

French bean intercropping with autumn sugarcane: A step towards higher resource use efficiency and profitability

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The adoption of the intercropping system has been made necessary by the rapidly growing population, increased food demand, limited scope for crop horizontal extension and diversified needs of farmers for both food and money. Intercropping is the practise of growing two or more crops simultaneously on the same piece of land in clearly defined rows in order to increase production per unit of space. It is a better and sustainable approach to make excellent use of the vacant space during the early growth stages of autumn planted sugarcane (3 to 4 months). Because of its wide spacing and slow growth, sugarcane is a long duration crop that provides ample opportunity for intercropping with short duration, high-value crops that generate income. This allows for increased household nutrition and economic security, especially for small and marginal cane growers. This may improve the area used for autumn planting. Sugarcane + French bean (1: 2) intercropping showed the higher cane equivalent yield (106.0 t/ha) and net returns (₹1, 87,400.0/ha) over sole sugarcane. The percentage increase in cane equivalent yield and net returns under sugarcane + French bean (1: 2) intercropping over sole sugarcane was 16.2 and 22.7%, respectively.

Keywords: Autumn sugarcane, French bean, Intercropping, System productivity

In India sugarcane is grown on 5.3 million hectares, with an average productivity of 80.0 t/ha, and is a major source of sugar in tropical and subtropical regions. The total area in Bihar planted to this crop is 0.26 million ha, with an average yield of 49.0 t/ha. The focus has changed from sole cropping to intercropping in recent years. Since sugarcane is a crop that takes a long time to cover the ground, requires wider spacing (75 to 150 cm), and grows slowly up to the period of 90 to 120 days, it results in one of the most fruitful, sustainable and economically successful intercropping systems. Production of more crops per unit area, optimum resource usage, and crop yield stabilization are the three main goals of intercropping. Sugarcane planted in the autumn season is most suited for intercropping since it grows more slowly due to the low temperatures in subtropical

India from November to February, which is ideal time for short-duration winter (*rabi*) season crops that can grow successfully when planted between sugarcane inter-spaces. Numerous studies showed that the total productivity of the intercropping system taken with sugarcane and *rabi* crops was significantly higher than the total productivity of *rabi* crops alone. It is vital to increase system productivity in order to fulfil the rising demand for various crops, stop further loss in factor productivity and increase the viability of the sugarcane production system. In addition to extending the area under pulse crops, growing French beans with sugarcane lessens the intensity of weeds, gives households mid-season income for further purchase of inputs for sugarcane and creates more jobs. French beans, a short-duration, early-bulking non-traditional grain legume with high

production potential in the winter (*rabi*) season in North India, can be intercropped with sugarcane in the autumn season to provide mid-season income for small and marginal cane growers. Sound package of practices must be made more widely known in order to maximize the benefits of sugarcane based cropping systems and to maintain their yield potential.

Package of practices

Field preparation: To improve contact between the setts of sugarcane and the soil, the soil must be finely ground, properly aerated, wet, and weed free. Soil turning ploughs should be used for the initial ploughing to allow at least 20 to 25 cm of soil to become loose. There should be 2 harrowing after it. Each harrowing should be followed by planking. Levelling must not be neglected when preparing the field for the sugarcane + French bean

intercropping system. For effective water management and to prevent water stagnation, a field must be appropriately levelled. Field prepared for sugarcane planting is also good for French bean too.

Sowing time: Optimum time for sowing of crops, autumn sugarcane and French bean in intercropping system is between mid-October to mid-November.

Varieties: Sugarcane variety such as CoP 9301, CoLk 1546', CoLk 16466, CoP 16437, CoP 09437, CoLk 12207, CoLk 12209, CoP 112 and CoSe 01434 are suited for the sub-tropical region. French bean varieties such as PDR. 14 (Uday), IIPR 96-4 (Ambar) and I.P.R. 98-5 (Utkarsha) are suitable for cultivation in sub-tropical region.

Seed rate, seed treatment and spacing: For sugarcane + French bean intercropping system 50–60 quintals seed of sugarcane and 60–65 kg seed of French bean is required. The seed of French bean should be treated with carbendazim @2 g/kg seed. The sugarcane setts should also be soaked for 10 minutes with carbendazim solution 2 g/litre water, which will take care of soil and sett borne diseases. Planting/sowing of sugarcane and French bean should be done in 1: 2 ratios. Row to row spacing should be 90 cm for sugarcane and 30 cm for French bean. The distance between cane and French bean row must be 30 cm. Seed to seed distance of French bean should be 10 cm.

Manure and fertilizer application: Apply well rotten FYM/compost @20 t/ha before last ploughing and mix it evenly in soil. Chemical fertilizers for both the crops should apply separately. The fertilizer application in intercrops should be based on the area occupied by them in the mixed stand. During a research it was observed that autumn sugarcane + French bean (1:2 row ratios) with 100% recommended dose of fertilizer (RDF) to sugarcane and 100% N and K to French bean and sugarcane + French bean (1: 2 row ratios) with 100% RDF to sugarcane and 100% N and P to French bean both are equally productive and cost-effective, offering the chance to

save phosphorus or potassium.

Irrigation: Rainfall in north India is sufficient to meet the water needs of the grand growth phase of sugarcane, but irrigation is necessary to meet the needs of the tiller initiation stage (formative stage). For the autumn sugarcane crop in this region, 5–6 irrigations are needed. It is important to take care to irrigate the crop in accordance with the requirements and kind of intercrops. Apply 2 irrigations up to the period of French bean at 45 and 75 days after sowing. Normal irrigation for sugarcane should apply only after harvest of French bean.

