Effect ofmillet based intercropping systems ongrowth and productivity of castor under irrigated condition

ABSTRACT

Aims: Nutri cereals are said to as famine reserves because they can grow well in low moisture conditions and castor is a significant oil seed crop. Both are used as intercrop due to increased inter and intra row spacing of castor,milletsare perfectly suited for intercropping with castor.
Study Design: The experiment was conducted in a Randomized block design (RBD) with ninetreatments and three replications.
Place and Duration of Study: Tamil Nadu Agricultural University, Coimbatore during *summer*season of 2022.
Methodology: The major objective is to study the effect of millet based intercropping systems on growth and productivity of castor under irrigated situation.The experimental details *viz*; 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.
Results: According to the findings of the study, highest growth parameters, yield attributes and castor seed yield were recorded in sole castor and it was on par with nutri cereal intercropping systems, paired row castor + proso millet and paired row castor + foxtail millet systems.
Conclusion: Proso millet and foxtail millet were indentified to be compatible intercrops with castor for improved productivity.

Keywords: Castor, nutri cereals, growth, seed yield

1. INTRODUCTION

Castor is a non-edible oilseed crop in India with significant industrial and commercial value. India is the world's largest producer of castor with 7.7 lakh tonnes produced from 7.86 lakh hectares, with 68 and 76 per cent share in the castor area and output and generates overrupees 4000 crores in export revenue each year. India outperforms the global average for castor productivity followed by other big producers like China and Brazil. It contains 85–90% naturally occurring ricinoleic acid, castor oil is significant economically. In India castor is cultivated in an area of 887.50 (‘000 hectares) with a production of 1646.96 (‘000 tonne) and productivity of 1856 kg ha^{-1}whereas in Tamil Nadu it is cultivated in an area of 5.7 (In ‘000 hectares) with a production and productivity of 1.80 (‘000 tonnes) and 312 kg ha^{-1} respectively [1].Due to its strong root structure, it thrives well in dry conditions as well as with minimal irrigation. Now a days cultivation of castor is currently growing in popularity due to its strong export potential and medical benefits. It is an indeterminate and non-edible oil seed crop grown under low rainfall conditions of semi-arid regions of India.

Consumption of minor millets has showed good health effects among diabetes patients. Intercropping has been recognised as a type of biological insurance against dangers in areas with abnormal rainfall patterns [2]. Castor is grown as a mixed or intercrop and as a solitary crop. Because the inter- and intra-row spacing is larger, it is perfect for intercropping systems. Hence, the present study was undertaken to identify the best nutri cereals intercropping systems to increase production.

2. MATERIAL AND METHODS

2.1 Site Selection

The field experiment was conducted during summer 2022, in Field No. 36 A at Eastern Block Farm, Tamil Nadu Agricultural University, Coimbatore. The experimental field is located in Western Agro Climatic Zone of Tamil Nadu with the geo-ordinates of 11°N latitude, 76°E longitude and at an altitude of 427 m above the mean sea level (MSL). The maximum and minimum temperatures recorded were 32.9^{o}C and 22.6^{o}C, respectively. The relative humidity was 82.7% in the forenoon (07:22 hrs.) and 47.2% in the afternoon (14:22 hrs.). The rainfall of 3.5 mm was received during crop growth period and it was widely distributed over 2 rainy days. The bright sunshine of 6.9 hours day^{-1} and the mean solar radiation of 355.7 cal cm^{-2} day^{-1} were recorded. The wind speed of 5.8 km hr^{-1}.The soil texture was sandy clay loam 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}).

2.2 Experimental Description

TNAU Castor hybrid YRCH 1 was selected for the experiment. The hybrid castor YRCH 1 was sown at the depth of 4-6 cm with the seed rate of 5 kg ha^{-1} with spacing for intercropping (150 x 120 cm) and for paired row spacing was carried out of about 90 x 120 cm. Three rows of nutri cereals were sown in between two rows of castor (1:3). Four rows of nutri cereals were sown in between two paired rows of castor (2:4). As per the blanket recommendation, 196:281:75 NPK kg ha^{-1} were supplied through urea, single super phosphate and muriate of potash. In irrigated situations apply 100% P and 50% N and K as basal and remaining quantity of N and K may be applied in two equal splits at 30th and 60th DAS. $ZnSO_4$was applied @ 12.5 kg ha^{-1}. The study was conducted in Randomized Complete Block design with following treatments *viz*., 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. Observations on growth parameters *viz*., plant height (cm), number of effective branches plant^{-1}, stem girth (cm), dry matter production (kg ha^{-1}) and yield attributes *viz*.,number of spike plant^{-1}**,** length of primary spike (cm), number of capsule spike^{-1},100 seed weight (g) and seed yield(kg ha^{-1}) were recorded. Five plants were randomly selected in each treatment plot. The data required for all analysis were collected and analysed statistically under the randomised block design as suggested by [3]. If the treatment differences were found to be significant, then the critical difference (CD) was worked out at 5% probability level (P=0.05). If no significant differences observed between any treatments, then it was considered as non-significant and indicated as NS.

