differential NFB (Table II). Sugarcane grown @ 150, 200 and 250-thousand buds ha^{-1} in 2-row strips (P_3D_2, P_3D_3, P_3D_4) gave the maximum NFB (Rs. 32974 to 34637 ha^{-1}), while the crop seeded @ 100-thousand buds ha^{-1} in single rows (P_4D_1) resulted in the minimum NFB (Rs. 20907 ha^{-1}).

Since NFB is not a final criterion for recommendation of an agro-technology to a common farmer because it does not tell about returns to investment. Dominance analysis (Table III) showed that 12 treatment combinations were dominated which were excluded from the further analysis (Sadiq *et al.,* 1998). The remaining four undominated treatment associations (P_3D_1, P_3D_2, P_3D_4, P_3D_3) were further considered in the marginal analysis.

Marginal analysis (Table IV) showed that sugarcane seeded @ 150-thousand buds ha^{-1} in 90 cm spaced 2 row strips (P_3D_2) gave the highest marginal rate of return (86%). Sugarcane planted at 90-cm spaced 2 row strips with seeding densities of 200 and 250 thousand buds ha^{-1} gave 83 and 84% MRR, respectively. Thus, farmer's of the Faisalabad are recommended to plant sugarcane in one of these treatment combinations @ 150, 200 and 250 thousand buds ha^{-1} (D_2, D_3, D_4) in 90-cm spaced 2 row strips. But

Table IV. Marginal analysis of the undominated combinations of planting patterns and seeding densities

Treatment combination	Cost that vary (Rs.ha^{-1})	Marginal costs (Rs. ha^{-1})	NFB (Rs.ha^{-1})	Marginal net benefits (Rs.ha^{-1})	Marginal rate of return (%)
P_3D_1 (90-cm spaced 2-row strips with 100-thousand buds ha^{-1})	32614		27986		
P_3D_2 (90-cm spaced single row with 150-thousand buds ha^{-1})	38426	5812	32974	4988	86
P_3D_4 (90-cm spaced 2-row strips with 250-thousand buds ha^{-1})	39425	999	33805	831	83
P_3D_3 (90-cm spaced 2-row strips with 200-thousand buds ha^{-1})	40413	988	34637	832	84

PD= Planting pattern x seeding density; NFB= Net field benefit

planting of sugarcane @ 200 thousand buds ha^{-1} in 90 cm spaced 2 row strips (P_3D_3) proved to be the best to examine returns to their investment in sugarcane.

CONCLUSION

The sugarcane growers in the central Punjab (Pakistan) are recommended to use 90 cm spaced 2 row strips along with 200 thousand buds ha^{-1} as the most economical treatment combination for sugarcane cultivation.

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