

Original Research Article

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Effect of Millets Intercropping Systems on Pest Incidence and Sustained Productivity of Castor (*Ricinus communis* L.)

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ABSTRACT

A field experiment was conducted during *kharif* season of 2017-18 at College of Agriculture, Vijayapura, in medium black soils to study the performance of castor (*Ricinus communis* L.) based millets intercropping systems under rainfed condition. The experiment was laid out in Randomized block design. The results indicated that sole castor recorded significantly higher seed yield (2416 kg ha⁻¹) and higher number of capsules per plant and capsule weight per plant (293.25 plant⁻¹) than the other intercropped castor and lower capsules per plant (143.84 plant⁻¹) was recorded in castor intercropped with pearl millet in 1:2 row proportion. Among intercrops sole foxtail millet recorded higher number of productive tillers (63.00). At harvest higher total dry matter accumulation was recorded in sole castor (379.41 g plant⁻¹) and among intercrops sole pearl millet recorded higher total dry matter production (57.16 g plant⁻¹). Among different intercropping systems the incidence of semilooper and percent capsule borer were found to be lower in castor + foxtail millet (9.66 larvae plant⁻¹ and 8.79 %, respectively) in 1:2 row proportion while, sole castor recorded higher incidence of semilooper and capsule borer damage (14.23 larvae plant⁻¹ and 16.84 %), similarly castor + little millet (1:2) recorded higher castor equivalent yield (3325 kg ha⁻¹) and higher net returns (78,720 Rs ha⁻¹).

Keywords

Castor, Millets,
Semilooper,
Capsule borer,
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Introduction

Intercropping of different cereals, millets, pulses and oilseed crops simultaneously on the same piece of land with or without any row proportion will minimize the risk of crop failures, acts as barrier for pests, builds soil fertility and makes the farmer self-sufficient. It is often stated that pests will be less

damaging in fields with a mixture of crops than in fields with a single sole crop, also known as monocultures. Castor is an important oil seed crop and millets are known as famine reserves as they can come up well in low moisture conditions. They are highly nutritive and are having short duration, to make better utilization of resources and space millets are well suited for intercropping

systems. There is little scope to bring additional area under these crops due to stiff competition from major cereals and other commercial crops. Thus, in absence of possibilities for horizontal expansion, the vertical expansion of castor yield through intercropping with millets offering varying competition in space and time enhances the productivity.

The castor, *Ricinus communis* L., is a species of perennial flowering plant in the spurge family, Euphorbiaceae.. Castor is indigenous to the south eastern Mediterranean Basin Eastern Africa and India but, it is widespread throughout tropical regions. Castor seed is the source of castor oil which has a wide variety of uses. The seeds contain between 40 to 60 per cent oil that is rich in triglycerides mainly ricinolein. The seed also contains ricin, a water-soluble toxin, which is also present in lower concentrations throughout the plant. In the world, castor is cultivated around 1.26 m ha with a production of 1.78 mt with average productivity 1414 kg ha⁻¹ (FAOSTAT, 2016). In India castor is cultivated around 0.87 m ha with a production of 1.55 mt with average productivity 1786 kg ha⁻¹ (FAOSTAT, 2016) and Gujarat accounts 73 per cent of production and 56 per cent total area of the country. In Karnataka, castor crop is cultivated around 0.16 lakh hectare with a production of 0.14 lakh tonnes with a productivity of 926 kg ha⁻¹ (Anon., 2016).

Similarly, intercropping of millets with castor delayed the succession of almost all the major pests. Intercropping leads to higher yields and increase the economic returns and greater crop equivalent yield as compared to sole cropping.

Materials and Methods

Field experiment was conducted during the rainy season (*khariif* -2017-18) at the Agricultural College, Vijayapura, Karnataka

on Vertisol having pH 7.55 and EC 0.4 dS m⁻¹. The soil was medium in organic carbon content (0.53 %) and available P₂O₅ (25.60 kg ha⁻¹) and low in available N (215.00 kg ha⁻¹) with available K content (384.00) and clay content (47.20).

The experimental site was located at a latitude of 16° 55' North, longitude of 75° 58' East and an altitude of 444.39 meters above mean sea level. The experimental site comes under the Northern Dry Zone of Karnataka (Zone 3)

There were eleven treatments as detailed in Table 1 i.e. intercropping of castor with pearl millet, finger millet, foxtail millet, little millet and proso millet in 1:2 proportion and six sole crops and their duration (castor 48-1 and 180 days), pearl millet (ICMV-221 and 90 days), finger millet (DHFMV-78-3 and 110-115 days), foxtail millet (DHFT-109-3 and 80 days), little millet (DHLM-36-3 and 75-80 days) and proso millet (DHP-2769 and 70 days).

