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Performance of Groundnut and Millet Based Intercropping System Under Rainfed Condition

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Abstract

A field experiment was carried out during *Kharif* 2017, 2018 and 2019 at Zonal Agricultural and Horticultural Research Station, Babbur farm, Hiriyur to study the productivity and profitability of groundnut + millets intercropping system under rainfed ecosystem. Experiment was laid out with Randomized Complete Block Design (RCBD) with total ten treatments were replicated thrice. Treatments comprises of testing of sole groundnut, finger millet and foxtail millet against intercropping of groundnut with finger millet, little millet and foxtail millet at 5:2 and 6:1 row proportion. The results of pooled data indicated that significantly higher groundnut pod equivalent yield (2123 kg ha^{-1}) was recorded with Groundnut + finger millet (5:2) as compared to other treatments. However, significantly higher net returns (Rs. 58532 ha^{-1}) and B:C ratio (2.55) were recorded with Groundnut + foxtail millet (6:1) as compared to other treatments.

Key words : *Intercropping systems, groundnut pod equivalent yield, productivity*

Introduction

Groundnut is referred as the “king of oilseeds” crops and is one of the most significant oilseed crops grown in tropical and subtropical areas of the world. Groundnut is a member of the Leguminaceae family. Another name for groundnut is “poor man’s almond” and it is one of food and economic crop of the country. India has 6.09 million hectares of groundnut cultivation, producing 10.21 million tonnes at a productivity of 1676 kg ha^{-1}. The greatest producer in India was Gujarat, which produces 40.42 per cent of all groundnuts, followed by Rajasthan (18.91 %), Tamil Nadu (9.25 %), Andhra Pradesh (7.62 %), and Karnataka (6.62 %) (1). In Karnataka, it is grown over an area of 0.70 million hectare with a production of 0.68 million tonnes having a productivity of 966 kg ha^{-1}. The productivity of groundnut is very lower than national average productivity because primarily it is grown under rain fed situation and low fertile marginal lands which are subjected to the vagaries of monsoon. Low yield and in the worst circumstances, complete crop failure are the results of insufficient and unpredictable rainfall combined with insect pest damage. Millets are tough and robust plants that may be produced in a variety of unfavourable agro-climatic conditions. They play a significant part in the food security of communities that depend on livestock for their way of life. Since intercropping is one of the important cropping systems which is recommended to mitigate the aberrant climatic conditions (2), it was undertaken to study the effect of intercropping system on growth and yield of groundnut under rain fed condition. Intercropping aims to increase total productivity per unit area through equitable and judicious use of land resource and farming inputs, including labour.

Materials and Methods

Experimental site and soil : The field experiment was conducted at Zonal Agricultural and Horticultural Research station, Babbur farm, Hiriyur during *kharif* 2017, 2018 and 2019 under rainfed situation which comes under Central Dry Zone of Karnataka. The experimental site is situated at 13º 57’ 32” North latitude and 70º 37’ 38” East longitude and at an altitude of 606 meters above MSL. The soil of the experimental site is belonged to order vertisol with slightly alkaline pH (8.10), low in organic carbon (1.90 g kg^{-1}), available nitrogen (258 kg ha^{-1}), medium in available phosphorus (35 kg ha^{-1}) and potassium (315 kg ha^{-1}).

Design of experiment and treatment details : The experiment was laid out in complete randomized block design (RCBD) concept consist of ten treatments with three replications. The treatment comprises of T_1: Sole groundnut, T_2: Sole finger millet, T_3: Sole little millet, T_4: Sole foxtail millet, T_5: Groundnut + finger millet (5:2), T_6: Groundnut + little millet (5:2), T_7: Groundnut + foxtail millet (5:2), T_8: Groundnut + finger millet (6:1), T_9: Groundnut + little millet (6:1) and T_{10}: Groundnut + foxtail millet (6:1). The cultivar used are groundnut - G-2-52, finger millet - ML-365, little millet - Sukshema and foxtail millet - HMT 100-1. Best performed intercropping system *i.e.*, Groundnut + foxtail millet (6:1) was taken for farm trial at

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different locations *viz.*, Hiriyur, Kathalagere and Chitradurga during *Kharif* 2020 and 2021.

