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Castor based nutri-cereals intercropping system on Weed density, Weed dry weight and Weed Smothering Efficiency

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Abstract
Field experiment was conducted during summer season, 2022 at Tamil Nadu Agriculture University, Coimbatore to study the influence of castor based nutri cereal intercropping on weed density, weed dry weight and Weed Smothering Efficiency. The experimental was laid out in Randomize Block Design (RBD) comprises of thirteen treatments and three replications. Results revealed that lesser weed density and weed dry weight at 30, 60 and 90 DAS was recorded under solo little millet, proso millet and foxtail millet followed by intercropping with castor + foxtail millet (1:3), castor + proso milet (1:3) and castor + little millet (1:3) when compare to paired row cropping (2:4). Solo castor recorded higher weed density and total weed dry matter production at 30 DAS, 60 DAS and 90 DAS. Castor intercropped with foxtail millet (1:3), proso millet (1:3) and little millet (1:3) recorded highest Weed Smothering Efficiency when compared to paired row cropping.

Keywords: Castor, nurti cereals, weed density, weed dry weight, Weed Smothering Efficiency

1. Introduction
Castor is an important oil seed crop, India's semi-arid low-rainfall regions are where castor (*Ricinus communis* L.) is produced as an indeterminate, non-edible oil seed crop. Castor bean production in the globe is dominated by India, followed by China and Brazil. Castor oil is being utilised to produce energy for animals to eat (Daisy, 2019) [4]. World major castor producing countries are India (18.42 lakh tonnes), Mozambique (0.85 lakh tonnes), China (0.27 lakh tonnes), Brazil (0.14 lakh tonnes) and Myanmar (0.12 lakh tonnes). In India Gujarat, Andhra Pradesh, Rajasthan, Tamil Nadu, Karnataka, and Orissa are the main states that grow castor. Enhancing castor productivity in India is necessary given the crop's potential for industrial applications and the constantly rising demand for castor oil and its derivatives around the world (Pushpanathan *et al*., 2017) [6].

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. Due to their innate ability to mature early, higher yield due to the C_4 mechanism, ability to produce superior yields even on infertile soil under inadequate management, and low and 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 (Vinay *et al*., 2021) [11].

Intercropping is the practice of growing two or more crops in proximity. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop. Similar to this, millets and castor were intercropped to delay the succession of practically all significant weeds. The main consideration for mixed or intercropping is to cover the risk of failure and better use of natural resources, *viz*., sunlight, land and water (Kalaghatagi *et al.*, 2010) [5]. In agricultural cultivation, weeding has generally required a lot of labour. Due to the increased demand and high expense of human labour, manual weeding is rarely feasible. Because it allows for the possibility of a variety of crops obtaining a larger proportion of the available resources than in monocropping, intercropping holds potential as a weed control method (Ishaq Rahimi *et al.*, 2019) [7]. In this context, the present investigation was carried out to findout the influence of castor based nutri cereal intercropping system on weed density, weed dry weight and Weed

Smothering Efficiency (WSE %) under irrigated conditions.

Material and Methods

Field experiment was conducted at Eastern block farm of Tamil Nadu Agricultural University, Coimbatore during *summer* 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 soil exhibit nitrogen (120 kg ha^{-1}), phosphorous (80 kg ha^{-1}) and potassium (800 kg ha^{-1}) content. 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 YRCH 1 and nutri cereals foxtail millet (ATL 1), proso millet (ATL 1), little millet (ATL 1) and kodo millet were taken. Pre emergence herbicide pendimethalin was applied on 3 DAS followed by two hand weeding was taken.

Weed population and total dry matter production (TDMP) were taken on 30, 60 and 90 DAS respectively and Weed Smothering Efficiency was worked out. The total weed count was recorded by using 0.25 m^2 quadrate at four places in each plot and expressed as number m^{-2} as suggested by Burnside and Wicks (1965) [12]. Weeds present in four quadrates were removed, shade dried and then oven dried at 80 ± 2 °C till constant weight was attained. The weed dry weight was recorded and expressed in kg ha^{-1}. The values were subjected to square root transformation (X + 0.5) as described by Bartlett (1947) [2] and analyzed statistically. Weed Smothering Efficiency (WSE) was computed using the formula and expressed in percentage.

$$WSE\ (\%) = \frac{Mdw - Idw}{Mdw} \times 100$$

Where, Mdw-Mean dry weight of weeds in pure crop plot (kg ha^{-1}), and Idw-Mean dry weight of weeds in intercropped plot (kg ha^{-1}).

