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Production potential of vegetables as intercrops in autumn planted sugarcane under north hill zone of Chhattisgarh

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Abstract
A field experiment was conducted during kharif and *rabi* seasons of 2015-16 & 2016-17 at the Research Farm, IGKV, RMD College of Agriculture & Research Station Ambikapur, Surguja (Chhattisgarh) to find out the most profitable vegetables grown as intercrops with autumn planted sugarcane. Six treatments formulated with intercropping *i.e.* sugarcane sole, sugarcane+ radish, sugarcane+ onion, sugarcane+ Spinach, sugarcane+ French bean and sugarcane+ potato in randomized block design. Based on the two years study, onion intercropping was selected as most remunerative in autumn cane with the highest cane equivalent yield (156.30 t/ ha) and gross return (Rs. 484716) among all the intercropping systems. Sugarcane + potato intercropping was also found comparable with sugarcane + onion produced cane equivalent yield of 150.0 t/ha and gross return (Rs. 465000/ha). Whereas, lowest cane equivalent yield and net return recorded under sugarcane+ French bean intercropping system among the vegetables.

Keywords: Production potential, vegetables, sugarcane, hill zone.

Introduction
The cost of production of sugarcane is increasing every year. The increase in cost of production was mainly on account of increase in the price of key inputs such as fertilizers, irrigation water, insecticides and human labor charges. The increasing cost of production of sugarcane and reduced profit margin has compelled farmers to think about the cropping systems which are economically feasible. Fortunately sugarcane provides considerable scope for intercropping with short duration crops and thus improves overall productivity and profitability of the cane growers. Autumn planted sugarcane is most suitable for growing intercrops due to its delayed germination and slow growth because of low temperature during November to February and conditions are favorable for short duration vegetable crops. Sugarcane planted under autumn season gives about 20-30 % higher cane yield and also 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. Though intercropping of different crops in autumn sugarcane has been reported in some parts of the Northern India (Kumar *et al.*, 2007) [1], the information on the intercropping of rabi vegetables is meager under north hill zone of Chhattisgarh conditions. Therefore, intercropping of rabi vegetables with autumn cane may be a viable and productive agronomic practice especially for north hill zone of Chhattisgarh. Hence, the experiment has been made 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 kharif and *rabi* seasons of 2015-16 and 2016-17 at the Research Farm, IGAU, RMD College of Agriculture & Research Station Ambikapur, Surguja (Chhattisgarh). The soil was sandy loam in texture, acidic in reaction (pH 6.2), low in available nitrogen, phosphorus and medium in potassium. The experiment comprised of eight (8) treatments, the details of which are given below

Experimental details
Year	:	2015-16 and 2016-17
Design	:	RBD (Randomized Block Design)
Replication	:	Three

Treatments : Six (6)
Gross plot size : 4.5 m x 4.0 m = 18 m^2
Season : *Kharif and Rabi*
Crop : Sugarcane with radish, onion, fenugreek, French bean and potato

Treatments		Time of sowing/planting
Cropping Systems		
T_1	Sugarcane sole	Second week of November
T_2	Sugarcane + Radish	Fourth week of November
T_3	Sugarcane+ Onion	Fourth week of November
T_4	Sugarcane+ Spinach	Fourth week of November
T_5	Sugarcane+ French bean	Fourth week of November
T_6	Sugarcane+ Potato	Fourth week of November

Treatments comprising six cropping systems viz. sole sugarcane, sugarcane + radish, sugarcane + onion, sugarcane + Spinach, sugarcane + French bean, and sugarcane + potato were tested in randomized block design with three replications. Autumn cane (CoT-8201) was planted in second week of November. Two rows each of radish, Spinach and French bean, three rows of onion and one row of potato were sown in between two rows of sugarcane on fourth week of November. Sugarcane was fertilized with 250:100:80 kg of NPK. Whereas, intercrops were fertilized on the basis of their population ratio in sole and intercropping situations with RDF. Other operations were done as per recommended package of practices for the respective intercrops. Sugarcane was given with full phosphorus and potassium and half nitrogen as basal and remaining half nitrogen top dressed in four three splits after harvest of intercrops.

