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Effect of different intercrops on growth, productivity and profitability of sugarcane (*Saccharum officinarum* L.) under drip fertigation

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Abstract

An experiment on sugarcane was conducted at Research cum Instructional farm, IGKV, Raipur, Chhattisgarh, India during *rabi* season of 2017-18 to assess the effect of different intercrops on growth, yield and economics of sugarcane. Eleven treatments of different intercrops consisted of onion, potato, sweet corn, wheat, chickpea and gobhi sarso sown at different ratio as first intercrops and sesame, groundnut were sown at 1:1 ratio as second intercrops and one treatment of sole sugarcane were allocated randomly in simple randomized block design and replicated thrice. Results revealed that maximum millable cane yield was recorded under intercropping of Sugarcane + onion (1:3). Significantly higher intercrops yield, equivalent cane yield were recorded with sugarcane + sweet corn (1:2) and (1:3) and with sugarcane + onion (1:3). Second intercrops sesame and groundnut did not success. Maximum net returns was recorded with sugarcane + sweet corn (1:3) whereas, significantly higher benefit per rupee invested was recorded with sugarcane + sweet corn (1:2) and with sugarcane + onion (1:3).

Keywords: Sugarcane, intercropping, growth, yield, economics

Introduction

Sugarcane (*Saccharum officinarum* L.) is an important sugar and commercial crop in India and plays a pivotal role in agricultural and industrial economy of our country. Sugarcane produces sugar, jaggery, khandasari, molasses from which ethanol is produced, press mud which is used as a plant nutrients source, bagasse used for cogeneration of power to produce electricity and for manufacturing paper. Sugarcane being a giant crop producing huge quantity of biomass generally demands higher amounts of nutrient elements. In India during 2018-19, sugarcane was cultivated in 5 million hectare area with production of 400.16 million tones and with productivity of 78.3 tonnes per hectare. In Chhattisgarh, sugarcane was cultivated in 0.21 lakh hectare area with 8.48 lakh tonnes production and 40.4 tonnes per hectare productivity during 2016-17 (Anonymous, 2018). The productivity of land could be enhanced substantially by growing intercrops in the space left between sugarcane rows. Sugarcane crop remains in the field for a year or more and the space between sugarcane rows range from 70 to 90 cm providing ample chance for profuse weed growth which draws huge amount of nutrients and moisture from the soil. Hence, besides suppressing weeds in the inter-row spaces, additional production could be taken by growing suitable intercrops in between the cane rows. Some of the Intercrops have been found to have no/negligible adverse effect on sugarcane yield. Intercropping of different crops like cabbage, potato, mungbean etc with sugarcane have been reported advantageous in comparison to growing sole sugarcane (Alam *et al.*, 2000) [2] in many parts of the country. It increases sugarcane yield with additional income of intercropping.

Materials and Methods

An experiment was conducted at Research cum Instructional farm, IGKV, Raipur, Chhattisgarh, India during *rabi* season of 2017-18 to assess the effect of different intercrops on growth, yield and economics of sugarcane. Eleven treatments of different intercrops consisted of onion, potato, sweet corn, wheat, chickpea and gobhi sarso sown at different ratio as first intercrops and sesame, groundnut were sown at 1:1 ratio as second intercrops and one treatment of sole sugarcane were allocated randomly in simple randomized block design and replicated thrice. Sugarcane ploy bag seedlings were planted on 10th December 2017 at spacing of 120cm x 60cm. Single sugarcane seedling of variety CO-86032 was transplanted in each hill. The first intercrops were sown in between the lines of sugarcane on 12-13th December 2017 and second intercrops were sown in the month of March to April 2018 as per harvesting of first intercrops.

