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Growth, Yield Attributes and Yield of Pigeonpea + Niger Intercropping System as Influenced by Planting Pattern under Rainfed Condition of Marathwada Region

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A B S T R A C T

A field experiment was conducted during *Kharif* 2016 at College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani to study the effect of crop growth, yield attributes and yield of pigeonpea + niger intercropping system as influenced by planting pattern under rainfed condition of Marathwada region. The experiment was laid out in Randomised Block design with three replication consists of T_1- pigeonpea + niger (1:2 row), T_2- pigeonpea + niger (1:2 rows), T_3- pigeonpea + niger (1:3 rows), T_4- pigeonpea + niger (1:3 rows), T_5- pigeonpea + niger (1:4 rows), T_6- pigeonpea + niger (1:4 rows), T_7- sole pigeonpea, T_8-sole niger. Pigeonpea equivalent yield (kg/ha) was significantly higher in sole pigeonpea (90×20cm) (1650kg/ha) followed by pigeonpea (120×30cm) + niger in 1:3 row proportion (1384.05kg/ha), pigeonpea (150×30cm) + niger in 1:4 row proportion (1321.6kg/ha) and pigeonpea (90×30cm) + niger in 1:2 row proportion (1311.81kg/ha). Lower pigeonpea equivalent yield was recorded in sole niger with planting geometry of 30x 10cm (646.76kg/ha).

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] This is also well known as redgram, arhar, tur, congopea, gungopea, no eye pea. It is an important kharif pulse crop grown for its dhal, fuel, and fodder belonging to the family fabaceae. It provides protein rich food, firewood and income for resource poor small farmers. With the complementary effect of pigeonpea on soil fertility improvement, nutrient recycling, smothering of weeds and efficient utilization of soil moisture under different cropping systems, it occupies more area in cropping systems than as a sole crop. Niger (*Guizotiaabyssinica)* commonly known as ramtil, kalatiland gurelluis a minor oilseed crop of India belongs to the family compositeae, indigenous to tropical Africa particularly to Ethiopia islands. It is very important oilseed crop in terms of oil content (40 percent), quality and potentiality. In India during 2016-17 pigeonpea was cultivated an area of 5.39 m.ha with a production of 4.60 m.t and productivity of 854 kg ha^{-1}andniger was cultivated an area of 2.51 m.ha with a production of 0.74 m.t and productivity of 295 kg ha^{-1}.In Maharashtraduring 2016-17

pigeonpea was cultivated an area of 1.26 m.ha with a production of 0.93 m.t and productivity of 741 kg ha^{-1}andniger was cultivated an area of 0.17 m.ha with a production of 0.04 m.t and productivity of 235 kg ha^{-1}. (Ministry of Agriculture and farmers welfare, GOI 2017). Among the abiotic constraints, the methods of planting and plant population play an important role in production of grain yield of pigeonpea. Thus it becomes necessary to develop an efficient and profitable pigeonpea based intercropping system for scarcity zone of Maharashtra. Success of any crop depends on use of quality seed and improved cultural practices. Among the agronomic practices, spacing play important role in maximizing the grain yield. A few studies of intercropping pigeonpea with oilseed like soybean, groundnut, sunflower etc., with pulses like green gram, black gram etc., was success. But studies on pigeonpea + niger intercropping system was lacking in India. An account of these facts an experiment was undertaken pigeonpea + niger intercropping system in different row proportion.

Materials and Methods

The experiment was conducted during *kharif* 2016 in Research farm of Division of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Geographically location of the site is situated at 19^0 16' North latitude and 76^0 47' East longitude and at 409 altitudes above sea level and has a semi-arid climate. The mean annual rainfall received during the crop growing period was1127 mm. The experimental soil was black soil having pH 8.1, medium in organic carbon (0.56%), low in available nitrogen (215.03$kgha^{-1}$) medium in available phosphorus (14.96 $kgha^{-1}$) medium in available K (506.6 $kgha^{-1}$). The experiment was laid out in RBD with 3 replications consists of 8 treatment combinations viz., T_1- pigeonpea + niger (1:2; 90x30 cm), T_2- pigeonpea + niger (1:2; 90x30 cm), T_3- pigeonpea + niger (1:3; 120x30 cm), T_4- pigeonpea + niger (1:3; 120x45 cm), T_5- pigeonpea + niger (1:4; 150x30 cm), T_6- pigeonpea + niger (1:4; 150x45 cm), T_7- sole pigeonpea (90x20 cm), T_8-sole niger (30x10 cm). The recommended dose of fertilizer for pigeonpea and Niger was applied separately (25 kg N: 50 kg P_2O_5 and 20 kg N: 20 kg P_2O_5 respectively).