The experiment was laid out in randomized complete block design with three replications in plot size of 9 m x 6 m.

Both the component crops were planted simultaneously and recommended dose of fertilizers were applied to all crops as per the recommended package of the region.

In intercropping system, the component crops received fertilizers in proportionate to their plant density at the time of sowing in the form of urea, DAP and muriate of potash.

The crops were sown as per the row proportions in intercropping systems and as well as their sole during the period of I fortnight (FN) of July i.e on 11th July 2017 during *khariif* 2017 when field was attained optimum moisture conditions and total rainfall received during cropping season was 590.3

mm i.e in July, August, September, October, November, December and January (74.0 mm, 161.0 mm, 188.3 mm, 148.8 mm, 0.0 mm, 18.2 mm and 0.0 mm respectively). The growth and yield observations were recorded from the net plot size and grain yield of various crops were converted to hectare basis in kilograms. The economics of each system was computed with prevailing market prices of that year.

Results and Discussion

Effect of intercropping on insect pest incidence

The data presented in Table 1, revealed that, among the various intercropping systems tried with castor at 1:2 row proportions. Significantly lower semilooper incidence was noticed at 60, 75 and 90 days after sowing (8.80, 12.33 and 7.86 larvae plant⁻¹, respectively) and capsule borer incidence (8.79 %) were found in castor + foxtail millet compared to sole castor and other intercropping systems while, sole castor recorded significantly higher incidence of semilooper (16.53, 18.78 and 11.93 larvae plant⁻¹, respectively) and percent capsule borer damage (16.84).

This might be due to pest migration after initial establishment was possibly inhibited by non host plants act as a physical barrier to inter or intra row migration within intercropping treatments as a result of finding difficulties of host experienced in castor intercropped with millets grown in 1:2 row ratio. Similar results were reported in castor + cluster bean (Rao *et al.*, 2012) system.

Castor + pigeonpea intercropping system (Chand and Sujatha, 2000). Similarly in chickpea significantly lower pod damage was recorded in chickpea + sunflower in (5:1) intercropping system (19.50 %) compared to sole chickpea (Pattar *et al.*, 2012)

Effect of intercropping on growth parameters, yield parameters and net returns of intercropping system

The data presented in Table 2 revealed that, among the various intercropping systems tried with castor at 1:2 row proportions, castor recorded higher total dry matter production in sole castor (379.41 g plant⁻¹) when compared with rest of the intercropping systems and lowest was recorded in castor + pearl millet (203.52 g plant⁻¹) in 1:2 row proportion and among intercrops sole pearl millet recorded higher dry matter (57.16 g plant⁻¹).

This might be due to competition for growth resources between two crops at initial stage led to competition for moisture and nutrients favoured better availability of moisture and nutrients for both the crops in a system. The results are in conformity with the findings of Veeranna (2003). Similar results were recorded in castor intercropped with mungbean reported by Kumawat and Adreshna (2014) and koli *et al.*, (2004).

Higher number of productive tillers was noticed in sole millets compared to intercrops. Among different crops foxtail millet recorded higher number of productive tillers both in sole and intercropping condition (63.00 and 57.67 tillers plant⁻¹). This was mainly due to good rainfall distribution and better utilization of resources in sole crop when compared to intercropping systems (Triveni *et al.*, 2017).

Among the various intercropping systems tried with castor at 1:2 row proportions, castor recorded higher yield (2283 kg ha⁻¹) with little millet, when compared with rest of the intercropping systems this might be due to least competition for growth resources between two crops at initial stage led to no competition for moisture and nutrients favoured better availability of moisture and nutrients for both the crops in a system.

Table.1 Incidence of semilooper and capsule borer damage in castor as influenced by various intercropping system (1:2)

