Studies on castor and nutricereals based intercropping systems onyield and oil contentof castor

ABSTRACT

Field experiment was conducted during *summer* season, 2022 at Tamil Nadu Agricultural University, Coimbatore to study the castor and nutricereals based intercropping systems on yield and oil content of castor. The experiment was laid out in Randomize Block Design (RBD) comprises of thirteen treatments and three replications.The experiment result revealed that nutri cereals intercropping system and spacing between the castor row have no significant difference on the oil content of the castor. The highest castor seed yield (2098 kg ha^{-1}) was recorded in sole castor (T_9) which was found on par with paired row castor + proso millet (2:4) and paired row castor + foxtail millet (2:4) (2003 and 1914 kg ha^{-1}respectively). Highest castor equivalent yield (2647 kg ha^{-1}) was recorded in paired row castor + foxtail millet (2:4) (T_5) and it was on par with paired row castor + proso millet (2:4) (2604 kg ha^{-1}) which was higher than sole castor (2098 kg ha^{-1}).

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Comment [Jc2]: Add conclusion

Keywords: Castor, nutri cereals, yield, oil content

1. INTRODUCTION

Castor (*Ricinus communis L.*) is an indeterminate and non-edible oilseed crop. It belongs to the family *Euphorbiaceae*. It is native to Eastern Africa and originated in Ethiopia. Cultivated in low rainfall regions (drought tolerant) of the semi-arid region of India. India is the largest producer of castor in the world. Castor seeds contain 50-55 percent oil and are the world's second-largest source of non-edible oil. Castor oil is mainly used for the manufacture of wide range of ever-expanding industrial products such as nylon fibres, jet engine lubricants, hydraulic fluids, cosmetics, pharmaceuticals. Castor oil is a good choice for converting oil in to bio-diesel.Gangadhar et al. [2] found that castor cake provides highly concentrated organic manure with 4.5, 2.6 and 1.2 percent of nitrogen, phosphorous and potash, respectively and it also offers 22.37 per cent protein and 45-46 percent of carbohydrates.However, castor is a long-term, widely spaced crop with a comparatively thin population of plants, providing scope for intercropping with quick growing and short duration food grain (cereals), pulses and oilseed crops in appropriate geometryto increase the growth, yield attributes and yield per unit area. Willey [13] reported that advantage of intercropping in castor can be increased by reorienting crop geometry for better availability of solar energy and putting suitable intercrops.

Small millets are the age old crops cultivated in marginal and sub marginal lands for both food and fodder purpose. Small millets are drought tolerant crop, water requirement is very meager compared to other crops with high nutritional benefits and less susceptible to pests and diseases. Due to its wider adaptability it can be grown under varied climatic conditions. Himasreeet al. [3]found that sustainable yields can be expected from the crop even under adverse conditions and are popularly known as climate resilient crops. Traditional field crops in India, millets are often referred to as "nutri cereals" due to their abundance in micronutrients, minerals, and vitamin B-Complex. Since these millets have a low glycaemic index and are also referred to as "wonder grains," consumption of them has showed good health effects among diabetes patients. According to Vinay et al. [12] due to their innate ability to mature early, higher yield due to the C4 mechanism, ability to produce superior yields even on infertile soil under inadequate management and low, irregular rainfall conditions, they have attracted a lot of attention in recent. As a result, in Indian agriculture, they are also referred to as "climate resilient" crops.

Intercropping systems involve two or more crop species or genotypes growing together and coexisting for a time. According to Li et al.[5] this latter criterion distinguishes intercropping from mixed monocropping and rotation cropping. Under these circumstances, intercropping can support increased aggregate yields per unit input, insure against crop failure and market fluctuations, meet food preference and cultural demands, protect and improve soil quality and increase income as reported by Rusinamhodzi et al.[8].Various nutri cereals were investigated as intercrops between castor rows with sufficient space between them. With this view, the field studywas taken to evaluate the impact of various nutri cereals intercropping on yield and oil content of castor.