The herbicide Pendimethalin@ 1.0 kg *a.i.* ha^{-1} was sprayed as pre-emergence for controlling weed and followed by hand weeding. Other package of practices was followed as per recommendation of Maharashtra state Department of Agriculture 2016. The plants from net plot were harvested from the ground level and were left for sun drying in the same field and were threshed manually. Grains were cleaned and weighed for expressing yields in $kgha^{-1}$. The weight of stalks was recorded separately and used for estimating stover yield. Pigeonpea equivalent yield was worked out for yield of one crop converted in to equivalent yield of other component crop using the following formula PEY (kg/ha).

Results and Discussion

Growth characters: Plant height

Sole crop of pigeonpea (90×20 cm) had significant influence on plant height (148.7 cm) due to more availability of all resources like nutrient, moisture and space. Sole crop of pigeonpea treatment was on par with pigeonpea intercropped with niger in 1:4 ratio and 1:2 ratio due to more competition of nutrients and light. Pigeonpea intercropped with niger in 1:3 ratio had recorded lower plant height of pigeonpea due to adequate space and proper row proportion. This result was in accordance withYadav and Maurya (2012) who reported that closely spaced pigeonpea plants grow rapidly in pigeonpea + soybean intercropping system (Table 1).

Table.1 Growth parameters of pigeonpea + niger intercropping system as influenced by planting pattern at harvest

Treatment	Plant height (cmplant$^{-1)}$		No. of functional leaves		No. of branches			Leaf area (dm^2 plant^{-1})		Drymatter production (g plant^{-1})	
	Main crop	Inter crop	Main crop	Inter crop	Main crop	Inter crop		Main crop	Inter crop	Main crop	Inter crop
						primary	secondary				
1:2 (90×30 cm:30×10 cm)	142.1	91.3	112.9	42.1	11.5	9.2	12.4	76.4	26.32	106.4	27.5
1:2 (90×45 cm:30×10 cm)	135.8	90.2	118.8	44.5	11.7	9.6	12.6	88.4	26.33	106.6	27.9
1:3 (120×30cm:30×10 cm)	117.5	96.0	184.0	38.4	12.9	8.6	11.6	92.1	24.67	109.9	26.0
1:3 (120×45cm:30×10 cm)	113.6	95.6	188.0	40.8	13.2	8.8	11.8	97.6	24.68	112.0	26.9
1:4 (150×30cm:30×10 cm)	133.5	103.8	140.0	34.6	11.8	7.7	10.5	90.9	23.03	108.1	24.2
1:4 (150×45cm:30×10 cm)	132.2	100.4	143.8	36.5	12.3	8.1	10.7	91.0	23.54	108.4	24.9
Sole pigeonpea (90×20 cm)	148.7	0.0	217.0	0.0	14.8	0.0	0.0	105.9	0.0	120.0	0.0
Sole niger (30×10 cm)	0.0	107.2	0.0	32.8	0.0	7.4	9.5	0.0	21.66	0.0	23.6
$SE_m\pm$	5.9	3.2	11.8	2.2	0.67	0.3	0.46	4.62	0.76	3.3	0.8
CD	17.8	9.8	35.6	6.8	2.03	0.9	1.42	14.00	2.31	10.1	2.5

Table.2 Effect of planting pattern in pigeonpea + niger intercropping on yield attributes at harvest

Treatment	Pigeonpea (main crop)				Niger (inter crop)			
	No. of pods plant^{-1}	Wt. of pods (g plant^{-1})	Wt. of seeds (g plant^{-1})	Seed Index (g)	No. of capitulae plant^{-1}	Wt. of capitulae (g plant^{-1})	Wt. of seeds (g plant^{-1})	Test weight (g)
1:2 (90×30cm:30×10 cm)	105.0	61.65	30.15	8.6	43.7	5.59	4.7	4.80
1:2 (90×45cm:30×10 cm)	112.5	63.03	31.53	8.7	44.0	5.64	4.8	4.82
1:3 (120×30cm:30×10 cm)	121.8	75.04	41.54	10.4	41.7	5.42	4.4	4.73
1:3 (120×45cm:30×10 cm)	128.0	77.55	44.05	10.6	42.2	5.53	4.5	4.76
1:4 (150×30cm:30×10 cm)	114.7	67.86	35.36	9.4	37.8	5.37	4.2	4.60
1:4 (150×45cm:30×10 cm)	117.5	69.11	36.61	9.5	38.2	5.38	4.2	4.65
Sole pigeonpea (90×20 cm)	134.0	83.08	49.58	11.4	0.0	0.0	0.0	0.0
Sole niger (30×10 cm)	0.0	0.0	0.0	0.0	29.8	4.66	3.6	4.20
$SE_m\pm$	3.9	2.7	2.98	0.4	1.38	0.07	0.20	0.23
CD	12.0	8.2	9.04	1.4	4.19	0.24	0.56	NS

Table.3 Effect of planting pattern on yield of pigeonpea + niger intercropping at harvest