Result and Discussion

Weed flora of the experimental field

Weeds present in the experimental field were *Chloris barbata*, *Cynodon dactylon*, *Dactyloctenium aegyptium* and, *Dinebra retroflexa* under grasses, *Cyperus rotundus* under sedges and *Trianthema portulacastrum*, *Digera arvensis*, *Amaranthus viridis*, *Datura metal*, *Parthenium hysterophorus* under broad leaved weeds.

Among the grass weeds, *Dactyloctenium aegyptium*, *Cynodon dactylon* and *Echinchloa crusgalli*, *Dinebra retroflexa* were the dominant ones. *Cyperus rotundus* was the only sedge present. Among the broad-leaved weeds *Trianthema portulacastrum* and *Amaranthus viridis* were the dominant weeds.

Weed density, weed dry weight and WSE

Weed population and total dry matter production were significantly impacted by the intercropping strategy. Less weeds and weed total dry matter production were observed when intercropping systems were used. Lesser weed density and total weed dry weight at 30, 60 and 90 DAS was recorded under solo little millet, proso millet and foxtail millet followed by intercropping with castor + foxtail millet (1:3), castor + proso milet (1:3) and castor + little millet (1:3) than compare to paired row cropping (2:4) and solo castor recorded higher weed density and total weed dry matter production at 30 DAS, 60 DAS and 90 DAS because of wider spacing (Table 1 & 2). This may have happened as a result of the intercropping system's full crop coverage and high plant density, which created intense competition with weeds and stunted their growth (Velayutham *et al.*, 2002) [10], reported that intercrops effectively cover the land, which inhibits the growth of weeds. These results are consistent with previous reports. As compared to solo crops, intercrops with rapid growth frequently smother the weed population. In addition, it was noted that intercropping maize with legumes reduced weed density in comparison to a pure stand of maize because the legumes were more effective at burying weeds and provided less light for their germination and growth (Bilalis *et al*., 2010) [3]. According to (Singh and Lal 2008) [8], cowpea (*Vigna unguiculata* L. Walp), a spring-planted sugarcane intercropping plant, considerably reduced the dry weight of weeds (10.1 g/m^2) and effectively suppressed the weed density (81/m^2) in early sugarcane growth stages (60 days after planting).

In castor based nutri cereal intercropping the highest weed smothering efficiency at 30 DAS was observed in castor + little millet (46%) and castor+ proso millet (43%) and castor + foxtail millet (42%) respectively. At 60 DAS weed smothering efficiency was higher in castor + little millet (52%), followed by castor + foxtail millet (50%) castor + proso millet (41%). At 90 DAS Weed Smothering Efficiency was higher in castor + foxtail millet (46%) (Table 3). This might be because castor and intercrops grew vegetatively more successfully, increasing WSE and creating intense competition between the plants. Silimar result was shown in findings of (Thavaprakaash *et al.*, 2005) [9] in the baby corn + amaranthus intercropping system and Muhammad Azim Khan *et al.* (2012) [1] in the maize + mungbean intercropping system.

Table 1: Influence of castor based nutri cereal intercropping on Total weed density (No/m^2)