3. RESULT AND DISCUSSION

3.1 Growth parameters

Experimental results revealed that the growth and development showed significant improvement in growth parameters such as plant height, number of branches plant^{-1}, stem girth and dry matter production which are direct indices to measure plant growth and vigour. All the growth components were influenced due to different intercropping systems at harvest stage of castor (Table 1).At harvest sole castor recorded highest plant height (175.36 cm), which was on par with paired row castor + proso millet (2:4) (170.20 cm) and was followed by paired row castor + foxtail millet (2:4) (155.61 cm). The reason behind this was wider spacing leads to taller plants. These results are consistent with those of [4] and [5]. Among the treatments, sole castor recorded more number of branches plant^{-1} (9.20) and stem girth (9.50 cm) at harvest and was followed by paired row castor + proso millet (2:4), paired row castor + foxtail millet (2:4). A crop's biological and economic yield directly correlates with the number of branches per plant. Having more branches means producing a higher yield, hence branches per plant are an important characteristic [6].Sole castor recorded higher dry matter production (3545 kg ha^{-1}) which was closely followed by paired row castor + proso millet (2:4) (2983 kg ha $^{-1}$) and paired row castor + foxtail millet (2:4) (2925 kg ha^{-1}). Paired row castor with kodo millet (2:4) had most competitive effect for least DMP of 2050 kg ha^{-1}. Similarly castor + kodo millet (1:3) also showed inhibitive effect among all. The higher DMP under paired row sowing may be attributable to the higher leaf area index, which received more photosynthetically active radiation, leading to an increase in photosynthetic efficiency. In addition, paired row sowing was associated with higher nutrient uptake than regular row sowing [7] and [8].

3.2 Yield attributes and yield

Sole castor recorded significantly a greater number of spike plant^{-1} (28.2), number of capsule spike^{-1} (55.8) and highest length of primary branch (40.1 cm) and was comparable to paired row castor + proso millet and paired row castor + foxtail millet (2:4) in all pickings. The yield parameters were not significantly affected by the number of castor plants cultivated in intercrops (1:3) and paired rows (2:4). This was brought about by an increase in light absorption, more available space and reduced competition for nutrients, water and light. These results were given in the findings of [9] and [10]. In castor with leguminous intercropping systems, [11] showed similar results where the intra-specific competition was not increased by the pairing of rows as compared to castor that was sown in evenly spaced rows, this gave space for additional rows of intercrops. Castor + kodo millet (1:3) intercropping and castor + kodo millet grown in paired rows both had significantly less spike plants^{-1}, primary spike length and capsule plants^{-1} (2:4) due to competitive effect and less use efficiency of space, light, nutrients and more weed density in kodo millet intercropped castor systems.The various treatments showed no significant influence on the weight of 100 castor seeds. Similar findings were observed by [12]. The highest castor seed yield (2098 kg ha^{-1}) was recorded in sole castor which was found on par with paired row castor + proso millet (2:4) (2003 kg ha^{-1}) and paired row castor + foxtail millet (2:4) (1914 kg ha^{-1}). This was observed from [13],that castor + Dolichos (1:3) intercropping had the highest seed yield, followed by castor + french bean (1:2). Intercropping castor with greengram (1 or 2 rows) or sesame (1 or 2 rows) recorded higher castor seed yield on par with castor sole treatment [14].

CONCLUSION

Based on the experimental results it was concluded that highest growth parameters, yield attributes and seed yield were recorded in sole castor and it was on par with nutri cereal intercropping systems,paired row castor + proso millet and paired row castor + foxtail millet systems. Thus, proso millet and foxtail millet were indentified to be compatible intercrops with castor under paired row system for improved productivity.

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Table1.Effect of millet based intercropping on growth parameters of castor

Tr No.	Treatment	Plant height (cm)	No. of effective branches plant^{-1}	Stem girth (cm)	Dry matter production (kg ha^{-1})
T_1	Castor + foxtail millet (1:3)	138.61	6.80	6.40	2656
T_2	Castor + proso millet (1:3)	148.20	7.00	6.60	2802

T_3	Castor + little millet (1:3)	134.25	6.50	6.50	2425
T_4	Castor + kodo millet (1:3)	124.12	6.25	7.00	2116
T_5	Paired row castor + foxtail millet (2:4)	155.61	7.20	7.00	2925
T_6	Paired row castor + proso millet (2:4)	170.20	7.90	8.70	2983
T_7	Paired row castor + little millet (2:4)	131.24	6.50	6.80	2216
T_8	Paired row castor + kodo millet (2:4)	120.41	6.23	6.40	2050
T_9	Sole castor	175.36	9.20	9.50	3545
	SE.d	**7.7**	**0.47**	**0.43**	**156.1**
	CD (P=0.05)	**16.51**	**1.01**	**1.00**	**331.1**

Table 2. Effect of millet based intercropping on yield attributes and yield of castor

Tr No.	Treatment	No. of spike plant^{-1}	Length of primary spike (cm)	No. of capsule spike^{-1}	100 seed weight (g)	Seed yield (kg ha^{-1})
T_1	Castor + foxtail millet (1:3)	23.1	30.2	45.4	29.0	1728
T_2	Castor + proso millet (1:3)	25.2	31.4	48.1	29.2	1818

T_3	Castor + little millet (1:3)	21.8	29.0	42.2	29.3	1633
T_4	Castor + kodo millet (1:3)	19.0	28.3	38.7	30.2	1240
T_5	Paired row castor + foxtail millet (2:4)	26.1	32.2	50.4	30.1	1914
T_6	Paired row castor + proso millet (2:4)	27.2	34.5	52.3	30.6	2003
T_7	Paired row castor + little millet (2:4)	20.0	29.7	40.1	30.6	1612
T_8	Paired row castor + kodo millet (2:4)	18.1	25.5	37.3	30.1	1165
T_9	Sole castor	28.2	40.1	55.8	31.6	2098
	SE.d	**1.24**	**1.67**	**3.42**	**1.11**	**98.19**
	CD (P=0.05)	**2.64**	**3.55**	**7.25**	**NS**	**208.15**