RESEARCH ARTICLE

PRODUCTION POTENTIAL AND ECONOMICS OF INTERCROPPING IN AUTUMN PLANTED- SUGARCANE UNDER NORTH HILL ZONE OF CHHATTISGARH

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Abstract: A field experiment was conducted during autumn season of 2017-18 at Instructional-cum-research farm RMD CARS, Ambikapur to evaluate the most profitable crops grown as intercrops with winter planted sugarcane under thirteen treatments formulated with intercropping *i.e.* sugarcane sole, sugarcane + onion (1:3), sugarcane + onion (1:4), sugarcane + potato (1:1), sugarcane + potato (1:2) , sugarcane + sweetcorn (1:1), sugarcane + sweetcorn (1:2), sugarcane + wheat (1:2), sugarcane + wheat (1:3), sugarcane + frenchbean (1:2), sugarcane + frenchbean (1:3), sugarcane + mustard (1:1) and sugarcane + mustard (1:2) in randomized block design. Based on the one year study, onion (1:3) intercropping was selected as most remunerative in autumn/winter cane with the highest no. of millable cane (93.69 x 10^3 ha^{-1}), millable cane length (309.26 cm), cane weight (2.72 kg $cane^{-1}$), cane yield (255.41 t ha^{-1}), cane equivalent yield (295.95 t ha^{-1}) and net return and B:C ratio (Rs. 799244 ha^{-1} and 9.08) among all the intercropping systems. Sugarcane + onion (1:4) and sugarcane + potato (1:1) intercropping were also found comparable with sugarcane + onion (1:3). Whereas, lowest no. of millable cane (44.55 x 10^3 ha^{-1}), millable cane length (258.33 cm), cane weight (1.61 kg $cane^{-1}$), cane yield (71.79 t ha^{-1}), cane equivalent yield (89.58 t ha^{-1}) and net return and B:C ratio (Rs. 189227 $ha^{-1}$and 2.38) recorded under sugarcane + wheat (1:3) intercropping system among the intercrops.

Keywords: Production potential, Economics, Sugarcane, Intercropping, Cane equivalent yield

INTRODUCTION

Autumn planted sugarcane is most suitable for growing intercrops due to its delayed germination and slow growth because of low temperature during December to February and condition are favorable for short duration crops. Sugarcane planted under autumn season gives about 20-25 % higher cane yield and also 0.5 unit higher sugar recovery as compared to spring cane. Inspite of these benefits, farmers are least interested to grow autumn sugarcane and are growing cereal, oilseed and pulse *rabi* crops, as per demand in the area of priority in autumn and sugarcane in spring which leads to loss in production potential per unit area and time. Sugarcane requires 4 to 6 weeks for germination and initial growth is also very slow for first two months. This time required for germination and subsequent initial slow growing period can be made better use of growing short duration intercrop as a bonus crop. As sugarcane is planted at wider row spacing and this inter row space practically remains vacant in early growth stages which extends nearly 3 to 4 months where suitable short duration winter crops may be grown as intercrop that increase total crop equivalent yield, higher net return and greater resource utilization and fulfils the diversified needs of the farmers and also introduce mechanization in sugarcane to reduce cost of production in constrast to conventional method of planting. Intercropping in sugarcane with various short duration crops like onion, potato, mungbean and cabbage etc. have been proven beneficial in comparison to growing sugarcane as sole crop (Alam *et al*., 2000, Panghal, 2010 and Chaudhary *et al.*, 2010). Hence, the experiment had been conducted to know the production potential of vegetables as intercrops in autumn planted sugarcane under North hill zone of Chhattisgarh.

MATERIALS AND METHODS

The present field experiment was conducted during *rabi* seasons of 2017-18 at Instructional-cum-research farm RMD CARS, Ambikapur, Surguja (Chhattisgarh). The soil of experimental field was '*Inceptisols*' which is locally known as '*Chawar*'. The soil was acidic (pH 5.7) in nature with low fertility having 0.35% soil organic carbon, low N (235 kg ha^{-1}) and P_2O_5 (12.5 kg ha^{-1}) and medium K_2O (290 kg ha^{-1}). The experiment comprised of thirteen (13) treatments *i.e*. sugarcane sole, sugarcane + onion (1:3), sugarcane + onion (1:4), sugarcane + potato (1:1), sugarcane + potato (1:2) , sugarcane + sweetcorn (1:1), sugarcane + sweetcorn (1:2), sugarcane + wheat (1:2), sugarcane + wheat (1:3), sugarcane + french bean (1:2), sugarcane + french bean (1:3), sugarcane + mustard (1:1) and sugarcane + mustard (1:2) in randomized block design with three replications. Autumn cane (CO-8036) was planted in first week of December. Recommended dose of fertilizer on sugarcane *viz*., 250:100:150 N: P: K kg ha^{-1} with 10 ton FYM ha^{-1} was used for field experiment. At the time of sowing of crop give 34 kg N, 10 kg P_2O_5 and 8 kg K_2O as a basal and the remaining dose of fertilizer of N, P and K was

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applied through drip fertigation at different stages of crop growth. In case of intercrops gives there recommended dose of fertilizer as a basal and side placement at the time as per recommended of practices *viz.*, onion, potato, wheat, mustard, sweet corn and french bean.

