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Growth, Yield and Yield Attributes of Pigeon Pea in Rainfed Uplands of Western Central Table Land Zone of Odisha

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ABSTRACT

Growth and yield attributes of pigeon pea were higher due to intercropping with black gram and groundnut but were lower when grown in association with sesamum and fingermillet. Plant height of pigeon pea at harvesting stage was highest when intercropped with groundnut (270 cm), horizontal spread at 90 DAS (152.7 cm) so also dry matter accumulation was highest at 210 DAS(315.7g/plant). Intercropping with sesamum, black gram, groundnut and fingermillet decreased the seed yield of pigeon pea by 20.5, 18.7, 14.1 and 12.3 respectively as compared to maximum seed yield of 1098 kg/ha from pigeon pea+ rice intercropping system. Pigeon pea+ rice was most productive and remunerative with net return of Rs 17,477/ha and benefit cost ratio 1.98.

INTRODUCTION

Intercropping involves growing two or more crops or varieties simultaneously on the same piece of land with definite row ratio. Crop intensification is in both time and space dimensions. There is intercrop competition during all part of crop growth (Prasad and Shrivastava, 2011). Intercropping provides insurance against drought, modifies soil environment, improves moisture and radiation use, ensure better weed control, reduces disease and pest incidence and in whole increases and stabilizes the productivity. Intercropping has been identified as a kind of biological insurance against risks under aberrant rainfall behaviour. Crop diversification is also necessary to get higher yield and return to maintain soil health, conserve natural resources, preserve environment, meet daily food requirement of human and animals, withstand price fluctuation and ensure constant flow of income.(Siddique *et al*, 2012).

Pigeon pea is a deep rooted hardy crop grown either as sole crop or intercrop in combination with variety of crops. Initial slow growth habits, wider row spacing and long maturity period of pigeon pea make it ideal as a component crop with most of the cereal or millets, pulses, oilseed and vegetables in rain fed uplands. Its deep root systems help tap plant nutrients from deeper layers allowing the base food crop to feed at top layers of the soil. The pigeon pea based intercropping systems give greater relative yield advantage under stress and can provide useful buffer against low yields in poor years. For a required monetary advantage it is reported that the sole crops failed much more often than the pigeon pea based intercropping system. The current shortage of both pulses and vegetable oil has stimulated thought on developing productive intercropping systems of pigeon pea including these crops. Many intercropping and crop sequences have been developed and recommended for different agro climatic conditions of Odisha. However, their relative performance in a location has not been studied in detail. Therefore, a field experiment was conducted at the Upparjhar village of Bolangir district of Odisha to study the “Growth, yield and yield attributes of pigeon pea in rain fed uplands of western central table land zone of Odisha”.

MATERIAL AND METHOD

A field experiment was conducted at Bolangir district of Odisha to assess the production potential of different cropping system in rain fed uplands during 2011-12.The experiment with five different cropping systems was conducted in a randomised block design with three replications. The cropping systems were:

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T_1: Pigeon pea+ Rice (2:5)

T_2: Pigeon pea + finger millet (2:4)

T_3: Pigeon pea+ black gram (2:3)

T_4: Pigeon pea+ ground nut (2:6)

T_5: pigeon pea+ sesamum (2:4)

The salient characteristics of variety used:

Crop	Variety	Duration
Rice (Oryza sativa L.)	ZHU XI-26	80
Pigeonpea (Cajanus cajan L.)	Asha(ICPL-87119)	180
Greengram(Vigna radiate L.)	PDM-54	70
Ground nut (Arachis hypogeal L.)	Smruti	100
Black gram (Vigna mungo L.)	Pant U-30	75
Finger millet (Elusine coracana L.)	Bhairabi	105-110

Table1. *Effect of intercropping systems on plant height (cm) of pigeon pea at successive growth Stages*

Particular	Days after sowing			Harvest
	30	60	90	
Pigeon pea+ rice(2:5)	66.0	146.7	188.3	253.3
Pigeon pea+ fingermillet(2:4)	67.7	131.7	185.0	235.3
Pigeon pea+ blackgram(2:3)	65.3	158.0	210.0	267.0
Pigeon pea+ groundnut(2:6)	63.0	176.3	213.3	270.0
Pigeon pea+ sesamum(2:4)	62.7	137.3	186.7	228.0
SEm (±)	1.64	5.75	6.31	8.90
CD(P=0.05)	NS	18.7	20.6	29.0