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2. MATERIAL AND METHODS

Field experiment was conducted at Eastern block farm of Tamil Nadu Agricultural University, Coimbatore during *summe*r season, 2022. The experimental farm is situated at 11°N latitude and 76°E longitude and at an altitude of 426.7 m above the mean sea level (MSL). The soil texture was sandy clay loam with pH of 7.9 and electrical conductivity (EC) 0.22 dSm^{-1}. The organic carbon content was high (0.49 %) and the nutrient status of soil was observed with low range of available nitrogen (174 kg ha^{-1}),medium range of available phosphorus (22.3 kg ha^{-1}) and high range of available potassium (800 kg ha^{-1}).The study was conducted in Randomized Complete Block design with three replications with the plot size (6 x 5) meter. In three replications, a total of thirteen treatments were used and they are as follows T_1 - castor + foxtail millet (1:3), T_2 - castor + proso millet (1:3), T_3 - castor + little millet (1:3), T_4 - castor + kodo millet (1:3), T_5 - paired row castor + foxtail millet (2:4), T_6 - paired row castor + proso millet (2:4), T_7 - paired row castor + little millet (2:4), T_8 - paired row castor + kodo millet (2:4), T_9 - sole castor, T_{10} - sole foxtail millet, T_{11} - sole proso millet, T_{12} - sole little millet, T_{13} - sole kodo millet. Castor hybrid YRCH1 and nutri cereals foxtail millet (ATL1), proso millet (ATL1), little millet (ATL1) and kodo millet (ATL1) were taken. After harvesting, harvest index, castor equivalent yield, oil content and oil yield was calculated using formula given below:

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$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

$$\text{Oil content (\%)} = \frac{(\text{Weight of sample before extraction} - \text{weight of sample after extraction})}{\text{Weight of sample before extraction}} \times 100$$

3. RESULT AND DISCUSSION

3.1. Effect of intercropping systems on castor yield

The findings indicated that the mean seed yield of sole castor (T_9) (2098 kg ha^{-1}) was higher than that in the rest of intercropping systems presented in Table 1. Next best treatment for castor seed yield was paired row castor + proso millet (2:4) (2003 kg ha^{-1}) followed by paired row castor + foxtail millet (2:4) (1914 kg ha^{-1}) presented in Fig.1. This was primarily caused by a significant increase in yield components, such as the number of spike plant^{-1}, the number of capsule plant^{-1} and the length of the primary spike, as a result of improved light distribution up to lower leaves, adequate soil moisture availability and higher nutrient uptake in paired row systems. This increased photosynthetic rate led to an increase in sink size, which in turn had an impact on crop yield. These results were consistent with those of Singh and Singh [11], who found that planting maize in paired rows (30/90 cm) with soybean greatly increased the grain output. Comparable result was found in castor that seed yield of sole castor was higher than intercropping system and this was on par with paired row system of castor + cluster bean and castor + groundnut with ratio of 2:4 as reported by Nanjappaet al. [6].

Seed and stalk yield of castor were reduced in intercropping system of 1:3 ratio than sole and paired row system of castor (2:4). Among the different 1:3 ratio intercrops, castor + proso millet 1:3 ratio (T_2) produced more castor seed yield and was on par with castor + foxtail millet 1:3 ratio (T_1). Due to the absence of competition and the fact that proso millet appears to be less detrimental for castor, higher LAI, length of the primary spike, number of spike per plants, number of capsules per spike. This might be as a result of its short lifespan and the fact that their growth phases did not coincide. These results were consistent with Dhimmar [1].

According to the data**,** the sole castor treatment (T_9) recorded a considerably higher stalk yield than other treatments. The stalk yield likewise exhibited the same pattern as the seed yield. This might be because there was no competition for non-renewable resources in lone castor, which performed on par with paired row castor in terms of space, water, nutrients and incoming solar radiation. The result is similar with findings of Hooda et al.[4].Foxtail millet and proso millet intercropped with castor at 1:3 ratio and paired row castor + foxtail millet observed higher percentage of harvest index (30%), this might be increased economic yield.

The data indicated that different treatments in experiment significantly influenced the castor equivalent yieldas presented in Table 1. Highest castor equivalent yield was recorded (2647 kg ha^{-1}) in paired row castor foxtail millet (2:4) (T_5) and it was on par with paired row castor + proso millet (2:4) (2604 kg ha^{-1}) which was higher than sole castor (2098 kg ha^{-1}) captivatingly, the intercropping ratio of 1:3 castor + proso millet (2495 kg ha^{-1}) was statistically on par with castor + foxtail millet (1:3) (2478 kg ha^{-1}).The least castor equivalent yield was recorded in paired row castor + kodo millet (1719 kg ha^{-1}) (T_8) with 2:4 row proportions.

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3.2. Effect of intercropping systems on oil content (%) and oil yield (Kg ha^{-1})

The evidence showed that the oil content of castor had no significant relationship to the different intercropping systems presented in Table 2. These results are consistent with Patel et al.[7]. Highest oil yield was recorded in sole castor (T_9) followed by paired row castor + proso millet (T_6) (2:4) and paired row castor + foxtail millet (T_5) (2:4) due to higher seed yield of castor as compared to other intercropping system. Similar results were found in findings of Yadav et al. [14] reported that slightly higher oil content was seen when castor was cultivated as the sole crop as compared to other intercropping systems. Castor produced in an intercropping system may have less oil because to increased competition from intercrops for scarce natural resources such space, plant nutrients, moisture and solar radiation. Similar findings were reported by Singh [9] and Singh et al.[10].

