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Growth, Sugar Yield and Profitability of Spring Sugarcane as Influenced by Sett Size, Seed Rate and Sett Treatment

R.D. Yadav, Dheer Singh and Amit Bhatnagar*
Department of Agronomy, G.B. Pant University of Agriculture and Technology
Pantnagar - 263145, Uttarakhand

Field experiment was conducted during spring 2009-10 to study the effect of sett size, seed rate and sett treatment on performance of sugarcane. The treatments consisted of three sett size (one, two and three budded), two seed rate (90,000 and 120,000 buds ha^{-1}) and three sett treatment (carbendazim, carbendazim + gibberellic acid and no sett treatment) were tested in factorial RBD with three replications. The results revealed that germination per cent was not affected significantly due to reduction in sett sizes and seed rate but setts treated with carbendazim attained significantly higher germination (39.0%). Two budded setts resulted in significantly more shoot population and dry matter accumulation per shoot. Though plant population under seed rate of 90,000 buds ha^{-1} was lower, this accumulated significantly more dry matter. Setts treated with carbendazim showed better plant growth. Juice quality remained unaffected due to treatments. Significantly more cane (71.2 t ha^{-1}) and commercial cane sugar (CCS) yield (8.4 t ha^{-1}) was obtained in two budded sett that was at par with three budded sett. Variations in seed rate did not influence cane yield significantly but 120,000 buds ha^{-1} recorded significantly more CCS. Sett treatment with carbendazim alone resulted in significantly higher cane and CCS yield. Net return was maximum in two budded, setts at a seed rate of 90,000 buds ha^{-1} and sett treatment with carbendazim.

Key words : Spring sugarcane, sett size, seed rate, sett treatment, profitability

*Corresponding author email: bhatnagaramit75@gmail.com

Sugarcane in India is cultivated under wide range of agro-ecological situations, both in tropical and subtropical regions. The productivity of sugarcane in India is around 60 t ha^{-1} with 9 – 10 per cent recovery for last many years. In order to meet the demand, our country will require to produce 415 million tonnes of sugarcane by 2020 A.D. (Shahi, 2002) . However, due to enormous pressure from food and fibre crops, there will be hardly any space left to expand the area under sugarcane crop and therefore, the only option available is to raise the productivity. The productivity of spring sugarcane can be improved by maintaining optimum shoot population through proper sett size, optimum seed rate and sett treatment. Generally farmers in North India plant sugarcane in spring season and use three budded setts without sett treatment. The planting of cane without sett treatment results in poor sprouting of buds. To compensate the poor emergence, they use high seed rate. Thus, huge amount of sugarcane is wasted in seed. Sett treatment with suitable fungicide lowers the risk of diseases and productivity of sugarcane can be increased (Singh, 1998). The germination of buds may be improved by breaking of the dormancy, if setts are treated with hormone such as gibberellic acid. Therefore, keeping the above facts in view, the present investigation was undertaken to study the effect of sett size, seed rate and sett treatment on growth, yield and profitability of sugarcane.

Materials and Methods

The field experiment was conducted during spring season of 2009-10 at Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India (29° N latitude, 79.5° E longitude and altitude of 243.8 m msl). The soil of experimental plots was silty clay loam, rich in organic carbon (1.05%), low in available nitrogen (223.6 kg ha^{-1}), rich in phosphorus (49.5 kg ha^{-1}) and medium in available potassium (243 kg K ha^{-1}). The soil was neutral in reaction (pH 7.4). Bulk density of the soil was 1.34 Mg m^{-3}. For the experiment, sugarcane setts were cut in three sizes i.e. one budded, two budded and three budded. Two seed rates 90,000 and 120,000 buds ha^{-1} were used. Carbendazim (0.1%) and carbendazim (0.1%) + gibberellic acid (100 ppm) solution were used for sett treatment. Thus, treatments were consisting of 3 sett size (one, two and three budded), 2 seed rate (90,000 and 120,000 buds ha^{-1}) and 3 sett treatment i.e. dipping of setts in carbendazim (0.1%), carbendazim (0.1%)
+ gibberellic acid (100 ppm) and no sett treatment. The experiment was laid out in factorial randomized block design with three replications. The gross plot and net plot size was 30.0 and 18m^2, respectively. Sugarcane crop (variety CoPant-90223) was planted on March 14, 2009 and harvested on February 15, 2010. A fertilizer dose of 150 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare was applied. Half dose of nitrogen and full amount of phosphorus and potassium was