Data collection for analysis : The crops were harvested separately from the net plot at physiological maturity and were threshed manually and the pod and grain yield were weighed from the net plot and converted into kg ha^{-1}. Intercrop yields were computed as groundnut pod equivalent yields (GPEY). GPEY is a simple expression in intercropping to compare the economics of intercrops by converting grain/seed/economic part *etc.* in terms of gross returns/net returns for valid comparison. The economics was worked out from prevailing market prices of inputs and outputs for different treatments. Land Equivalent Ratio (LER) is the sum of the fractions of the intercropped yields divided by the sole- crop yield. LER is calculated using the equation LER = ? (Ypi/Ymi), where Yp is the yield of each crop in the intercrop and Ym is the yield of each crop in the sole crop.

Statistical analysis : The data recorded during the investigation were compiled and analysed for statistical significance as per the analysis of variance for the Randomized Complete Block Design (RCBD). Fisher's method of analysis of variance (ANOVA) as described by (3) was adopted for the purpose. Standard error of mean and coefficient of variability have been worked out for a set of observations under each character at p=0.05 to interpret the significance.

Results and Discussion

Productivity of groundnut + millets intercropping systems : Growing of crops as a sole crop found to be risky under rainfed conditions due to low and erratic rainfall, which ultimately results in low productivity. Under such conditions in order to achieve higher productivity intensification and diversification of crops is essential. In the present investigation, the result revealed that higher groundnut pod yield (2383 kg ha^{-1}) and gross returns (Rs. 111838 ha^{-1}) were obtained in sole groundnut, this could be due to optimum plant population in sole groundnut and compared to intercropping groundnut
(Table-1). Unlike observed in sole millets. Among the intercropping systems, groundnut + finger millet (5:2) recorded significantly higher Groundnut Pod Equivalent Yield (GPEY) of 2124 kg ha^{-1} than other treatments. However, it was statistically on par with Groundnut + little millet (5:2), Groundnut + foxtail millet (5:2), Groundnut + finger millet (6:1), Groundnut + little millet (6:1) and Groundnut + foxtail millet (6:1). It was mainly due to more space available between two millet rows thus there is a better availability of light lead to higher yield of groundnut in the intercropping system and thereby envisages

Table-1 : Groundnut pod yield, millet grain yield, groundnut pot equivalent yield and economics of groundnut and millet based intercropping systems under rainfed conditions.

Treatments	Groundnut Pod Yield (kg/ha)				Millet Grain Yield (kg ha^{-1})	GPEY (kg ha^{-1})	LER	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
	2017	2018	2019	Mean						
T_1: Sole groundnut	1862	2565	2721	2383	-	2383	1.00	111838	54766	1.96
T_2: Sole finger millet	-	-	-	-	2257	1174	1.00	51316	24103	1.89
T_3: Sole little millet	-	-	-	-	1531	757	1.00	35889	13314	1.59
T_4: Sole foxtail millet	-	-	-	-	1870	758	1.00	35454	13195	1.59
T_5: Groundnut + finger millet (5:2)	1260	1517	1620	1475	1158	2124	1.20	97371	56935	2.41
T_6: Groundnut + little millet (5:2)	1334	1634	1745	1571	754	1989	1.22	90992	53431	2.42
T_7: Groundnut + foxtail millet (5:2)	1486	1656	1768	1636	900	2060	1.24	91709	53726	2.41
T_8: Groundnut + finger millet (6:1)	1590	1723	1840	1717	671	1971	0.99	93693	53257	2.32
T_9: Groundnut + little millet (6:1)	1683	1850	1975	1836	482	1972	1.04	93805	56244	2.50
T_{10}: Groundnut + foxtail millet (6:1)	1744	1910	2039	1897	575	2015	1.05	96237	58532	2.55
S.Em±	95	156	6.86	86	76	124	0.05		-	
C.D. at 5 %	286	479	21.14	260	228	372	0.17			

Table-2 : Yield and economics farm trial at different locations.

