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INFLUENCE OF NUTRIENT MANAGEMENT ON PRODUCTIVITY AND COMPETITIONFUNCTIONS OF RAINFEDPIGEONPEA + RADISH INTERCROPPING SYSTEM IN NORTH EASTERN GHAT ZONE OF ODISHA.

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ABSTRACT

A field experiment was conducted to study the influence of nutrient management on productivity and competition functions of rainfedpigeonpea + radish intercropping system in north eastern ghat zone of Odisha. The study was carried out for two consecutive years during *Kharif* seasons of 2018 and 2019 at Instructional Farm, RRTTS, G.Udayagiri, OUAT, Kandhamal, Odisha with twelve treatments replicated thrice in a randomized block design. Among the intercropping systems with different levels of nutrient management practices, almost all the growth parameters as well as yield attributing parameters, yield and competition functions*viz.*pigeonpea equivalent yield(PEY), monetary advantage (Rs.56336/ha),land equivalent ratio (LER), area time equivalent ratio(ATER),relative value total (RVT), relative crowding co-efficient(RCC) and aggressivity(A) showed the higher values with the treatment where 100 % RDF was applied to the base crop as well as to the intercrop. Sole crop of pigeonpea with 100% RDF produced the highest seed yield (1195 kg ha^{-1}) andsole radish crop with 100% RDF showed the highest root yield (17.70 t ha^{-1}) over other treatments followed by pigeonpea + radish with 100 % RDF to base crop + 100% RDF to intercrop during both the years of experiment and in pooled data.The highest pigeonpea equivalent yield (1984 kg/ha),monetary advantage (Rs.56336/ha),land equivalent ratio (1.81), area time equivalent ratio(44.53), relative value total (2.63),relative crowding co-efficient(107.36), andaggressivity (A = +1.19)) were obtained where 100 % RDF was applied to the base crop as well as to the intercrop.

Key words:pigeonpea(base crop), radish(intercrop), intercropping, nutrient management, yield,pigeonpea equivalent yield,competition functionsand recommended dose of fertilisers (RDF).

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is grown predominantly under rainfed conditionsis relatively inefficient because of its slow initial growth rate and low harvest index therefore it is grown as intercrop. Pigeonpea offers a good scope for intercropping with fast growing early maturing and shallow rooted crops.Radish(*Raphanus sativus* L) is one of the important root vegetables and being a quick growing and short duration crop, it is easily planted as a companion crop or intercrop between the rows of tall growing pulses and vegetables. To reduce the drought risks pigeonpea + radish intercropping system has been recommended for the rainfed areas (Behera *et al*, 1998). In Orissa, upland occupies about 46 per cent of the total cultivated area of which 70 per cent is rainfed. Pigeonpea being grown as a rainfed crop contributes about 28 per cent of the *kharif* pulses in Orissa and 80-90 per cent area of pigeonpea is intercropped.Keeping in view of the above mentioned ideas, the present studywas undertaken to study the influence of nutrient management on productivity and competition functions of rainfed pigeonpea + radish intercropping system in north eastern ghat zone of Odisha.

Materials and Method

The field experiment was conductedat the Unit-II farm, Regional Research and Technology Transfer Station (RRTTS), G. Udayagiri, OUAT, Dist: Kandhamal, Odisha(India)during 2018 and 2019 for two consecutive*Kharif* seasons with an average annual rainfall of 1422.45mm. The soil was sandy loam in texture with pH- 5.4, organic carbon-0.39%, available N- 240.80 kg/ ha, available P- 22 Kg/ha and available K- 215.34 kg/ha. Pigeonpea*cv.* UPAS-120 and radish*cv.*Pusachetki were sown on 21 June, 2018 and 22 June, 2019 during *kharif* seasons of 2018 and 2019respectively in specified crop geometry and all farm operations were conducted as per recommendations of the crops. The experiment consisted of twelve treatments (ten paired row arrangements 30/90 cm and sole crop of pigeonpea and radish) each with three replications was laid out in randomized block design (RBD). The treatments were T_1- Pigeonpea (100% RDF) + Radish (100% RDF),T_2- Pigeonpea (100% RDF) + Radish (75% RDF),T_3- Pigeonpea (100% RDF) + Radish (50% RDF), T_4- Pigeonpea (100% RDF) + Radish (25% RDF), T_5- Pigeonpea (100% RDF) + Radish (0% RDF) , T_6- Pigeonpea (75% RDF) + Radish (100% RDF),T_7- Pigeonpea (50% RDF) + Radish (100% RDF), T_8- Pigeonpea (25% RDF) + Radish (100% RDF),T_9- Pigeonpea (0% RDF) + Radish (100% RDF),T_{10}-Pigeonpea (0% RDF) + Radish (0% RDF) Control,T_{11}-Sole Pigeonpea (100% RDF), T_{12}-Sole Radish (100% RDF).The required quantities of fertilizers were applied as per the treatments with the area occupied by the component crop.Pigeonpea was harvested on 21 0ctober, 2018 and 22 0ctober, 2019 radish on 07 August, 2018 and 09August, 2019.Observations on

growth and yield attributes were recorded periodically and yield was recorded at harvest of crops. The data were tabulated and analyzed as per the standard procedure for "Analysis of Variance" (ANOVA) as described by Gomez and Gomez (1984) and the significance of treatments was tested by 'F' test (Variance ratio).