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The soil of experimental field was midland, Inceptisol (Sandy loam) having low available nitrogen ($162.40 \text{ kg ha}^{-1}$), medium phosphorus (9.15 kg ha^{-1}) and potassium ($250.71 \text{ kg ha}^{-1}$) with normal pH (6.8). The variety and recommended dose of fertilizers (RDF) of intercrops were: variety red nasik of onion with RDF 100:50:50 where, P and K were applied as basal and, N was applied in three splits at 25 days interval; variety Kufri pukhraj of potato with RDF 150:50:50 where, N was applied in three splits at 20 days interval and P, K were applied in two splits at 20 days interval; variety Sugar 75 of sweet corn with RDF 120:60:40 where, N was applied in two splits at 20 days interval and P, K were also applied in 2 splits at 45 days; variety GW 366 of wheat with RDF 100:60:40

where, N was applied in two splits at 30 days interval and P, K were applied as basal; variety JG 130 of chickpea with 50 kg DAP per acre and variety RP 9 of Gobhi sarso with RDF 100:60:40 where, N was applied in four splits at 25 days and P, K were applied in two splits at 45 days. The second intercrops varieties Vibhuti 999 and TG-17 of crop sesame and groundnut respectively were sown as per the treatments. Sugarcane crop was harvested in the month of December 2018. The first intercrops were harvested in the month of March to April 2018. The sugarcane crop was fertilized and irrigated through drip fertigation as per given schedule in table 1.

Table 1: Fertigation schedule for sugarcane

Sugar Cane Growth Stages	Days	No. of Fertigation	Urea (kg/ha)	MAP (kg/ha)	MOP (kg/ha)
Germinations (16-45)	30	7	8.60	2.60	1.79
Tillering (46-90)	45	11	16.42	3.31	2.27
Grand Growth (91-180)	90	22	5.47	4.14	3.41
Maturity Stage(181-240)	60	15	2.01	1.21	5.83
	Total	55	391.30	163.93	200.00

- Above Fertigation schedule- Every Fourth Day.
- Magnesium Sulphate – Once in a Month- 5 kg/100 litre through drip
- First dissolves MOP (White), then urea and then MAP (Mono ammonium phosphate) with double quantity of water.

Results and Discussion

The growth and yield parameters of sugarcane are presented in table 2. All the growth and yield parameters and benefit per rupee invested of sugarcane were influenced significantly due to different intercrops.

Growth and yield

Significantly higher number of tillers plant⁻¹ were recorded with sugarcane + onion (1:3) fb sesame (T₁) which was at par with sole sugarcane (T₁₂). Minimum number of tillers plant⁻¹ were observed with sugarcane + gobhi sarso (1:2) fb groundnut (T₁₁). Higher cane length (369.63 cm), cane weight (1.78 kg) and cane diameter (3.00 cm) were recorded with sole sugarcane (T₁₂). Minimum cane length and cane weight were observed with sugarcane + gobhi sarso (1:2) fb groundnut (T₁₁) whereas, minimum cane diameter was recorded with sugarcane + wheat (1:5) fb sesame (T₈). Significantly higher millable cane yield was noted with sugarcane + onion (1:3) fb sesame (T₁) i.e. 132.51 t ha⁻¹ however, it was statistically at par with sole sugarcane (T₁₂) i.e. 131.76 t ha⁻¹ and with sugarcane + potato (1:2) fb sesame (T₃) i.e. 129.63 t ha⁻¹. Minimum millable cane yield was recorded with sugarcane + gobhi sarso (1:2) fb groundnut (T₁₁). Higher intercrops yield and equivalent cane yield were recorded with sugarcane + sweet corn (1:2) and (1:3) fb ground nut (T₅ and T₆). However, these treatments were statistically at par with sugarcane + onion (1:3) and (1:4) fb

sesame (T₁ and T₂). Minimum intercrops yield was recorded with sugarcane + chickpea (1:2) and (1:3) fb ground nut (T₉ and T₁₀) whereas, minimum equivalent cane yield was recorded with sole sugarcane (T₁₂). Higher millable cane yield recorded with sugarcane + onion (1:3) fb sesame (T₁) might be due to higher number of tillers and better cane length, weight and diameter coupled with efficient conversion of tillers in to millable canes at harvest. The second intercrops sesame and groundnut did not grow successfully and crop could not stand in the field till their harvesting. This reason might be due to shadow effect of vigorous growth of sugarcane after four months of transplanting and onset of monsoon. The vertical planted sugarcane intercropped with garlic and metha as vegetable followed by onion as vegetable produced similar cane yield and were significantly better than rest of the intercropping systems (Chogatapur *et al.*, 2017)^[5].

