

Effect of relay intercropping of castor in *kharif* groundnut on system productivity and economic returns

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ABSTRACT

Castor and groundnut are important oilseed crop in India. Groundnut crop is sown at the onset of monsoon and while castor is grown in September in Gujarat. Hence, castor crop can be sown as relay intercrop in groundnut. It may increase crop production and profitability of farmers. Therefore, a field experiment was conducted at Centre for Oilseeds Research, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to study the feasibility of castor as relay intercropping in *kharif* groundnut during 2019–20 to 2021–22. Significantly higher groundnut equivalent yield (4,479 kg/ha) was found with groundnut + castor (4:1) [groundnut (30 cm) + castor (180 cm × 120 cm)] relay inter cropping which was at par with groundnut + castor (3:1) [groundnut (30 cm) + castor (150 cm × 120 cm)].

Key word: Groundnut equivalent yield, Kernal yield, Pod yield and Relay intercropping,

From the ancient times, farmers and researchers are developing different crop production systems to increase productivity and sustainability which includes intercropping, mixed cropping, relay cropping, etc. There are many factors which affect the growth of component species in mixed cropping, intercropping and relay cropping like variety, seeding ratios, planting pattern and competition between the crops. Relay cropping is an important practice followed mainly in rainfed systems in several parts of India. The main objectives of relay intercropping are to maximize crop production and secure additional income by optimizing the use of natural resources and to overcome the risk. Castor (*Ricinus communis* L.) is an important non-edible oilseed crop widely grown in arid and semi-arid regions of the country. India is the largest producer of castor in the world. It earns valuable foreign exchange of worth Rs. 8900 crores and plays an important role in the agricultural economy of the country during 2020 (Keelery, 2024).

Groundnut (*Arachis hypogaea* L.) is 3rd important oilseed crop after soybean and rapeseed and mustard grown in the tropics and subtropical region in India. Groundnut is not only an important oilseed crop of India but also an

important agricultural export commodity. Globally, Groundnut covers 295 lakh hectares with the production of 487 lakh tonnes with the productivity of 1647 kg per hectare (FAOSTAT, 2019). There is need for increasing production of edible oilseeds to meet huge edible oil demand in the country. However, area under oilseeds does not seem likely to expand because nowadays land has become limiting factor due to rapid industrialization and urbanization. Therefore, increasing the production by improving productivity of oilseed crops grown in the existing area through adopting appropriate agronomic practices is paramount (Avasthe *et al.*, 2023). Intercropping system is one of the best ways to increase productivity and production per unit area and time. The yield advantages in intercropping systems are associated with full use of environmental resources over time and space (Willey *et al.*, 1986).

In Gujarat, groundnut is sown with onset of monsoon while castor is grown in second fortnight of August. Hence, castor crop can be sown as relay intercrop in groundnut for getting higher income from same piece of land. However, optimum spacing of castor as relay intercropping in groundnut need to be worked out for getting higher yield and income and optimize resource use. Therefore, this study was undertaken with above mentioned objectives.

MATERIALS AND METHODS

A field experiment was conducted at Centre for Oilseeds Research, Sardarkrushinagar Dantiwada Agricultural

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Table 1. Effect of relay intercropping of castor on groundnut yield (pooled results)

Treatment	Pod yield (kg/ha)	Kernel yield (kg/ha)	Haulm yield (kg/ha)
Sole castor (150 cm × 120 cm)	-	-	-
Sole groundnut (45 cm)	2,076	1,468	2,105
Groundnut + Castor (3:1) [Groundnut (30 cm) + Castor (150 cm × 120 cm)]	1,472	1,027	1,729
Groundnut - Castor (3:1) [Groundnut (45 cm) + Castor (180 cm × 120 cm)]	1,425	989	1,613
Groundnut - Castor (4:1) [Groundnut (30 cm) + Castor (180 cm × 120 cm)]	1,668	1,185	1,827

Table 2. Effect of relay intercropping of castor with groundnut on yield attributes and yield of castor (pooled results)

Treatment	Capsule/primary spike	Length of primary spike (cm)	Seed yield (kg/ha)	Stalk yield (kg/ha)
Sole castor (150 cm × 120 cm)	66.72	61.38	3378	1864
Sole groundnut (45 cm)	-	-	-	-
Groundnut + Castor (3:1) [Groundnut (30 cm) + Castor (150 cm × 120 cm)]	59.13	55.95	3,026	1,709
Groundnut + Castor (3:1) [Groundnut (45 cm) + Castor (180 cm × 120 cm)]	61.78	55.57	2,716	1,527
Groundnut + Castor (4:1) [Groundnut (30 cm) + Castor (180 cm × 120 cm)]	61.43	57.95	2,742	1,544

University, Sardarkrushinagar to study the feasibility of castor as relay intercropping in *kharif* groundnut during 2019–20 to 2021–22. The seasonal rainfall received was 861.1 mm, 1255.5 mm and 487 mm in 44, 39 and 21 rainy days during *kharif* season of 2019-20 and 2020-21, respectively. The experiment was laid out in randomized block design with three replications. There were total five treatments taken for the study viz Sole castor sole at 150 cm × 120 cm spacing, Sole groundnut at 45 cm spacing, Groundnut + Castor (3:1) [Groundnut (30 cm) + Castor (150 cm × 120 cm)], Groundnut + Castor (3:1) [Groundnut (45 cm) + Castor (180 cm × 120 cm)] and Groundnut + Castor (4:1) [Groundnut (30 cm)+Castor (180 cm × 120 cm)]. Normal crop husbandry practices were followed for the successful raising of the crops. Groundnut equivalent yield (GEY) was calculated in terms of groundnut yield of all intercropping treatments on the basis of prevailing market prices (₹/kg). It was calculated using formula suggested by Lal and Ray (1976). Groundnut Equivalent Yield (kg/ha) = [Seed yield of castor (kg/ha) × Price of castor (₹/kg) / Price of groundnut (₹/kg)] + Seed yield of groundnut (kg/ha). The statistical analysis of data of various characters studied in the investigation was done using analysis of variance techniques as suggested by Panse and Sukhatme (1985). The critical differences for comparing treatment means were worked out at 5% level of significance.