Results and Discussion

Yield and yield attributes

Germination Per cent of sugarcane at 60 days after planting stage (DAP) recorded highest (60 per cent) in sole condition and lowest (50 per cent) when sugarcane intercropped with spinach. However, differences among the intercropping system were not significant Table 1. Shoot population at maximum growth stage in sugarcane ranged from 141000/ha in sugarcane+ potato to 160000/ ha under sole sugarcane. All the intercrops reduced shoot population significantly over sole sugarcane. Panwar *et al.* (1990) [2] also observed similar results.

Table 1: Growth and yield of sugarcane with different intercropping systems

Treatments	Germination (%)	Shoot population (000/ha)	No of Millable canes (000/ha)	Cane yield (t/ha)	Vegetables yield (q/ha)
Cropping Systems					
Sugarcane sole	60	160	139	94.6	-
Sugarcane + Radish	57	144	127	86.5	180.6
Sugarcane+ Onion	58	142	125	85.2	222.6
Sugarcane+ Spinach	50	148	131	84.6	220.6
Sugarcane+ French bean	54	146	129	84.0	60.0
Sugarcane+ Potato	54	141	134	93.4	250.3
CD (P=5%)	NS	11.66	9.83	8.33	-

Table 2: Growth and yield of different intercropping systems

Treatments	Cane equivalent yield (t/ha)	Commodity price (Rs/q)	Gross return (Rs/ha)	Reduction in cane Yield (%)
Cropping Systems				
Sugarcane sole	94.6	310	293260	-
Sugarcane + Radish	144.76	1000	448756	8.56
Sugarcane+ Onion	156.30	1000	484716	9.93
Sugarcane+ Spinach	127.30	600	394630	10.57
Sugarcane+ French bean	103.35	1000	320385	11.20
Sugarcane+ Potato	150.00	800	465000	1.27
CD (P=5%)	18.2	-	-	-

Sugarcane intercropped with radish, onion, spinach, French bean and potato reduced the cane yield to the tune of 8.56, 9.93, 10.57, 11.20 and 1.27 per cent, respectively as compared to sole crop of cane. However, significant reduction in cane yield was recorded only in case of onion, fenugreek and French bean intercropping system. In onion crop, delay harvesting might have resulted cane yield decline, French bean despite being a leguminous crop does not fix atmospheric nitrogen and might have released some allelopathy chemicals leaving adverse affect on sugarcane. The results are in close conformity with those of Singh *et al.* (2002) [4] and Saini *et al*. (2002) [3]. Radish and potato were harvested early and hence did not have shading effect on sugarcane during its grand growth phase. Kumar *et al.* (2007) [1] also recorded significant decline in cane yield with mustard intercropping. Number of milliable canes also followed the similar trend being highest in sole stand (139 thousand/ha). Reduction in number of millable canes was attributed to poor shoot proliferation under intercropping situation as results of higher inter specific competition.

Cane equivalent yield

Sugarcane + onion intercropping produced significantly highest cane equivalent yield (156.30 t/ha) followed by potato as intercrop (150.0 t/ha), being higher than sole sugarcane and its intercropping with radish, spinach and French bean, respectively (Table 1). This might have been due to additional yield from onion and potato without adverse effect on sugarcane and good market price of produce. Singh *et al.* (2003) also recorded higher cane equivalent yield with maize intercropping

Economics

Gross return (Rs /ha) followed the trend similar to that of cane equivalent, being highest (Rs 487716 /ha) in sugarcane + onion followed by sugarcane + potato (Rs 465000/ha) as

against Rs. 293268 in sole sugarcane.

Conclusion

Thus, it can be concluded that sugarcane intercropped with onion followed by potato gave highest cane equivalent yield and net profit over sole sugarcane crop under north hill zone of Chhattisgarh.

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