RESULTS AND DISCUSSION

Yield Attributes and Yield

Millable cane length (cm):- A critical analysis of data clearly reveals that in general, gradual increase in cane length with intercropping was observed significant by during harvesting stage which has been presented in Table 1. The maximum millable cane length (309.26 cm) was observed when sugarcane was intercropped with onion (1:3) followed by sugarcane+ onion (1:4) , sugarcane + potato (1:1), sugarcane + potato (1:2) , sole sugarcane and the lowest millable cane length (258.33 cm) recorded when sugarcane intercropped with sugarcane + wheat (1:3), which were statistically equal to that sugarcane intercropped with wheat (1:2), mustard (1:1), mustard (1:3), frenchbean (1:2), frenchbean (1:3), sweetcorn (1:1) and sweetcorn (1:2).

Onion and potato as intercropping with sugarcane does not show any adverse effect on sugarcane yield and growth. Potato intercropped plots produced second highest tiller, highest millable cane, maximum height, diameter, unit stalk weight and yield of sugarcane. These findings were strongly corroborated with Miah *et al.* (1994). This might be possible due to beneficial effects of crop management practices for onion and potato that ultimately helped to produce better yield attributes and yield.

Cane weight (kg cane^{-1}):- The maximum cane weight (2.72 kg plant^{-1}) was recorded when sugarcane was intercropped with onion (1:3) followed by sugarcane + onion (1:4), sole sugarcane, sugarcane + potato (1:1) and sugarcane + potato (1:2). The lowest cane weight (1.61 kg plant^{-1}) was recorded when sugarcane was intercropped with wheat (1:3) which was found at par with sugarcane + wheat (1:2), sugarcane + mustard (1:2), sugarcane + mustard (1:1), sugarcane + sweetcorn (1:2) sugarcane + sweetcorn (1:1) sugarcane + frenchbean (1:3) and sugarcane + frenchbean (1:2) Singh *et al.* (2010) who also gave similar reports that the onion as vegetable produced canes of similar weight and were significantly heavier than all the other intercropping systems. The production of taller and heavier canes under the onion intercropping systems indicated that these intercrops did not compete with main crop.

Number of millable cane (x10^3 ha^{-1}):- It is clear from data that number of millable canes was significantly influenced due to sugarcane intercropped with onion (1:3) and it recorded maximum number of millable canes (93.69 x10^{3}ha^{-1}) which was comparable to sugarcane + onion (1:4), sugarcane + potato (1:1), sole sugarcane and sugarcane + potato (1:2) but significantly superior over sugarcane + wheat (1:3), sugarcane + wheat (1:2), sugarcane + mustard (1:2), sugarcane + mustard (1:1), sugarcane + sweetcorn (1:2), sugarcane + sweetcorn (1:1), sugarcane + frenchbean (1:2) and sugarcane + frenchbean (1:3). The lowest number of millable cane (44.55 x10^3 ha^{-1}) was recorded when sugarcane was intercropped in wheat (1:3).The reduction in number of millable canes was attributed to poor short proliferation under intercropping situation as a result of higher inter-specific competition.

Cane yield and cane equivalent yield (t ha^{-1}):- The maximum cane yield and cane equivalent yield (255.41 and 295.75 t ha^{-1}) was recorded when sugarcane was intercropped with onion (1:3) and it was statistically at par with sugarcane + onion (1:4), sole sugarcane, sugarcane + potato (1:1) and sugarcane + potato (1:2) but significantly superior over sugarcane + wheat (1:3), sugarcane + wheat (1:2), sugarcane + mustard (1:2), sugarcane + mustard (1:1), sugarcane + sweetcorn (1:2), sugarcane+ sweetcorn (1:1), sugarcane + frenchbean (1:2) and sugarcane + frenchbean (1:3). The lowest cane yield and cane equivalent yield (71.79 and 89.58 t ha^{-1}) was recorded when sugarcane was intercropped in wheat (1:3).Similar findings was reported by Kumar *et al.* (2003) they reported that the reduction in cane yield as a result of sarson and wheat was attributed to exhaustive competition between the component crops for essential nutrients, water and other growth factors. Lower yield was observed when sugarcane was intercropped with wheat may be due to late vacation of field and competition between wheat and cane plant during that period resulted in production of lower number of tillers and millable canes and cane yield as compared to sole sugarcane.