applied in furrows at the time of planting and remaining nitrogen was top dressed in two equal splits in the last week of May and June at 30 days interval. The setts were dipped in carbendazim and GA solution for 15 minutes prior to planting as per treatment. Furrows at 20 cm depth were opened 75 cm apart with the help of tractor mounted ridger. The setts were planted in furrows using seed rate as per treatment. The juice was analyzed as described by Spencer and Meade (1955). The cost of cultivation was worked out by considering the prevailing prices of the inputs/ commodities used in the experiment. The gross return was worked out keeping in view the return from cane yield of sugarcane at prevailing market price. Cost of cultivation was subtracted from gross return to obtain the net return. The benefit:cost ratio was calculated on the basis of gross return obtained and incurred cost of cultivation.

Results and Discussion

Germination percentage

Germination per cent was not affected significantly due to reduction in sett sizes and seed rate but varied with sett treatment (Table 1). Setts treated with carbendazim recorded significantly higher germination (39.0%). Significant reduction in germination was observed in sett treated with carbendazim + GA over carbendazim alone, however

Table 1. Effect of sett size, seed rate and sett treatment on germination and number of shoots.

Treatment	Germination (%)	Number of shoots/000 ha^{-1}			
	45 Days after	Days after planting			
	planting	120	150	180	210
Sett size					
3 budded	37.3	106.4	111.7	119.1	107.9
2 budded	37.4	111.4	116.3	122.7	109.7
1 bud	37.3	103.6	109.8	110.6	102.9
S.Em.±	0.4	0.7	0.9	1.1	1.9
CD (P=0.05)	NS	2.0	2.7	3.2	5.6
Seed rate (buds ha^{-1})					
1,20,000	37.4	109.4	114.0	119.8	110.3
90,000	37.3	104.6	111.3	115.1	103.4
S.Em.±	0.3	0.6	0.7	0.9	1.5
CD (P=0.05)	NS	1.71	2.2	2.3	4.5
Sett treatment					
Carbendazim	39.0	110.1	115.9	121.1	113.2
Carbendazim+GA	37.2	107.7	113.2	117.3	106.1
No sett treatment	35.9	103.5	108.6	114.0	101.3
S.Em.±	0.4	0.7	0.9	1.1	1.9
CD (P=0.05)	1.1	2.0	2.7	3.2	5.6

was superior to no sett treatment. It revealed negative effect of GA on germination along with carbendazim. Many researchers in North West India also observed adverse effect of carbendazim + GA on germination (AICRP, Sugarcane, 2009-10). Higher germination in carbendazim treatment might be attributed to low mortality owing to control of disease infection. The results are in conformity of findings of Gohil and Vala (2003).

Shoot population

Shoot population increased upto 180 days and declined thereafter irrespective of the treatments (Table 1). Two budded setts resulted in significantly higher shoot population at all the growth stages, however was at par with three budded sett at 210 DAP. Single bud recorded significantly lower shoot population which might be because of high mortality of shoots.

Significantly higher shoot population was recorded in seed rate of 120,000 buds ha^{-1} than 90,000 buds ha^{-1}. It may be credited to planting of higher number of buds. Similar results were found by Srivastava and Ranwa (1994). Sett treated with carbendazim produced significantly higher number of shoot at all the growth stages while significantly lower value was recorded with no sett treatment. More shoot population under seed treatment with carbendazim might be due to less incidence and spread of disease infection and thus low mortality. These results are in close agreement with findings of Kalaimani and Giridharan (2001).

Shoot height

No significant difference in shoot height was observed due to alteration in sett size and seed rate at any stage of growth (Table 2). However, setts treated with carbendazim + GA exhibited significantly more plant height than no sett treatment at all the growth stages but was not superior to carbendazim alone. Sett treatment with fungicide and hormone might have favoured the growth of plants by control of disease and cell elongation, respectively thus helped in increasing plant height.

