

Coriander intercropping with sugarcane

A way forward for enhancing income and resource use efficiency

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Coriander intercropped in available wider space between the rows of autumn sugarcane quickly covers the ground and smothers the emerging weeds through competition and shading. It utilizes the vacant wide space of sugarcane very well during early part of sugarcane growth. Intercropping is better way to improve nutrient and water use efficiency. The production efficiency expressed in terms of sugarcane equivalent yield (SEY), land equivalent ratio (LER) and area time equivalent ratio (ATER) and economic feasibility in terms of gross returns, net returns and benefit: cost ratio showed higher value when the crops were grown in intercropping system than with sole crop of sugarcane. Sugarcane + coriander with 100% RDF to both the crops and residue incorporation showed the maximum cane yield, sugarcane equivalent yield (106.6 t/ha), gross returns (₹ 244,420/ha), net returns (₹ 159,260/ha), benefit: cost ratio (2.87), land equivalent ratio (1.64) and area time equivalent ratio (1.16) over rest of the treatments. Application of 2 irrigations at 60 and 90 DAS (I_2) produced significantly higher yield of sugarcane (88.4 t/ha) and coriander grain (1.44 t/ha) which resulted in significantly higher land equivalent ratio (1.70), area time equivalent ratio (1.20), sugarcane equivalent yield (110.4 t/ha), gross returns (₹ 252,970/ha), net returns (₹ 167,560/ha) and benefit: cost ratio (2.96).

Keywords: Coriander, Fertility level, Intercropping, Irrigation schedule, Productivity, Sugarcane, Yield advantage

SUGARCANE is an important commercial crop in India being cultivated in 5.3 million ha, with an average productivity of 63.7 t/ha. In Bihar, it is cultivated in an area of 0.28 million ha, with the productivity of 50 t/ha. Sugarcane is a widely spaced crop and has tremendous scope for intercropping. Intercropping has been recognized as potentially beneficial system of crop production. Evidences suggest that it can provide substantial yield advantage compared to sole cropping. The inclusion of coriander in sugarcane based intercropping systems as intercrop helps to get increased productivity, besides judicious utilization of costlier inputs like fertilizer and irrigation. Fertilizer and irrigation is one of the important factors for stepping up the productivity in sugarcane + coriander intercropping system. As optimum

fertilizer and irrigation not only increases crop productivity but also helps their equitable and judicious utilization. The fertilizer requirements of intercropping system may vary from sole cropping owing to dissimilar growth habits. Optimization of fertilizer needs of intercrops may increase the productivity and resource use efficiency. Excessive use and continuous increase in cost of fertilizers inspired the scientists to explore the possibilities to *in situ* incorporation of crop residues for soil health sustainability. Sugarcane is a long duration and high water demanding crop needs more irrigation for fulfillment of its water requirement. However, coriander does not require more irrigation, and both low and high moisture levels are detrimental for growth. Although, sugarcane + coriander intercropping

is in practice in Bihar, the present study identified suitable fertilizer and irrigation requirement to coriander with residue incorporation for enhancing productivity from this system.

Methodology

The present investigation was conducted during autumn season for two consecutive years. The total rainfall received during the cropping season was 1,194 mm. Experimental soil was sandy loam in texture and calcareous in nature having 8.2 pH, 0.43% organic carbon, and available N, P and K content were 206, 7.8 and 102 kg/ha, respectively. The experiment was laid out in factorial randomized block design with 3 replications. Fifteen treatment combinations in the experiment comprised of 5 fertility levels, viz. F_1 – Sugarcane + coriander (1:2) with

100% RDF to both the crops and residue incorporation; F₂ - Sugarcane + coriander (1:2) with 100% RDF to sugarcane + 50% RDF to coriander and residue incorporation; F₃ - Sugarcane + coriander (1:2) with 100% RDF to sugarcane + 100% N to coriander and residue removal, F₄ - Sugarcane + coriander (1:2) with 100% RDF to sugarcane + 100% N and P to coriander and residue incorporation; and F₅ - Sugarcane + coriander (1:2) with 100% RDF to sugarcane + 100% N and K to coriander and residue incorporation and 3 irrigation schedules (I₁ - 60 DAS, I₂ - 90 DAS and I₃ - 60 and 90 DAS) with one each sole crop of sugarcane and coriander with 100% RDF and recommended irrigation were tested in three replications to measure the land equivalent ratio (LER) and area time equivalent ratio (ATER). In intercropping, sugarcane was given full dose of recommended fertilizers and coriander was given fertilizers as per treatments based on proportionate area occupied in system. The recommended dose of fertilizers for sole sugarcane and coriander were 150-37.1-49.8 and 60-17.5-24.9 kg N-P-K/ha, respectively. However, only nitrogen is the existing recommendation for coriander when grown as intercrop. Half dose of nitrogen and full doses of phosphorus and potassium of sugarcane and coriander were applied as basal, while remaining N of sugarcane was applied in 2 equal splits after first irrigation and at the time of earthing up. In coriander, rest half of N was applied after first irrigation. BO 141 sugarcane and Pant Haritima coriander were sown 90 and 30 cm apart during first year and second year, using 5 tonnes and 18.0 kg seed/ha, respectively, for sole crops. However, in sugarcane + coriander intercropping, the plant population of the sugarcane was maintained as sole cropping system, but 2 rows of coriander were adjusted in between 2 rows of sugarcane, using seed rate of 5.0 t and 12 kg/ha for sugarcane and coriander, respectively. All other recommended practices were followed during crop growing season. Sugarcane and