Tr. No.	Treatment	Total weed density (No/m^2)		
		30 DAS	60 DAS	90 DAS
T_1	Castor + foxtail millet (1:3)	2.8 (7)	2.0 (4)	2.9 (8)
T_2	Castor + proso millet (1:3)	3.0 (8)	2.3 (5)	3.1 (9)
T_3	Castor + little millet (1:3)	3.3 (10)	2.7 (7)	3.0 (9)
T_4	Castor + kodo millet (1:3)	3.9 (15)	3.6 (13)	3.4 (11)
T_5	Paired row castor + foxtail millet (2:4)	3.2 (10)	4.1 (16)	2.3 (5)
T_6	Paired row Castor + proso millet (2:4)	3.8 (14)	4.1 (17)	2.7 (7)
T_7	Paired row castor + little millet (2:4)	3.8 (13)	3.6 (13)	3.7 (14)
T_8	Paired row Castor + kodo millet (2:4)	4.3 (18)	4.2 (17)	4.7 (22)
T_9	Solo castor	4.8 (23)	4.8 (23)	5.6 (31)
T_{10}	Solo foxtail millet	3.4 (8)	3.1 (9)	2.8 (7)
T_{11}	Solo proso millet	3.2 (7)	2.8 (7)	2.5 (6)
T_{12}	Solo little millet	3.3 (7)	2.3 (5)	2.1 (4)
T_{13}	Solo kodo millet	4.2 (14)	4.5 (20)	4.5 (20)
	S.Ed	0.29	0.20	0.20
	CD (P=0.05)	0.60	0.40	0.42

Data in parentheses are original value.

Data statistically analysed by $\sqrt{x+0.5}$ transformation

Table 2: Influence of castor based nutri cereal intercropping on Total weed dry weight (g/m^{-2})

Tr. No.	Treatment	Total weed dry weight (No/m^2)		
		30 DAS	60 DAS	90 DAS
T_1	Castor + foxtail millet (1:3)	4.0 (15.8)	3.5 (11.8)	3.5 (11.9)
T_2	Castor + proso millet (1:3)	4.0 (15.5)	3.6 (13.8)	3.8 (13.8)
T_3	Castor + little millet (1:3)	3.9 (14.4)	3.5 (11.2)	3.7 (13.0)
T_4	Castor + kodo millet (1:3)	4.6 (20.8)	4.3 (17.5)	4.1 (16.2)
T_5	Paired row castor + foxtail millet (2:4)	4.1 (15.8)	3.8 (15.9)	4.0 (15.4)
T_6	Paired row Castor + proso millet (2:4)	4.2 (17.5)	3.6 (13.7)	3.9 (14.9)
T_7	Paired row castor + little millet (2:4)	4.5 (19.4)	4.0 (15.8)	4.1 (16.4)
T_8	Paired row Castor + kodo millet (2:4)	4.8 (22.7)	4.9 (22.6)	4.6 (20.8)
T_9	Solo castor	5.3 (27.3)	4.6 (23.6)	4.7 (22.2)
T_{10}	Solo foxtail millet	4.0 (15.6)	4.0 (15.6)	3.8 (13.8)
T_{11}	Solo proso millet	3.7 (12.9)	3.9 (15.0)	3.6 (12.7)
T_{12}	Solo little millet	3.6 (12.4)	3.7 (14.0)	3.4 (11.1)
T_{13}	Solo kodo millet	4.6 (20.4)	4.4 (22.5)	4.5 (20.1)
	S.Ed	0.22	0.27	0.28
	CD (P=0.05)	0.45	0.57	0.59

Data in parentheses are original value.

Data statistically analysed by $\sqrt{x+0.5}$ transformation

Table 3: Effect of intercropping on Weed Smothering Efficiency (%)

Tr. No.	Treatment	30 DAS	60 DAS	90 DAS
T_1	Castor + foxtail millet (1:3)	42	50	46
T_2	Castor+ proso millet (1:3)	43	41	37
T_3	Castor + little millet (1:3)	47	52	41
T_4	Castor+ kodo millet (1:3)	23	21	27
T_5	Paired row castor + foxtail millet (2:4)	42	32	30
T_6	Paired row castor + proso millet (2:4)	35	41	32
T_7	Paired row castor + little millet (2:4)	28	31	26
T_8	Paired row castor + kodo millet (2:4)	16	4.2	6.3

Conclusion

Based on the study it was concluded that castor and nutri cereal intercropping shows significant effect on weed density, weed dry weight and Weed Smothering Efficiency. Solo millets crops and intercrop (1:3) showed less weed population and weed dry weight as spacing was less as compare to solo castor and paired row (2:4). Castor + foxtail millet (1:3), castor + proso millet (1:3) and castor + little millet (1:3) recorded highest Weed Smothering Efficiency that enhance crop yield and productivity in castor based nutri cereal intercropping.

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