RESULTS

Yield of groundnut

Groundnut pod yield (2,076 kg/ha) was found maxi-

mum with sole groundnut which was followed by groundnut + castor (4:1) [Groundnut (30 cm) + castor (180 cm × 120 cm) cropping system (Table 1). Groundnut kernel yield (1,468 kg/ha) was also found maximum with sole groundnut followed by groundnut + castor (4:1) [Groundnut (30 cm) + castor (180 cm × 120 cm)]. Growing groundnut at 45 cm spacing gave maximum groundnut haulm yield (2105 kg/ha) which was followed by groundnut - castor (4:1) [Groundnut (30 cm) + Castor (180 cm × 120 cm)]. A reduction in pod yield of groundnut was observed under relay intercropping treatments. The reduction in pod yield of groundnut in the relay intercropping system was mainly due to reduction in plant stand of groundnut in different relay intercropping treatments as replacement type of relay intercropping system was followed in the present study. Minimum reduction in pod yield of groundnut was observed with Groundnut + Castor (4:1) [Groundnut (30 cm) + Castor (180 cm × 120 cm)] because in this systems groundnut plant population was maximum as compared to other relay intercropping systems.

Yield attributes and yield of castor

Maximum number of capsule per primary spike (66.72) and length of primary spike (61.38 cm) were recorded in sole castor as compared to relay intercropping system. Castor seed yield (3378 kg/ha) was found maximum with sole castor at 150 cm × 120 cm spacing which was followed by groundnut + castor (3:1) [Groundnut (30 cm) + castor (150 cm × 120 cm)] (3,026 kg/ha). Sole castor gave higher castor stalk yield (1864 kg/ha)

Table 3. Effect of relay intercropping of castor on groundnut equivalent yield

Treatment	Groundnut Equivalent yield			
	2019–20	2020–21	2021–22	Pooled
T ₁ , Castor sole: 150 cm × 120 cm	3,307	4,443	3,305	3,685
T ₂ , Groundnut : 45 cm	2,077	2,176	1,976	2,076
T ₃ , Groundnut + Castor (3:1) [Groundnut (30 cm) + Castor (150 cm × 120 cm)]	4,636	5,309	4,374	4,773
T ₄ , Groundnut + Castor (3:1) [Groundnut (45 cm) + Castor (180 cm × 120 cm)]	4,277	4,727	4,162	4,389
T ₅ , Groundnut + Castor (4:1) [Groundnut (30 cm) + Castor (180 cm × 120 cm)]	4,540	4,958	4,479	4,659
SEm±	142	201	219	114
CD (P=0.05)	439	621	674	324
Y × T	-	-	-	NS
CV	7.6	9.3	12.0	9.7

* Selling price of year 2022 was considered for calculation of equivalent yield of all the years

Table 4. Economics of relay intercropping of castor in *kharif* groundnut

Treatment	System gross returns (₹/ha)	System cost of cultivation (₹/ha)	System Net returns (₹/ha)	Benefit cost ratio
Castor sole 150 cm × 120 cm	202,675	71,295	131,380	2.8
Groundnut 45 cm	114,180	48,751	65,429	2.3
Groundnut + Castor (3:1) [Groundnut (30 cm) + Castor (150 cm × 120 cm)]	262,515	103,352	159,163	2.5
Groundnut + Castor (3:1) [Groundnut (45 cm) + Castor (180 cm × 120 cm)]	241,395	100,420	140,975	2.4
T ₅ , Groundnut + Castor (4:1) [Groundnut (30 cm) + Castor (180 cm × 120 cm)]	256,245	106,010	150,235	2.4

followed by groundnut + Castor (3:1) [Groundnut (30 cm) + Castor (150 cm × 120 cm)] (1709 kg/ha). A reduction in seed yield of castor was observed under relay intercropping treatments. The reduction in seed yield of castor, in the relay intercropping system was mainly due to reduction in plant stand of castor and competition with groundnut at initial stage. Similar results were also observed by Mohsin *et al.* (2018).

Groundnut equivalent yield

Significantly higher groundnut equivalent yield (4479 kg/ha) was found with groundnut + castor (4:1) [groundnut (30 cm) + castor (180 cm × 120 cm)] relay intercropping which was at par with groundnut + castor (3:1) [groundnut (30 cm) + castor (150 cm × 120 cm)]. This is due to higher yield of castor and groundnut in the both the relay intercropping system and thereby effective utilization of the resources. Similar findings have been reported by Prasad *et al.* (2007) and Mohsin *et al.* (2018).

Economics

Maximum net realization of ₹ 159163 was obtained under the relay intercropping of groundnut + castor (4:1) [groundnut (30 cm) + castor (180 cm × 120 cm)] closely

followed by groundnut + Castor (3:1) [Groundnut (30 cm) + Castor (150 cm × 120 cm)] relay intercropping (Rs 150,235). This could be due to higher yield of groundnut and castor in both the relay intercropping systems as compared to other systems. Similar results reported by Chandrika *et al.* (2001).

Thus, it can be concluded that groundnut crop should be grown at 30 cm spacing with relay cropping of castor at 150 cm × 120 cm (3:1) or 180 cm × 120 cm (4:1) for getting higher system yield and net profit per unit of cultivated land and time.

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