Technology	Groundnut + Foxtail millet (6:1)			Sole groundnut		
	2020	2021	Pooled	2020	2021	Pooled
Groundnut Pod yield (kg ha^{-1})	1675	1663	1669	1901	1803	1852
Foxtail millet yield (kg ha^{-1})	884	1011	948	-	-	-
GPEY (kg ha^{-1})	2050	2082	2066	-	-	-
Gross returns (Rs. ha^{-1})	107994	111217	109606	99953	95034	97494
Net returns (Rs. ha^{-1})	67691	70626	69159	51456	48134	49795
B:C ratio	2.67	2.77	2.72	2.07	2.03	2.05

effective utilization of the resources along with millets. Similar findings have been reported by Shwethanjali *et al*. (2018). Yield of any crop depended on its yield parameters. Significantly higher number of pods and pod weight per plant were recorded under groundnut intercropped with foxtail millet at ratio of 6:1 followed by little millet and finger millet. This mainly due to variation in translocation of photosynthates from source to sink as there is a greater availability of light due to differential growth habit and its efficient use, less competition for resources by component crops and efficient utilization of available resources. Similar findings have been reported by (4, 5, 6).

When comparing returns, it was found that higher net returns (Rs. 58532 ha^{-1}) and B:C ratio (2.55) was recorded with Groundnut + foxtail millet (6:1) as compared to other treatments (Table 1). It was mainly due to higher groundnut pod equivalent yield and lower cost of cultivation under intercropping systems of Groundnut + foxtail millet (6:1) than other intercropping systems. Intercropping of groundnut + foxtail millet (6:1) recorded higher B:C ratio (2.55) to the tune of 23 per cent as compared to sole groundnut (1.96). This was mainly due to low cost of cultivation especially seed price of groundnut and higher yield of millets. Land Equivalent Ratio (LER) of all the intercropping treatments in the present study recorded more than one value indicating the yield advantage in all intercropping systems. This might be due to higher yield of groundnut in the intercropping system and thereby envisages effective utilization of the resources along with millets. Higher yield levels under intercropping systems were mainly due to variation in translocation of photosynthates from source to sink as there is a greater availability of light due to differential growth habit and its efficient use, less competition for resources by component crops and efficient utilization of available resources.

Based on on-farm trial data consecutive of two years *i.e.* 2020 and 2021 proves that growing of crops as a sole crop found to be risky under rainfed conditions due to low and erratic rainfall, which ultimately results in low productivity. Under such conditions in order to achieve higher productivity intensification and diversification of crops is essential.

In this study, the performance of groundnut based intercropping system with foxtail millet crops have been evaluated on yield at different locations, it produced nearly 10.35 per cent higher groundnut pod equivalent yield (2066 kg ha^{-1}) than sole groundnut (1852 kg ha^{-1}) and increased the net returns by Rs. 69159 ha^{-1} as compared to normal sole groundnut (Rs. 49795 ha^{-1}) (Table-2). The increase in net returns with intercropping of groundnut + foxtail millet (6:1) to the tune of 29 per cent over sole groundnut. Intercropping treatment having groundnut + foxtail millet (6:1) recorded higher B:C ratio (2.72) to the tune of 25 per cent as compared to sole groundnut (2.05). Under dry land conditions intercropping system provides a natural insurance against total crop failure and thus production sustainability.

Conclusions

From the above study it can be concluded that intercropping of groundnut + foxtail millet (6:1) was found profitable and efficient intercropping system as reported from the results of both research field trials and also the farm trials.

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