Table2. *Effect of intercropping systems on horizontal spread (cm) of pigeonpea at successive growth stages*

Particular	Days after sowing		
	30	60	90
Pigeon pea+ rice(2:5)	31.0	82.0	137.7
Pigeon pea+ fingermillet(2:4)	32.7	81.7	125.0
Pigeon pea+ black gram(2:3)	34.0	85.3	145.7
Pigeon pea+ groundnut(2:6)	33.0	87.7	152.7
Pigeon pea+ sesamum(2:4)	32.0	79.7	123.3
SEm(±)	0.82	1.40	4.34
CD(P=0.05)	NS	4.6	14.1

Table3. *Effect of intercropping system on dry matter accumulation (g/plant) of pigeon pea at successive growth stages*

Particulars	Days after sowing									
	30			60			90			210
	Stem	Leaf	total	Stem	Leaf	total	Stem	Leaf	Total	total
Pigeon pea+ rice(2:5)	1.01	1.22	2.23	25.37	16.93	42.30	49.70	44.40	94.1	258.7
Pigeon pea+ fingermillet (2:4)	0.85	1.30	2.15	16.68	13.39	30.27	39.43	34.73	74.2	237.0
Pigeon pea+ blackgram (2:3)	1.33	1.60	2.93	31.72	20.54	52.26	56.90	45.13	102.0	285.4
Pigeon pea+ groundnut (2:6)	1.52	1.81	3.32	34.50	21.95	56.46	69.43	46.0	115.4	315.7
Pigeon pea+ sesamum (2:4)	0.90	1.14	2.04	15.39	13.57	28.96	37.20	25.93	63.1	225.2
SEm (±)	0.07	0.13	0.18	1.48	0.94	1.31	2.20	1.62	2.93	10.02
CD(P=0.05)	0.23	0.42	0.57	4.84	3.06	4.28	7.18	5.28	9.56	32.7

Table4. *Effect of intercropping systems on CGR and RGR of pigeon pea at successive growth Stages*

Particular	Days after sowing						
	CGR(g/d/plant)				RGR(g/g/d)		
	0-30	30-60	60-90	90-120	30-60	60-90	90-120
Pigeonpea+ rice(2:5)	0.074	1.34	1.73	1.37	0.099	0.027	0.008
Pigeonpea+ fingermillet(2:4)	0.072	0.94	1.46	1.36	0.088	0.030	0.010
Pigeonpea+ blackgram(2:3)	0.098	1.64	1.66	1.53	0.096	0.022	0.009
Pigeonpea+ groundnut(2:6)	0.111	1.77	1.97	1.67	0.094	0.024	0.008
Pigeonpea+ sesamum(2:4)	0.068	0.90	1.14	1.35	0.088	0.026	0.011
SEm(±)	0.006	0.043	0.12	0.07	0.003	0.002	0.001
CD(P=0.05)	0.019	0.14	0.40	0.21	NS	NS	NS

CGR- crop growth rate, RGR- relative growth rate

Table5. *Rainfall and rain water use efficiency (RWUE) of various intercropping and cropping systems*

Particular	Intercropping system			Cropping system		
	REY (Kg/ha)	Rainfall (mm)	RWUE (kg/ha-mm)	REY (kg/ha)	Rainfall (mm)	RWUE (kg/ha-mm)
Pigeon pea+ rice(2:5)	4882	1585	3.08	4882	1585	3.08
Pigeon pea+ fingermillet(2:4)	3630	1593	2.28	3630	1593	2.27
Pigeon pea+ blackgram(2:3)	2738	1593	1.72	2738	1593	1.71
Pigeon pea+ groundnut(2:6)	4697	1595	2.94	4697	1595	2.94
Pigeon pea+ sesamum(2:4)	3641	1585	2.30	3641	1585	2.29

Table6. *Effect of intercropping systems on yield and yield attributes of pigeon pea*