Sugarcane + coriander (1: 2 row ratio)

coriander were harvested in January and March.

Cane juice was extracted with power crusher and juice quality was estimated as per standard procedure. The land equivalent ratio (LER) and area time equivalent ratio was measured by the standard formula. Cost of cultivation, gross returns, net returns and B: C ratios were also determined on the basis of cost of inputs and prices of outputs in respective experimentation year.

Research outcome

Crop yield: Sole crop of sugarcane and coriander (Table 1) produced significantly higher cane yield and coriander grain yield over intercrop combination due to less interspaces competition and increased population of sugarcane and coriander under sole stand. Among fertility levels, higher yield of sugarcane was recorded under sugarcane + coriander with 100% RDF to both the crops and residue incorporation (F₁), sugarcane + coriander with 100% RDF to sugarcane and 100% N and K to coriander and residue incorporation (F₅) and sugarcane + coriander with 100% RDF to sugarcane and 100% N and P to coriander and residue incorporation (F₄), which were comparable to each other. The significantly higher grain yield of coriander (1.38 t/ha) was recorded due to sugarcane + coriander with 100% RDF to both the crops and residue incorporation (F₁) followed by F₅ and F₄, whereas the lowest grain yield (0.89 t/ha) was recorded with F₃ followed by F₂ and F₄. The significantly higher cane yield (88.4 t/ha) and coriander grain yield (1.44 t/ha) were obtained with 2 irrigations applied at 60 and 90 DAS (I₃)

followed by 1 irrigation at 60 DAS (I₁) and 1 irrigation at 90 DAS (I₂) and in each case the difference was significant (Table 1). The difference in yield of coriander at different irrigation schedule might be due to availability of adequate moisture at 2 irrigations and competition for moisture at one irrigation applied either at 60 (I₁) or 90 DAS (I₂) of coriander.

System productivity and resource use efficiency:

Intercropping system showed superiority over sole cropping with respect to CEY (99.3 t/ha) which was 10.2 and 222.4% higher (Table 2) than sole sugarcane and sole coriander, respectively. The higher cane equivalent yield in intercropping system was on account of additional yield of intercrops without much reduction in yield of base crop. Sugarcane + coriander intercropping system recorded significantly higher LER (1.46) over sole crops, reflected the advantage of intercropping over sole cropping as 46% more area would be required by sole sugarcane to get the same yield level that was obtained from one hectare of intercropping. Similarly, intercropping system noticed significantly highest ATER (1.08) over sole crops (Table 1) indicated better utilization of resources per unit land and time by intercropping system.

The inspection of data indicated that fertility levels produced marked variation in productivity and resource use efficiency (Table 1). The maximum cane equivalent yield (106.6 t/ha) was obtained with F₁ followed by F₅ (100.7 t/ha) and F₄ (99.9 t/ha) whereas minimum values for the same was recorded with F₃ (92.4 t/ha) followed by F₂ (97.0 t/ha). The significantly higher LER (1.64) and ATER (1.16) were also recorded with F₁ followed by F₅ (1.48 and 1.10) and F₄ (1.46 and 1.09) in regards to LER and ATER respectively, while the minimum values for the same were recorded in F₃ (1.32 and 1.01) followed by F₂ and F₄. Among irrigation schedules, 2 irrigations recorded significantly higher LER, ATER and CEY of the system. The data showed that

Table 1. Effect of fertility levels and irrigation schedule on yield, resource use efficiency and economics of sugarcane + coriander intercropping system (pooled data of 2 years)