Treatments	Semilooper incidence (number of larvae plant ⁻¹)				Capsule borer incidence (%)
	60 DAS	75 DAS	90 DAS	Average	
T₁ –Castor + Pearl millet (1:2)	13.07 (3.68)*	15.95 (4.05)*	9.90 (3.23)*	12.97	13.88 (21.10)**
T₂ - Castor + Finger millet (1:2)	12.46 (3.60)*	15.07 (3.94)*	9.20 (3.11)*	12.24	11.36 (20.47)**
T₃ - Castor + Foxtail millet (1:2)	8.80 (3.05)*	12.33 (3.58)*	7.86 (2.89)*	9.66	8.79 (18.10)**
T₄ - Castor + Little millet (1:2)	10.27 (3.28)*	13.86 (3.79)*	8.93 (3.07)*	11.02	9.25 (19.38)**
T₅ - Castor + Proso millet (1:2)	11.23 (3.43)*	14.30 (3.85)*	9.03 (3.09)*	11.52	9.44 (19.83)**
T₆ -Sole Castor	16.53 (4.13)*	18.78 (4.39)*	11.93 (3.52)*	14.23	16.84 (23.37)**
T₇ -Sole Pearl millet	-	-	-	-	-
T₈ -Sole Finger millet	-	-	-	-	-
T₉ -Sole Foxtail millet	-	-	-	-	-
T₁₀ -Sole Little millet	-	-	-	-	-
T₁₁ -Sole Proso millet	-	-	-	-	-
S.Em ±	0.27	0.42	0.33		0.44
C.D. (5%)	0.81	1.24	0.98		1.30

* - Angular transformed values

Table.2 Growth parameters, yield parameters and net returns of castor based millets intercropping systems

Treatments	Total dry matter accumulation at harvest (g plant ⁻¹)		Number of productive tillers at harvest	Number of capsules per plant	Yield (kg ha ⁻¹)		Castor equivalent yield (CEY)	Net returns (Rs ha ⁻¹)
	Castor	millets			Castor	Intercrop		
T₁ –Castor + Pearl millet (1:2)	203.52	49.33	37.00	143.84	1454	1273	2003	39742
T₂ - Castor + Finger millet (1:2)	231.10	17.00	46.67	158.00	1705	1386	2696	55328
T₃ - Castor + Foxtail millet (1:2)	276.64	16.93	57.67	223.60	1923	1730	3159	73134
T₄ - Castor + Little millet (1:2)	334.48	16.35	56.67	263.94	2283	1458	3325	78720
T₅ - Castor + Proso millet (1:2)	302.61	12.07	50.00	231.40	2112	1400	3112	71259
T₆ -Sole Castor	379.41	-	-	293.25	2416	-	2416	49726
T₇ -Sole Pearl millet	-	57.16	39.00	-	-	1659	711	9237
T₈ -Sole Finger millet	-	18.55	47.67	-	-	2082	1487	18790
T₉ -Sole Foxtail millet	-	17.59	63.00	-	-	2431	1736	30893
T₁₀ -Sole Little millet	-	17.13	61.00	-	-	2293	1638	27443
T₁₁ -Sole Proso millet	-	13.88	51.67	-	-	2068	1477	22394
S.Em ±	5.71			7.07	54		72	2409
C.D. (5%)	16.85			20.86	158		212	7108

The seed yield of sole castor (2416 kg ha⁻¹) was higher than that of the castor in rest of the intercropping systems. This might be due to fact that component crop compete for all growth resources both on above and below ground. Among the intercrops foxtail millet, recorded higher grain yield (1730 kg ha⁻¹) as compared to other millets. Among millets sole foxtail millet recorded higher grain yield (2431 kg ha⁻¹).

The results are in conformity with the findings in castor based intercropping systems (Guggari and Kalaghatagi, 2010) and also with the findings of Ramachadrappa *et al.*, (2016)

The castor equivalent yield (CEY) and land equivalent ratio (LER) differed significantly due to intercropping treatments. The data indicated that, significantly higher castor equivalent yield (3325 kg ha⁻¹) was obtained with castor + little millet which was on par with castor + foxtail millet (3159 kg ha⁻¹). The higher castor equivalent yield was due to higher additional grain yield from little millet. The results are in conformity with findings of Thanunathan *et al.*, (2006).

Significantly higher net returns was found in castor + little millet (78,720 Rs ha⁻¹) compared to sole castor and other intercropping systems which was on par with castor + foxtail millet (73,134 Rs ha⁻¹) in 1:2 row proportion this might be due to higher yield in castor intercropped with little millet and foxtail millet led to higher net returns and B:C. These results are in confirmatory with castor + green gram intercropping system (Mudalagiriappa *et al.*, 2011) and in pigeonpea + soybean intercropping system by Halvankar *et al.*, 2000.

From the above study it can be concluded that among various intercropping system both semilooper incidence and percent capsule

borer damage was found lowest in castor + foxtail millet (9.66 larvae plant⁻¹ and 8.79, respectively) and highest in sole castor (14.23 larvae plant⁻¹ and 16.84 %). Growing of castor with little millet at 1:2 row proportion recorded higher castor equivalent yield (3325 kg/ ha) compared to sole castor seed (2416 kg/ ha). Castor + little millet intercropping system is more remunerative over sole cropping. Therefore we conclude that castor + little millet (1:2) intercropping system for northern dry zone of Karnataka under rainfed condition.

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