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Influence of intercropping on the growth and yield of little millet and pigeonpea

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ABSTRACT

A field experiment was conducted at Saidapur farm, Main Agricultural Research Station, Dharwad during *Kharif* 2002 on alfisols to study the effect of row proportions of little millet + pigeonpea intercropping system on growth and yield of component crops. Among the intercropping treatments little millet and pigeonpea intercroped in 5:1 row ratio produced significantly higher dry matter production, ear length, grain weight, grain yield of little millet and pigeonpea. As regards sole and intercropping systems, yield of little millet and pigeonpea was highest in sole cropping. The highest little millet equivalent yield was recorded with 4:2 row ratio followed by 2:1, 6:2 and 3:1 row ratios. Relay cropping of little millet + horsegram recorded significantly higher LMGEY than that obtained under little millet alone. Among all the treatments sole little millet alone recorded the lowest LMGEY.

Key words : Little millet, Pegionpea, Intercrops, LMGEY, Row proportion

INTRODUCTION

Little millet (*Panicum sumatrense* L.) and pigeonpea (*Cajanus cajan* L.) are important *Kharif* crops on shallow alfisols of northern transitional zone of Karnataka. Little millet is quick growing and early maturing crop. Under the present system of cultivation the land and other resources are under utilized. The land use efficiency can be increased particularly after harvest of this crop, which can be efficiently utilized by adopting intercropping system. In intercropping system, the competitive effects between main and intercrop depends on the rooting pattern, canopy structure and days to maturity. The intercropping system of cereals + pigeonpea/legumes were tested and found to be profitable systems (Dhoble *et al.*, 1990; Goyal *et al.*, 1993; Pal *et al.*, 1991). The present experiment, therefore, was planned to study the competitiveness of short duration little millet with long duration pigeonpea crops grown in intercropping systems.

MATERIALS AND METHODS

The field experiment was conducted at Saidapur farm, Main Agricultural Research Station, Dharwad during the *Kharif* season 2002 using Sukshema (TNAU-63) variety of little millet and Asha (ICPL-87119) variety of pigeonpea in 2:1,3:1,5:1, 4:2 and 6:2 row ratio. It was laidout in randomised block design with three replications. The crops were sown on 14th June 2003 on alfisols (red soil). Both the crops were fertilized separately as per the recommendation. The data on dry matter accumulation per m row length in leaf, stem and reproductive parts and total dry matter production, yield and yield components were recorded in both the crops. Harvest index and LMGEY were also computed. Little millet was harvested on 7th September 2002 and that of pigeonpea on 10th December 2002.

RESULTS AND DISCUSSION

Little millet yield obtained in sole and intercropping treatments differed significantly. Growing of little millet as an entire crop with normal row spacing (30 cm) recorded significantly higher grain yield (783 kg/ha) than the intercropped little millet (549 kg/ha). It was at par with little millet in relay intercropping systems (776 kg/ha). The extent of reduction in grain yield of little millet due to intercropping was 29.88 per cent compared to sole cropping. The higher yield of little millet under sole cropping could be attributed to higher population and competition free environment as compared to intercropped little millet (population varied from 66.67-83.33%) which resulted in better growth and yield components. Similar findings had been reported by Shashidhar *et al.* (2000) in little millet + pigeonpea.

Row proportion had a significant influence on grain yield of little millet. Little millet and pigeonpea in 5:1 row ratio recorded significantly higher little millet grain yield (650 kg/ha). The extent of increase in grain yield of little millet in 5:1 row proportion was to an extent of 10.77, 16.92, 21.54 and 28.47 per cent over 6:2, 3:1, 4:2 and 2:1 row proportions, respectively. This variation in the grain yield of little millet could be attributed to better yield components, higher population of little millet in 5:1 row proportion and least competition between the component crops. The extent of increase in population in 5:1 was 11.11, 11.11, 24.99 and 24.99 per cent over 6:2, 3:1, 4:2 and 2:1 row ratios, respectively. Though the population was same in 6:2 and 3:1 or 4:2 and 2:1, higher grain yield of little millet was recorded in 6:2 and 4:2 compared to

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3:1 and 2:1, respectively. It was due to greater availability of light and its efficient use. Similar results were also reported by Gadhia *et al.* (1995) in pearl millet + pigeonpea or greengram or groundnut (3:1), Raghavulu and Rama Rao (1994) in foxtail millet + pigeonpea (5:1), Shashidhar *et al.* (2000) in little millet + pigeonpea (4:2).

The lowest grain yield of little millet (465 kg/ha) was recorded with 2:1 row proportion on an account of lowest population, yield components and greater competition between little millet and pigeonpea.

Straw yield was significantly higher in sole little millet (1278 kg/ha) and relay intercropped little millet (1266 kg/ha) compared to intercropped little millet (956 kg/ha) but sole and relay intercropping little millet were at par with each other. This increase in the straw yield could be attributed to higher population, plant height, total dry matter production and its distribution into leaves and stem parts at harvest.