Treatment	Cane yield (t/ha)	Sucrose in juice (%)	Coriander yield (t/ha)	LER grain yield (t/ha)	ATER	CEY (t/ha)	Gross returns (x10 ³ ₹/ha)	Net returns (x10 ³ ₹/ha)	B:C ratio
<i>Fertility level (% RDF)</i>									
F ₁ : Sugarcane + coriander (1:2) with 100% RDF to both the crops and residue incorporation	85.4	16.70	1.38	1.64	1.16	106.6	244.42	159.26	2.87
F ₂ : Sugarcane + coriander (1:2) with 100% RDF to sugarcane and 50% RDF to coriander and residue incorporation	81.5	16.68	1.01	1.42	1.06	97.0	222.37	138.21	2.64
F ₃ : Sugarcane + coriander (1:2) with 100% RDF to sugarcane and 100% N to coriander with residue removal	78.7	16.75	0.89	1.32	1.01	92.4	211.56	127.84	2.53
F ₄ : Sugarcane + coriander (1:2) with 100% RDF to sugarcane and 100% N and P to coriander and residue incorporation	83.7	16.66	1.06	1.46	1.09	99.9	228.92	144.36	2.71
F ₅ : Sugarcane + coriander (1:2) with 100% RDF to sugarcane and 100% N and K to coriander and residue incorporation	84.0	16.67	1.09	1.48	1.10	100.7	230.87	146.81	2.74
SEm±	1.56	0.12	0.01	0.02	0.01	1.59	3.790	3.69	0.04
CD (P=0.05)	4.5	NS	0.04	0.06	0.03	4.6	10.93	10.65	0.12
<i>Irrigation schedule</i>									
I ₀ : 60 DAS	83.1	16.56	0.98	1.41	1.07	98.1	224.87	141.08	2.68
I ₁ : 90 DAS	76.5	16.69	0.85	1.28	0.98	89.5	205.04	121.25	2.45
I ₂ : 60, 90 DAS	88.4	16.83	1.44	1.70	1.20	110.4	252.97	167.56	2.96
SEm±	1.21	0.09	0.01	0.01	0.01	1.23	2.940	2.86	0.03
CD (P=0.05)	3.5	NS	0.04	0.03	0.03	3.6	8.48	8.26	0.09
<i>Intercrop vs sole crop</i>									
Intercrop	82.7	16.69	1.09	1.46	1.08	99.3	227.63	143.30	2.70
Sole crop	90.1	16.83	2.00	1.00	1.00	90.1 (30.8)	206.91 (70.02)	126.74 (39.58)	2.58 (2.31)
SEm±	1.97	0.25	0.02	0.02	0.02	2.01	4.79	4.39	0.06
CD (P=0.05)	5.7	NS	0.06	0.06	0.06	5.8	13.83	13.48	NS

Selling price (₹/tonne): Sugarcane ₹ 2,300; Coriander ₹ 35,000. CEY, Cane equivalent yield; LER, land equivalent ratio; ATER, area time equivalent ratio. Figures in parenthesis indicate values of sole coriander.

application of 2 irrigations at 60 and 90 DAS (I₃) gave 32.8 and 20.6; 22.4 and 12.1; 23.4 and 12.5% higher LER, ATER and CEY of the system over single irrigation applied either at 90 DAS (I₂) and 60 DAS (I₁), respectively. This may be as a result of better yield contributing character and yield with the application of 2 irrigations.

Quality and system economics: Irrespective of the treatments, sucrose per cent in juice did not vary significantly by fertility levels, irrigation schedule and sole vs intercrops. However, comparatively higher values (16.83%) was obtained with sole sugarcane which was 0.84% higher than treatments (Table 1) confirms that sucrose content is governed by genetic- makeup and least affected by management practices. Among irrigation schedule, the difference was also non-significant but comparatively higher

values were obtained with higher level of irrigations. The intercropping system fetched significantly higher gross and net returns over sole cropping (Table 1). Among fertility levels, sugarcane + coriander (1: 2) with 100% RDF to both the crops and residue incorporation (F₁) was superior with maximum gross and net returns of ₹ 244,420/ha and ₹ 159,260/ha, respectively with 2.87 benefit: cost ratio, whereas the lowest gross returns (₹ 211,560/ha), net returns (₹ 127,840/ha) and benefit: cost ratio (2.53) were recorded with F₃ followed by F₂ and F₄. In case of irrigation schedule, higher cost of cultivation, gross returns, net returns and benefit: cost ratio were recorded owing to application of 2 irrigations at 60 and 90 DAS (Table 1). Application of 2 irrigations at 60 and 90 DAS incurred higher cost of cultivation (₹ 85,420/ha) but gave 12.5; 23.4, 18.8; 38.2 and 10.4;

20.8% higher gross returns, net returns and benefit: cost ratio, respectively over 1 irrigation applied either at 60 DAS (I₁) and 90 DAS (I₂). The increase in profit with I₃ over I₁ and I₂ was owing to higher cane equivalent yield.

SUMMARY

It is concluded that for realizing higher productivity, profitability as well as optimum resource use efficiency from intercropping coriander with autumn planted sugarcane, it should be given 2 irrigations before harvesting of coriander at 60 and 90 days after sowing of coriander (I₃) with 100% RDF to both the crops and residue incorporation.

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