Particular	Plant population/m^2	Total branches/plant	Effective branches/plant	Total pods/plant	Effective pods/plant	Length of pod (cm)	Seeds/pod	Damaged seeds (%)	1000 seed weight (g)	Seed yield(kg/ha)	Stick yield (kg/ha)	Harvest index (%)
Pigeon pea+ rice(2:5)	5.00	33.7	27.3	253.0	234.0	4.50	3.20	10.12	100.67	1098	8111	11.93
Pigeon pea+ fingermillet(2:4)	4.82	32.1	25.3	199.7	189.7	4.60	3.17	5.60	98.67	963	7822	10.96
Pigeon pea+ black gram(2:3)	3.79	38.0	30.7	271.0	262.3	4.57	3.05	5.82	106.00	893	7220	11.01
Pigeon pea+ groundnut(2:6)	2.93	40.6	31.7	282.3	271.7	4.66	3.10	8.44	107.33	943	7793	10.79
Pigeon pea+ sesamum(2:4)	3.46	29.2	23.3	201.7	193.0	4.33	3.20	10.46	100.67	873	7017	11.07
SEm (±)	0.27	2.25	1.69	17.46	18.15	0.11	0.18	2.12	2.61	44.65	183.8	0.48
CD(P=0.05)	0.87	7.34	5.50	56.91	59.2	NS	NS	NS	7.4	1.46	600	NS

Table7. *Economics of intercropping and cropping system*

Particulars	Gross return	Net return	B: C
Pigeonpea+ rice(2:5)	35,337	17,477	1.98
Pigeonpea+ fingermillet(2:4)	25,813	9,741	1.61
Pigeonpea+ blackgram(2:3)	20,398	7,443	1.57
Pigeonpea+ groundnut(2:6)	31,752	13,982	1.79
Pigeonpea+ sesamum(2:4)	25,309	12,620	1.99

Various intercrops like rice, finger millet, black gram, groundnut and sesamum influenced the growth like plant height, spread and dry matter accumulation and growth rate of pigeon pea from 60 DAS onwards. Intercropping with groundnut or black gram increased the growth parameters of pigeon pea. This might be ascribed to the short stature (75 to 80 cm) of the intercrops. The space between two paired rows of pigeon pea was also more, particularly in pigeon pea+ groundnut (210 cm). Pigeon pea plants in association with groundnut and black gram put up better initial growth (1.64 to 1.77 g/day/plant during 30 to 60 DAS) that resulted in production of more number of total (38.0 to 40.6) and effective (30.7 to 31.7) branches as well as total pods (271.0 to 282.3) per plant. Adikant *et al* (2014), Hiebsch and Collum(2009) and Jukanti *et al* (2012) have also reported no adverse effect of black gram and groundnut on growth of associated pigeon pea crop. On the other hand taller plants of sesamum (145 cm) and fingermillet (105 cm) from 60 DAS onwards might have depressed the growth of associated pigeonpea whose growth rate was usually low in initial stages i.e., 0.068 to 0.072 g/day/plant during first 30 DAS to 0.90 to 0.94 during next one month period. Depressing effect of fingermillet and sesamum was also visualised on branches and pods per plant of pigeon pea. Zhang *et al* (2009) have also reported suppressing effect of tall growing and initial vigorous growth of sesamum on associated rice crop. Varshney et al (2010), Rubyogo *et al* (2011) have also reported reduction in drymatter accumulation and yield of pigeonpea in association with fingermillet due to crop incompatibility. But length of pods, number of seeds per pod as well as 1000 seed weight being the varietal characterictics were not much influenced by any of the intercrops. However the seed yield on hectare basis in pigeon pea+ groundnut or pigeon pea+ black gram system was not higher because of less plant population/m^2 i.e., 2.93 and 3.79 respectively as compared to 5.0 in pigeon pea+ rice and 4.82 in pigeon pea+ fingermillet. As a result pigeon pea+ rice system produced the maximum pigeon peas yield of 1098 kg/ha. This is in agreement with the findings of Kar and Verma (2008) under Odisha condition. But with respect to stick yield pigeon pea+ rice, pigeon pea+ fingermillet and

pigeon pea+ groundnut were at par with each other i.e., 8111 kg/ha, 7822 kg/ha and 7793kg/ha respectively. Pigeon pea+ rice (2:5) and pigeon pea+ groundnut (2:6) were the most profitable pigeon pea based intercropping systems in conformity with the findings of Khan *et al* (2009), Panigrahi and panda (2008).

Pigeon pea+ rice and Pigeon pea+ groundnut intercropping systems were more efficient in rain water use with RWUE of 2.94 to 3.08 kg/ha, primarily because of their higher REYs. This is in agreement with the findings of Adikant *et al* (2014) . Inspite of higher system yield, RWUE of pigeon pea based intercropping systems were more or less equal because the pigeon pea cv. ICPL-87119(Asha) occupied the field for more than seven months and experienced more rainfall (1590 mm).

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