Dry matter accumulation per shoot

The dry matter accumulation per shoot was affected significantly due to variation in sett size, seed rate and sett treatment at all the growth stages except at 150 days after planting (Table 2). Reduction in sett size from three buds to two buds resulted in significantly higher dry matter accumulation per shoot but further reduction to one bud caused significantly lower value. More dry matter accumulation in two budded sett might be attributed to less competition for light, space nutrient, etc. The poor growth and vigour of shoot in one budded sett led to low dry matter accumulation. Lower seed rate of 90,000 buds ha^{-1}was proved significantly better in terms of dry matter accumulation per shoot. Low plant population in 90,000 buds ha^{-1} faced less competition for growth factors and thus might have accumulated more dry matter.

Sett treatment with carbendazim + GA resulted in significantly higher dry matter accumulation at all the growth stages, which might be ascribed to better plant growth as evident by plant height. Similar results were also observed by Kalaimani *et al.* (1996).

Juice quality

There was no significant difference in brix, sucrose and cane available sugar per cent due to

treatments which indicated that reduction in sett size from three buds to one bud, lowering of seed rate and sett treatment with fungicide or hormone alone or in combination did not alter the juice quality (Table 3). Patel *et al.* (2001) have also reported that sucrose content was not influenced significantly either by seed rate or sett size.

Commercial cane sugar yield

Crop grown with two budded sett produced significantly more commercial cane sugar yield (8.4 t ha^{-1}) than one bud sett, but remained at par with three budded sett (Table 3). Compared to one budded sett, per cent increase in CCS under two budded sett was 13.7. Higher seed rate of 120,000 buds ha^{-1} resulted in significantly more commercial cane sugar yield (8.1 t ha^{-1}) than 90,000 buds ha^{-1}. Sett treatment with carbendazim exhibited significantly more commercial cane sugar yield than carbendazim + GA and no treatment by a tune of 2.4 and 12 per cent. Higher commercial cane sugar yield in carbedazim may be attributed to more cane yield under this treatment.

Table 2. Effect of sett size, seed rate and sett treatment on shoot height and drymatter accumulation.

Treatment	Shoot height (cm)				Dry matter accumulation (g shoot^{-1})			
	Days after planting				Days after planting			
	120	150	180	210	120	150	180	210
Sett size								
3 budded	245.1	271.2	293.3	320.0	134.3	155.1	169.0	183.7
2 budded	248.9	278.0	291.6	318.4	133.3	157.9	171.9	186.2
1 bud	243.1	279.2	295.2	309.6	133.8	155.4	167.8	182.7
S.Em.±	2.2	3.1	3.2	3.7	0.4	0.3	0.1	0.3
CD (P=0.05)	NS	NS	NS	NS	NS	0.9	0.4	1.0
Seed rate (buds ha^{-1})								
1,20,000	248.0	278.5	294.8	318.5	132.9	154.8	169.4	183.4
90,000	243.4	273.7	291.9	313.5	134.7	157.5	169.7	185.2
S.Em.±	1.8	2.5	2.6	3.0	0.3	0.3	0.1	0.3
CD (P=0.05)	NS	NS	NS	NS	1.0	0.8	0.3	0.8
Sett treatment								
Carbendazim	246.6	280.6	296.2	321.7	137.0	154.7	168.7	183.3
Carbendazim+GA	251.1	282.4	300.0	318.2	132.9	160.9	173.8	188.6
No sett treatment	239.5	265.3	283.8	308.2	131.4	152.8	166.2	181.1
S.Em.±	2.2	3.1	3.2	3.7	0.4	0.3	0.1	0.3
CD (P=0.05)	6.5	9.0	9.4	11.1	1.2	0.9	0.4	1.0

Similar results were also reported by Yadav (1992).