Results and Discussion

Seed yield of pigeonpea Seed yield of pigeonpea was significantly influenced by the fertility levels. Sole pigeonpeawith 100% RDF produced highest seed yield of 1195 kg ha^{-1}. It was found to be at par with full dose of fertilizers to ($P_{100\%}$ RDF + $R_{100\%}$ RDF) with 1163 kg ha^{-1}seed yield on pooled data basis and superior to other treatments during both the years and in pooled data.In the intercropping system application of full dose of fertilizers to ($P_{100\%}$ RDF + $R_{100\%}$ RDF) intercropping system of pigeonpea+ radish produced highest yield of 1163 kg ha^{-1} in pooled data basis which was followed by$P_{75\%}$ RDF + $R_{100\%}$ RDF with at par. Similar results have been reported by,Vishwanatha*et al* (2012) andSingh*et al*. (2017).

Root yield of radish-The highestroot yield of radish was obtained fromsole crop of radish (17.70 t/ha) with 100% RDF. This was significantly higher than all other intercropping treatments. Among the intercropping treatments, application of 100% RDF to base crop + 100% RDF to intercrop resulted in higher yield of radish 13.22 t/hain pooled data basis and it was followed by the treatment having75% RDF to base crop + 100% RDF to intercrop (12.23 t/ha on pooled data basis) and these treatments were found to be statistically at par in pooled data. The lowest radish yield was obtained from the treatment having no fertilizer application with$P_{0\%}$RDF + $R_{0\%}$RDF) to both pigeonpea and radish (4.28 t/ha on pooled data basis).Similar results have been reported byBrintha andSeran (2009).

Productivity and intercropping indices of pigeonpea and radish intercropping system influenced by nutrient management (Pooled data of two years)

Treatment	Pigeonpea yield (kg/ha)	Radish yield (t/ha)	PEY (kg/ha)	MA (Rs.ha^{-1})	LER	ATER	RVT	RCC			Aggressivity (A)	
								Kpr	Krp	K	A_{PR}	A_{RP}
$P_{100\%}$ RDF + $R_{100\%}$ RDF	1163	13.22	1984	56336.62	1.81	44.53	2.63	54.52	1.97	107.36	+ 1.19	-1.19
$P_{100\%}$RDF + $R_{75\%}$ RDF	1096	11.86	1778	45745.16	1.66	40.32	2.41	16.98	1.35	22.94	+ 1.18	-1.18
$P_{100\ \%}$ RDF + $R_{50\ \%}$ RDF	934	10.59	1589	30832.39	1.44	35.68	2.11	5.37	0.99	5.33	+ 0.96	-0.96
$P_{100\%}$ RDF + $R_{25\%}$ RDF	916	10.51	1578	29992.35	1.43	35.34	2.09	4.92	0.98	4.80	+ 0.93	-0.93
$P_{100\%}$RDF + $R_{0\%}$ RDF	862	10.30	1545	26004.25	1.37	34.36	2.01	3.88	0.93	3.60	+ 0.83	-0.83
$P_{75\%}$RDF + $R_{100\%}$ RDF	1106	12.23	1835	47615.38	1.68	41.41	2.46	18.64	1.49	27.78	+ 1.16	-1.16
$P_{50\%}$RDF + $R_{100\%}$ RDF	1098	11.98	1797	45591.39	1.65	40.65	2.42	16.61	1.40	23.17	+ 1.17	-1.17
$P_{25\%}$RDF + $R_{100\ \%}$ RDF	1026	11.29	1694	39055.69	1.56	38.26	2.28	9.11	1.17	10.69	+ 1.08	-1.08
$P_{0\%}$ RDF + $R_{100\%}$ RDF	987	10.87	1631	32991.45	1.46	36.83	2.19	7.12	1.06	7.55	+ 1.04	-1.04
$P_{0\%}$ RDF + $R_{0\%}$ RDF	439	4.28	642	-21187.71	0.70	17.68	1.03	0.87	0.29	0.25	+ 0.42	-0.42
Sole Pigeonpea ($P_{100\%RDF}$)	1195	-	1195	0.00	1.00	8.69	1.00	-	-	-	+ 2.50	-2.50
Sole Radish ($R_{100\%}$RDF)	-	17.70	2655	0.00	1.00	48.29	2.22	-	-	-	-1.67	+ 1.67
SEm(±)	29	0.57	63	-				54.52	1.97	107.36		
CD (P=0.05)	60.15	1.19	184	-				16.98	1.35	22.94		