Economics

Gross return, Net returns (Rs ha^{-1}) and B: C ratio: - Higher gross return, net return and B:C ratio (Rs. 887236, 799244 ha^{-1} and 9.08) was obtained with sugarcane intercropped with onion (1:3) followed by sugarcane + onion (1:4), sugarcane + potato (1:1) . The lowest gross return, net return and B:C ratio (Rs. 268727, 189227 ha^{-1}and 2.38) was recorded when sugarcane was intercropped with wheat (1:3) followed by sugarcane + mustard (1:1) and sugarcane + wheat (1:2).

Table 1. Effect of different intercropping system on no. of millable cane, cane length and cane weight of sugarcane

Treatments	No. of Millable cane ($x10^3$ ha^{-1})	Millable cane length (cm)	Cane weight (kg $cane^{-1}$)
T_1- S.cane + Onion (1:3)	93.69	309.26	2.72
T_2- S.cane + Onion (1:4)	92.99	303.00	2.52
T_3- S.cane + Potato (1:1)	86.75	300.06	2.45
T_4–S.cane + Potato (1:2)	83.33	298.46	2.44
T_5-S.cane + Sweetcorn (1:1)	60.79	270.00	1.90
T_6-S.cane + Sweetcorn (1:2)	58.99	266.00	1.87
T_7-S.cane + Wheat (1:2)	55.38	260.40	1.67
T_8- S.cane + Wheat (1:3)	44.55	258.33	1.61
T_9-S.cane + Frenchbean (1:2)	77.36	277.86	2.01
T_{10}-S.cane + Frenchbean (1:3)	77.36	275.40	2.00
T_{11}- S.cane + Mustard (1:1)	56.39	264.33	1.69
T_{12}- S.cane + Mustard (1:2)	56.12	262.40	1.69
T_{13}- Sole Sugarcane	86.29	299.53	2.45
SEm±	5.39	6.28	0.24
CD (P=0.05)	16.29	19.50	0.70

Table 2. Effect of different intercropping system on sugarcane yield, intercrop yield and sugarcane equivalent yield

Treatments	S. cane yield (t ha^{-1})	Intercrop yield (q ha^{-1})	S. cane equivalent yield (CEY , t ha^{-1})
T_1-Sugarcane + Onion (1:3)	255.41	110 (43.3)	295.75
T_2- Sugarcane + Onion (1:4)	236.50	144 (52.80)	289.30
T_3 -Sugarcane + Potato (1:1)	212.76	80 (27.46)	240.22
T_4 - Sugarcane + Potato (1:2)	204.53	103 (21.33)	225.87
T_5-Sugarcane + Sweetcorn (1:1)	115.43	83 (27.66)	143.09
T_6-Sugarcane + Sweetcorn (1:2)	110.11	90 (30.0)	140.12
T_7- Sugarcane + Wheat (1:2)	92.55	21 (12.88)	105.44
T_8- Sugarcane + Wheat (1:3)	71.79	29 (17.78)	89.58
T_9-Sugarcane + Frenchbean (1:2)	162.67	12 (4.00)	166.67

T_{10}-Sugarcane + Frenchbean (1:3)	160.14	13 (4.33)	164.47
T_{11}- Sugarcane + Mustard (1:1)	95.51	05 (7.00)	102.50
T_{12}- Sugarcane + Mustard (1:2)	94.66	07 (9.80)	104.47
T_{13}- Sole Sugarcane	213.74	-	213.74
SEm±	22.90	-	22.88
CD (P=0.05)	67.24	-	67.17

Table 3. Effect of different intercropping system on gross return, net return and B:C ratio on sugarcane

Treatments	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
T_1- S. cane + Onion (1:3)	87992	887236	799244	9.08
T_2- S. cane + Onion (1:4)	88900	867910	779010	8.76
T_3- S. cane + Potato (1:1)	90900	720662	629762	6.93
T_4 -S. cane + Potato(1:2)	92917	677597	584680	6.29
T_5-S.cane + Sweetcorn (1:1)	78667	429272	350605	4.46
T_6-S.cane + Sweetcorn (1:2)	79700	420352	340652	4.27
T_7- S.cane + Wheat (1:2)	78900	316320	237420	3.01
T_8- S.cane + Wheat (1:3)	79500	268727	189227	2.38
T_9-S.cane + Frenchbean (1:2)	76600	500016	423416	5.53
T_{10}-S.cane + Frenchbean (1:3)	77000	493421	416421	5.41
T_{11}- S.cane + Mustard (1:1)	78950	307515	228565	2.90
T_{12}- S.cane + Mustard (1:2)	79300	313402	234102	2.95
T_{13}- Sole Sugarcane	73166	641240	568074	7.76
SEm±	-	68632	68633	0.84
CD (P=0.05)	-	201518	201518	2.47

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