Treatment	Seed yield (kgha^{-1})		Pigeonpea equivalent yield (kgha^{-1})	Stalk yield (kgha^{-1})		Harvest index	
	Main crop	Inter crop		Main crop	Inter crop	Main crop	Inter crop
1:2 (90×30cm:30×10 cm)	1070.74	699.8	1311.81	3725.26	3398.82	22.35	17.07
1:2 (90×45cm:30×10 cm)	734.56	703.4	1077.77	2968.43	3451.08	19.83	16.93
1:3 (120×30cm:30×10 cm)	1022.77	760.8	1384.05	3213.24	3796.70	24.14	16.69
1:3 (120×45cm:30×10 cm)	718.66	762.5	1127.64	2617..35	3828.62	21.54	16.60
1:4 (150×30cm:30×10 cm)	722.80	790.0	1321.16	2871.2	3882.65	20.11	16.90
1:4 (150×45cm:30×10 cm)	494.14	795.2	981.99	2382.85	3901.32	17.15	16.93
Sole pigeonpea (90×20 cm)	1650	0.0	1650	5165	0.0	24.21	0.0
Sole niger (30×10 cm)	0.0	853.9	646.76	0.0	4652.66	0.0	15.50
$SE_m\pm$	24.96	23.0	188	318.9	261.5	0	0
CD	95.64	72.1	564	966.2	792.6	0	0

The plant height of sole niger crop recorded significantly superior and which was on par with row proportion of 1:4 because more plant population due to competition with main crop and inter crops. The row proportion of 1:4 ratios was on par with all the remaining treatments. The lower plant height of niger was recorded in 1:2 row proportion. Similar concomitant findings were observed in Sonawane *et al.,* (2011) also reported that closely spaced soybean plants grow rapidly.

No. of functional leaves, branches, leaf area and dry matter production

Sole pigeonpea (90×20cm) had also significantly influenced on maximum no, of functional leaves, branches, leaf area) and dry matter production (217, 14.8, 105.9 dm^2, 120 g $plant^{-1}$ respectively) due to less competition between plant to plant compared to other treatments. It was on par with 1: 3 row proportion of pigeonpea + niger intercropping system than other row proportion, because more aggressivity behaviour of pigeonpea on niger than other row proportion.

In niger maximum no. of leaves, branches, leaf area, dry matter production (44.5, primary-9.6, secondary-12.6, 26.33dm^2, 27.9 g $plant^{-1}$ respectively) was recorded under planting geometry (1:2; 90×45cm). This might be due to less competition for nearer rows of Niger to soil moisture and space for leaf proliferation and less aggressive behaviour of pigeonpea on Niger. It was on par with planting geometry (1:2; 90×30cm) and 1:3 rows proportion. The lower no. of leaves, branches, leaf area and dry matter production of niger was recorded under sole niger (30×10cm)

Yield and yield attributes

In pigeonpea no. of pods, weight of pods, weight of seeds, seed index (134, 83.8 g, 49.58 g, 11.4 g $plant^{-1}$ respectively) were significantly higher under sole pigeonpea (90×20cm). This was followed by 1:3 rows proportion over other planting geometry in different row proportion. This might be due to lower production of photosynthates and more competition for space, nutrients, and soil moisture due to reduced nutritional area $plant^{-1}$. These results are in conformity with the research findings concluded by Ujjinath *et al.,* (1990) (Table 2).

Planting geometry of Niger crop (1:2; 90×45cm) was recorded maximum no. of capitulae, weight of capitulae, weight of seeds (44, 5.64 g 4.8 g $plant^{-1}$ respectively), which was on par with planting geometry (1:2; 90×30cm) and 1:3 rows proportion due to maximum no. of leaves results to higher production of photosynthates.

Higher pigeonpea equivalent yield (1650 kg ha^{-1}) was obtained in narrow planting geometry of sole pigeonpea (90×20cm) due to higher seed yield. The similar trends of results are found in pigeonpea based intercropping system by Rathod *et al.,* (1990). The lower pigeonpea equivalent yield (981.99 kg ha^{-1}) was recorded in wider planting geometry of pigeonpea + niger (1:4; 150×45cm) in intercropping system. This could be attributed to lesser aggressivity of pigeonpea + niger intercropping system (Table 3).

From findings it can be concluded that Pigeonpea equivalent yield (kg/ha) was significantly higher in sole pigeonpea (90×20cm) followed by pigeonpea (120×30cm) + niger in 1:3 row proportion pigeonpea (150×30cm) + niger in 1:4 row proportion and pigeonpea (90×30cm) + niger in 1:2 row proportion (1650$kgha^{-1}$, 1384.05 $kgha^{-1}$, 1321.6$kgha^{-1}$ and 1311.81$kgha^{-1}$ respectively). Lower pigeonpea equivalent yield was recorded in sole niger with planting geometry of 30x10cm (646.76$kgha^{-1}$).

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