Economics

Maximum cost of cultivation incurred with sugarcane + sweet corn (1:3) fb ground nut (T₆) and minimum cost of cultivation incurred in sole sugarcane (T₁₂). Maximum net returns were obtained with sugarcane + sweet corn (1:3) fb ground nut (T₆) i.e. Rs.550696 ha⁻¹ and it was at par with sugarcane + sweet corn (1:2) fb ground nut (T₅) i.e. Rs. 549444 ha⁻¹. Whereas, higher benefit per rupee invested was noted with sugarcane + sweet corn (1:2) fb ground nut (T₅) i.e. 4.88 which was statistically at par with sugarcane + onion (1:3) fb sesame (T₁) i.e. 4.76 and with sugarcane + sweet corn (1:3) fb ground nut (T₆) i.e. 4.83. Zarekar *et al.* (2018)^[4] also reported that vegetable type of intercrops had economically more viable and got maximum additional benefit as compared to seed type of intercrops. The results are also in conformity with findings of Lithourgidis *et al.*, (2011)^[3].

Table 2: Effect of intercrops on growth, yield and economics of sugarcane

Treatment	No. of tillers/ plant	Cane length (cm)	Cane weight (kg)	Cane diameter (cm)	Millable cane yield (t/ha)	Intercrops yield (q/ha)	Equivalent cane yield (t/ha)	Cost of cultivation (Rs./ha)	Net returns (Rs/ha)	Benefit/ rupee invested
T ₁ - Sugarcane + Onion (1:3) fb Sesame	24	368.36	1.76	2.95	132.51	106.03	162.83	98980	470837	4.76
T ₂ -Sugarcane + Onion (1:4) fb Sesame	20	352.03	1.73	2.68	127.30	107.22	157.97	100230	452552	4.52

T ₃ -Sugarcane + Potato (1:2) fb Sesame	20	360.39	1.72	2.82	129.63	50.00	141.07	102895	390807	3.80
T ₄ -Sugarcane + Potato (1:3) fb Sesame	19	352.22	1.67	2.54	125.67	52.96	137.77	105985	376228	3.55
T ₅ -S.cane + Sweet corn (1:2) fb ground nut	18	347.75	1.49	2.40	119.82	242.59	189.13	112516	549444	4.88
T ₆ -S.cane + Sweet corn (1:3)fb ground nut	17	346.43	1.47	2.41	119.34	247.07	189.90	114016	550696	4.83
T ₇ -Sugarcane + Wheat (1:4) fb Sesame	15	345.68	1.40	2.38	118.30	34.83	136.23	95545	381217	3.99
T ₈ -Sugarcane + Wheat (1:5) fb Sesame	13	345.13	1.39	2.32	117.74	30.69	133.53	97648	369678	3.79
T ₉ -S.cane + Chickpea (1:2) fb ground nut	15	350.90	1.66	2.50	122.80	8.24	133.67	93874	374006	3.98
T ₁₀ -S.cane + Chickpea (1:3) fb ground nut	13	350.55	1.61	2.46	120.80	8.84	132.47	96416	367221	3.81
T ₁₁ -S.cane +Gobhi sarso (1:2) fb groundnut	11	344.54	1.28	2.39	116.33	16.02	132.33	101258	361955	3.58
T ₁₂ -Sole sugarcane	23	369.63	1.78	3.00	131.76	0.00	131.76	84125	377023	4.48
SEm±	0.79	4.62	0.029	0.036	1.35	4.23	1.44			0.05
CD at 5%	2.33	13.55	0.085	0.105	3.98	12.41	4.24			0.15

Conclusion

Maximum millable cane yield was recorded under intercropping of Sugarcane + onion (1:3). Significantly higher intercrops yield, equivalent cane yield were recorded with sugarcane + sweet corn (1:2) and (1:3) and with sugarcane + onion (1:3). Second intercrops sesame and groundnut did not success. Maximum net returns was recorded with sugarcane + sweet corn (1:3) whereas, significantly higher benefit per rupee invested was recorded with sugarcane + sweet corn (1:2) and with sugarcane + onion (1:3).

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