P-Base Crop (Pigeonpea),R- Intercrop (Radish), RDF of Pigeonpea-20-40-20 of N:P_2O_5:K_2O in kg ha^{-1}, RDF of Radish-50:50:75 of N:P_2O_5:K_2O in kg ha-1, KPR and K_{RP} = Relative Crowding Co-efficient for pigeonpea and radish, respectively,K = Product of Relative Crowding Co-efficient,A_{PR}= Aggressivity value of pigeonpea when intercropped with radish, A_{RP}= Aggressivity value of radish when intercropped with pigeonpea

Pigeonpea equivalent yield

Treatment with 100% RDF application to both pigeonpea and radish produced maximum pigeonpea equivalent yield followed by $P_{75\%}$RDF + $R_{100\%}$RDF,$P_{50\%}$RDF + $R_{100\%}$RDFand $P_{100\%}$RDF + $R_{75\%}$RDF.. Treatment $P_{0\%}$RDF + $R_{0\%}$RDFwithout application of fertilizers resulted in lowest value of PEY than rest of the treatments.Similar results were recorded byVishwanathaa*et al* (2012)

Monetary advantages (MA)

The highest monetary advantage was obtained from the treatment with 100% RDF application to pigeonpea and radish (₹56,336/ha). This was followed by the treatment with 75% RDF to base crop + 100% RDF to intercrop (₹ 47,615/ha). Monetary advantage decreased with the decreasing levels of fertilizers in both the crops. Similar results were recorded by Vishwanathaa*eta.,l* (2012).

Land equivalent ratio (LER)

With respect to advantages of intercropping in pigeonpea + radish system, LER value in each and every system was more than 1.0 except with the treatment P0 % RDF + R0% RDF. Land equivalent ratio values ranged from 0.70 to 1.81. The highest LER value was obtained in treatment with 100% RDF application to base and inter crop (LER= 1.81) which meant 81 percent yield advantage of intercropping with respect to sole cropping. This was followed by the treatment with 75% RDF to base crop + 100% RDF to intercrop (LER= 1.68). The LER values decreased with the decreasing levels RDF fertilizer application to both the crops.Our finding confirms that of Verma *et al*., 2005 and Vishwanathaa*et al.,* (2012).

Area-time equivalent ratio (ATER)

The highest ATER value was recorded in the treatment having 100% RDF to base and Inter crop (ATER= 44.53). This was followed by treatment with 75% RDF to base crop + 100% RDF to intercrop (ATER= 41.41). The lowest value of ATER was recorded with sole pigeonpea and among the intercropping treatments ATER value was lower in treatment where no fertilizers were applied. These results confirm the findings of Verma *et al*.2005,Sharma and Guled (2012),Vishwanathaa*et al.,* (2012) andDhandayuthapani*et al*. (2015).

Relative value total (RVT)

The highest RVT value was recorded in the treatment having 100% RDF to base crop + 100% RDF to intercrop (RVT= 2.63). This was followed by 75% RDF to base crop +100% RDF to intercrop (RVT= 2.46), 50% RDF to base crop + 100% RDF to intercrop (RVT= 2.42) and 100% RDF to base crop + 75% RDF to intercrop (RVT= 2.41). Lowest value of RVT recorded with sole pigeonpea and with respect to intercropping treatments the value is lowers in T_{10} where both the crops were grown without application of fertilizers.

Relative crowding co-efficient (RCC)

All the intercropping combinations under different nutrient management practices proved to be advantageous which was evident from the product value ofrelative crowding co-efficient(K). Intercropping system of pigeonpea + radish with 100% RDF application to base and inter crop recorded the highest K value (107.36) and lowest value of K was obtained in pigeonpea + radish intercropping system without any fertilizer application.These results confirm the findings ofVerma *et al.* 2005, Chaudhari *et al* (2017) and Sharmili and Manoharan(2018).

Aggressivity (A)

In different intercropping combinations the aggressivity values were found to be positive (+ve) in Pigeonpea from where Pigeonpea was found to be dominant crop. While the associated crop of Radish appeared to be the dominated one exhibiting negative (-ve) values of aggressivity. In intercropping systems the highest value of aggresivity was recorded when 100% RDF applied to both base and inter crop (A= +1.19) followed by 100% and 75% RDF application to base and inter crop, respectively (+1.18). Aggressivity value was found to be lowest with treatment having no fertilizer application to both the crops (A= +0.42).These results confirm the findings of Verma *et al*. 2005and Pandey*et al* (2013).

Conclusion

Application of 100 per cent recommended fertilizer dose to pigeonpea and to radish, on the basis of area occupied by each crop, was found to be the most remunerative fertilizer dose for the pigeonpea + radish intercropping system not only increase the yield but also get higher economic return. Hence intercropping not only solve the problems of pulses and vegetable (root crop) production but also helps to bring additional income to farmers and to get higher benefits, utilise the growth resources and time very efficiently .

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