4. CONCLUSION

Among the nutri cereal intercropping system sole castor recorded maximum seed yield (2098 kg ha^{-1}) and this was on par with paired row castor + proso millet (2003 kg ha^{-1}) and paired row castor + foxtail millet (1914 kg ha^{-1}). Higher castor equivalent yield was recorded in paired row castor + foxtail millet (2:4) and it was on par with castor + proso millet (2:4) grown under paired row system. It was concluded that castor in paired row system with foxtail millet or proso millet was found to be more profitable intercropping system in Tamil Nadu.

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Table1.Effect of intercropping on seed yield, stalk yield and harvest index of castor and Castor Equivalent Yield

Tr No.	Treatment	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Harvest index (%)	Castor Equivalent Yield (kg ha^{-1})
T_1	Castor + foxtail millet (1:3)	1728	4110	30	2478
T_2	Castor + proso millet (1:3)	1818	4285	30	2495
T_3	Castor + little millet (1:3)	1633	4102	28	2025
T_4	Castor + kodo millet (1:3)	1240	3850	24	1780
T_5	Paired row castor + foxtail millet (2:4)	1914	4557	30	2647
T_6	Paired row castor + proso millet (2:4)	2003	5041	28	2604
T_7	Paired row castor + little millet (2:4)	1612	4102	28	2032
T_8	Paired row castor + kodo millet (2:4)	1165	3574	25	1719
T_9	Sole castor	2098	5204	29	2098
	SE.d	**98.19**	**239.9**	**0.22**	**106.12**
	CD(P=0.05)	**208.15**	**508.58**	**0.48**	**224.10**

Table 2. Effect of intercropping on oil content (%) and oil yield (kg ha^{-1}) of castor

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Tr No.	**Treatment**	**Oil content (%)**	**Oil yield (kg ha^{-1})**
T_1	Castor + foxtail millet (1:3)	46.7	809
T_2	Castor + proso millet (1:3)	47.3	862
T_3	Castor + little millet (1:3)	46.5	761
T_4	Castor + kodo millet (1:3)	45.6	669
T_5	Paired row castor + foxtail millet (2:4)	47.6	912
T_6	Paired row castor + proso millet (2:4)	47.8	959
T_7	Paired row castor + little millet (2:4)	46.1	743
T_8	Paired row castor + kodo millet (2:4)	43.7	599

Comment [Jc7]: Confirm values

T_9	sole castor	48.8	1026
	SE.d	**2.54**	**90**
	CD(P=0.05)	**NS**	**191**

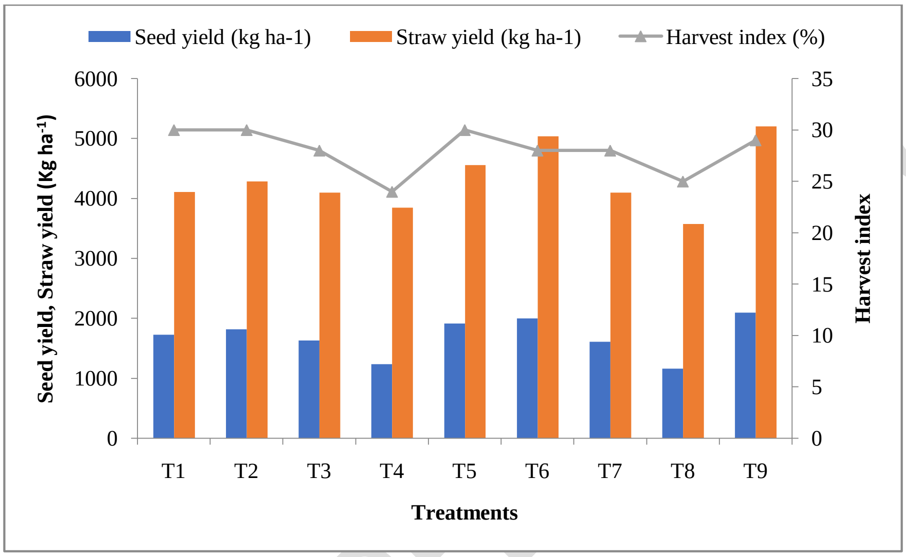

Fig.1. Effect of intercropping on seed, stalk yield (Kg ha^{-1}) and harvest index (%)