Weed management: Wider row spacing and slow initial growth of sugarcane provide congenial environment for the growth of weeds. The presence of weeds up to 120 days after planting cause reduction in yield indicating that initial weed infestation during tiller initiation period is harmful to the sugarcane as well as intercrop. However, intercropping smothers weeds because of its effect. High crop densities in an intercropping system provide intense competition for weeds, which in turn somewhat slows their growth. The weed population is reduced when French bean is used as an intercrop with autumn sugarcane, which lowers cultivation costs. In an intercropping system, weed control is often performed manually through interculturing activities; however, in the situation that labourers are not readily available, system-recommended herbicides may be applied.

Plant protection

Insects

Sugarcane borers: It is serious pest of sugarcane and cause considerable yield loss. It affects sugarcane from planting to cane formation stage. The different types of borer such as root, shoot, top and plassey borers are sporadic in nature and can be controlled by cultural, mechanical, biological and chemical method. Install 12 pheromone traps/ha to monitor the emergence of moths. It is effective to remove dead hearts from canes from April to June using a mechanical approach, as well as dry leaves at intervals of 1 month. Between June and August, at 10-day intervals, *Trichoderma chilonis* eggs @50,000/ha can be used. Despite the fact that chemical management is still effective, farmers must be informed on the use of pesticides, their resistance, resurgence, and emergence of secondary pests. Apply fipronil 0.3 G @33 kg/ha in furrows during planting as chemical control.

Diseases

Diseases of sugarcane: Sett treatment, deep summer ploughing, crop rotation, and the use of disease-resistant varieties could reduce the occurrence of red rot, wilt, and smut in sugarcane.

Beans white mold in French bean: In December, spraying crop with carbendazim 0.5 g/litre water is helpful against mealy bugs. After 15 days, repeat the spraying at the same rate.

Crop productivity

The intercropping system raised overall productivity as indicated



Sugarcane + French bean (1: 2 row ratio)

Table 1. Crop productivity as influenced by sugarcane + French bean intercropping system

Treatment	Yield (t/ha)		Reduction in cane yield over sole sugarcane (%)	Sugarcane equivalent yield (t/ha)	Increase in cane equivalent yield over sole sugarcane (%)
	Sugarcane	Grain yield of French bean			
Sole sugarcane	91.2	-	-	91.2	-
Sugarcane + French bean intercropping system	83.7	1.15	8.2	106.0	16.2

by sugarcane equivalent yield. Sugarcane + French bean (1: 2) system recorded 16.2% higher sugarcane equivalent yield than sole sugarcane due to marginal difference in sugarcane yield and additional yield of French bean, which resulted in higher cane equivalent yield in sugarcane + French bean (1: 2) intercropping system than in sole sugarcane (Table 1).

Economics

Economic analysis revealed that intercropping of sugarcane + French bean was beneficial over sole cropping of sugarcane in terms of gross returns, net returns and benefit: cost ratio (Table 2). The higher gross returns (₹3,28,600/ha) was recorded from sugarcane + French bean (1: 2) intercropping system due to higher values of cane equivalent yield. In addition, the economic analysis showed that the sugarcane + French bean (1: 2) intercropping system generated greater income with 22.7% more net

returns than sole sugarcane coupled with a higher benefit:cost ratio (2.33), demonstrating economic advantage of the association.

Intercropping of French bean with ratoon crop

When sugarcane is harvested and the subterranean stalks are left in the field, they sprout, this process known as ratooning. It is advantageous since it has a lower cost of production than a plant crop because planting operations and seed costs are reduced. Ratooning during winter (*rabi*) cause mortality of eye buds, which lowers cane production. Several agro-techniques have been employed to promote stubble bud sprouting. One of these is the intercropping of early maturing, high bulking crops, such as French beans, with winter-started ratoon. It raises the temperature of the canopy and promote the emergence of stubble buds. The productivity of the system was also boosted by intercropping French

beans with ratoon canes, which also gave extra income during the middle of the growing season that farmers could use to buy sugarcane inputs.

SUMMARY

Since sugarcane is a long duration, widely spaced, initially slow-growing, and one-time income-generating crop, there is enough scope for the intercropping of high-value crops. Due to the complementary time and space of the component crops, intercropping systems have a yield advantage over systems using only sugarcane. It is essential to increase system productivity in order to fulfil the rising demand for different crops, and increase the viability of the sugarcane production system. Sugarcane + French bean (1:2) intercropping system gave the higher cane equivalent yield (106.0 t/ha), net returns (₹1,87,400/ha) and benefit: cost ratio (2.33). The least profitable option was sugarcane alone. Hence, intercropping system (sugarcane + French bean) was adjudged the most productive and profitable, which deserves adoption by farmers of sub-tropical Indian conditions.

Table 1. Economic feasibility of sugarcane + French bean intercropping system

Treatment	Gross returns (₹/ha)	Net returns (₹/ha)	Benefit: cost ratio	Increase in net returns over sole sugarcane (%)
Sole sugarcane	2,82,720.0	1,52,720.0	2.17	-
Sugarcane + French bean intercropping System	3,28,600.0	1,87,400.0	2.33	22.71

Selling price of produce (₹/tonne): Sugarcane, 3100; French bean, 60,000.

*For calculation of economics, 2020 rates were considered.

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