Cane yield

The reduction in sett size from three buds to two buds resulted in significant increase in cane yield (71.2 t ha^{-1}). But further reduction to one bud led to significantly lower cane yield. Cane yield in two budded sett was 2 and 12.1 % more than three and one budded sett, respectively (Table 3). Though cane yield increased due to lowering of seed rate but

Table 3. Sugarcane juice quality, commercial cane sugar (CCS) and cane yield under different sett size, seed rate and sett treatment.

Treatment	Juice brix (%)	Juice sucrose (%)	Cane available sugar (%)	CCS(t ha^{-1})	Cane yield(t ha^{-1})
Sett size					
3 budded	19.0	17.3	11.9	8.3	69.8
2 budded	18.9	17.2	11.9	8.4	71.2
1 bud	18.9	17.1	11.7	7.3	62.6
S.Em.±	0.07	0.1	0.11	0.08	0.4
CD (P=0.05)	NS	NS	NS	0.2	1.2
Seed rate (buds ha^{-1})					
1,20,000	19.0	17.3	11.9	8.1	67.8
90,000	18.8	17.0	11.7	7.9	68.0
S.Em.±	0.05	0.09	0.09	0.07	0.3
CD (P=0.05)	NS	NS	NS	0.2	NS
Sett treatment					
Carbendazim	19.0	17.1	11.8	8.4	71.5
Carbendazim+GA	18.9	17.3	11.8	8.2	68.9
No sett treatment	18.9	17.2	11.8	7.5	63.2
S.Em.±	0.07	0.1	0.09	0.08	0.4
CD (P=0.05)	NS	NS	NS	0.2	1.2

Table 4. Effect of sett size, seed rate and sett treatment on economics of sugarcane cultivation

Treatment	Economic parameters			
	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
Sett size				
3 budded	66950	212333	145383	2.17
2 budded	69198	217205	148007	2.14
1 bud	73167	191386	118219	1.62
S.Em.±	81	1192	1112	0.01
CD (P=0.05)	233	3 429	3201	0.04
Seed rate (buds ha^{-1})				
1,20,000	71950	206364	134414	1.87
90,000	67594	207585	139991	2.07
S.Em.±	66	973	908	0.01
CD (P=0.05)	190	2800	2614	0.03
Sett treatment				
Carbendazim	69473	217369	147897	2.13
Carbendazim+GA	72602	210601	137999	1.90
No sett treatment	67241	192954	125713	1.87
S.Em.±	81	1192	1112	0.01
CD (P=0.05)	233	3429	3201	0.04

was not significant. The results are in the conformity with the findings of Singh and Singh (2001) who also observed no significant differences in cane yield due to reduction in seed rate. Sett treatment with carbendzim achieved significantly higher cane yield (71.5 t ha^{-1}) that was 2.6 and 8.3 t ha^{-1} more than carbendzim+GA and no sett treatment, respectively. Significantly higher cane yield in carbendazim might be ascribed to better growth of plants under this treatment. Singh and Goswami (2003) also observed that sett treatment with carbendazim resulted in significantly more yield. It is noteworthy that sett treatment with carbendazim+GA was inferior to carbendazim alone with respect to yield cane yield. It indicated antagonistic effect of GA on carbendazim. Many researches also observed that sugarcane yield decreased with sett treatment by carbendzim + GA as compared to carbendzim alone (Anon., 2010).

Economics

Maximum cost of cultivation was in one budded setts because of more expenditure on laborers for cutting of small size setts (Table 4). The high seed requirement under 120,000 buds ha^{-1} and extra cost incurred on sett treatment with carbendazim + GA resulted in higher cost of cultivation under these treatments. Planting of two budded sett gave the highest gross and net return owing to higher cane yield. Though significantly higher benefit cost ratio was obtained in three budded sett, it did not differ significantly with two budded sett. Owing to high cane yield and low cost of cultivation, lower seed rate showed significantly more gross and net returns and benefit cost ratio. Sett treatment with carbendazim exhibited significantly higher gross and net returns as well as benefit cost ratio because of higher cane yield.

Planting of spring sugarcane by using two budded sett, lower seed rate of 90,000 buds ha^{-1} and sett treatment with carbendazim (0.1%) may be helpful in increasing cane yield, sugar yield and net return.

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