Among different row proportions significantly higher straw yield was recorded with 5:1 row proportion (1067 kg/ha) which was at par with 3:1 and 6:2 row proportions (960 and 988 kg/ha, respectively). The extent of increase in straw yield of little millet with 5:1 row proportion was to an extent of 6.68, 9.52, 14.51 and 18.57 per cent over 6:2, 3:1, 4:2 and 2:1 row proportions, respectively. This was obviously because of higher population level over other row proportions. Significantly lowest straw yield (864 kg/ha) was recorded with 2:1 row proportion on account of lowest population which was at par with 4:2, 3:1 and 6:2 row proportions (907, 960 and 988 kg/ha, respectively).

The yielding ability of a crop is also the reflection of yield attributing parameters. The reduction in grain yield of little millet could be traced back to a significant reduction in yield components such as, number of effective tillers per meter row length, grain yield per panicle, grain yield per meter row length and ear length of little millet under intercropping as compared to the sole crop. Similar reduction in yield components in intercropping system as compared to sole cropping was observed by Singh *et al.* (1994) in pearl millet + pigeonpea, Singh and Arya (1995) and Ramulu *et al.* (1998) in pearl millet + pigeonpea.

Among different row proportions, significantly the higher grain yield of little millet in 5:1 row proportion could be attributed to higher number of effective shoots/meter row length, grain yield per panicle, grain yield/meter row length. Raghavulu and Rama Rao (1994) reported that significantly higher panicle length, panicle weight and number of grains per panicle were observed when foxtail millet was intercropped with pigeonpea in 5:1 row ratio compared 3:1 and 1:1 row proportions.

Table 1 : Dry matter accumulation in leaves, stem and reproductive parts (g/plant) of little millet as influenced by intercropping of little millet and pigeonpea in different row proportions

Treatments	Dry matter accumulation in leaves (g/m row length)			Dry matter accumulation in stem (g/m row length)			Dry matter accumulation in reproductive parts (g/m row length)		Total dry matter production (g/m row length)		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Sole little millet (30 cm)	5.70	18.83	18.33	2.87	32.40	50.53	7.89	31.20	8.57	59.12	99.06
Little millet + pigeonpea (2:1)	5.27	13.00	12.37	2.53	24.33	35.73	5.74	21.17	7.80	43.10	69.24
Little millet + pigeonpea (3:1)	5.40	13.77	13.20	2.63	24.90	37.50	6.02	23.13	8.03	44.72	74.57
Little millet + pigeonpea (5:1)	5.63	16.53	16.03	2.73	28.47	44.33	7.07	26.40	8.36	52.07	86.76
Little millet + pigeonpea (4:2)	5.47	14.40	13.93	2.67	25.27	38.87	6.29	23.17	8.13	45.96	75.97
Little millet + pigeonpea (6:2)	5.50	15.73	15.27	2.70	27.50	43.07	6.50	25.53	8.20	49.74	83.87
Little millet + relay horsegram	5.77	18.70	18.00	2.80	31.70	49.60	7.88	30.47	8.57	58.28	97.27
S.E.±	0.27	0.68	0.64	0.11	1.03	1.65	0.23	1.03	0.44	1.74	3.02
C.D. (P = 0.05)	NS	2.11	1.98	NS	3.16	5.09	0.70	3.16	NS	5.36	9.31
Cropping system											
Sole little millet	5.70	18.83	18.33	2.87	32.40	50.53	7.89	31.20	8.57	59.12	99.06
Relay little millet	5.77	18.70	18.00	2.80	31.70	49.60	7.88	30.47	8.57	58.28	97.27
Intercropped mean	5.45	14.69	14.15	2.65	26.09	39.90	6.33	23.88	8.11	47.12	78.08
S.E.±	0.16	0.58	0.52	0.08	1.00	1.52	0.25	0.89	0.31	1.84	2.98
C.D. (P = 0.05)	NS	2.26	2.02	NS	3.94	5.97	0.96	3.51	NS	7.21	11.69

NS – Non significant, DAS – Days after sowing

Table 2 : Yield and Yield components of little millet and pigeonpea and little millet grain equivalent yield (LMGEY) as influenced by intercropping of little millet and pigeonpea in different row proportions

Treatments	Little millet							Pigeonpea								
	Ear length (cm)	Grain yield (g) /panicle	Grain yield (g)/m row length	1000-seed weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index	No. of pods per plant	No. of seeds per pod	Seed yield per plant (g)	100-seed weight (g)	Grain yield (kg/ha)	Stalk yield (kg/ha)	Litter yield (kg/ha)	Harvest index	LMGEY (kg/ha)
Sole little millet (30 cm)	19.4	0.67	27.2	2.87	783	1278	0.38	-	-	-	-	-	-	-	-	1267
Sole pigeonpea (60 x 30 cm)	-	-	-	-	-	-	-	78.3	3.3	19.96	9.11	682	1670	494	0.29	1183
Sole pigeonpea (90 x 20 cm)	-	-	-	-	-	-	-	75.0	3.2	17.83	8.86	637	1638	452	0.28	783
Little millet + pigeonpea (2:1)	13.1	0.49	18.2	2.70	465	864	0.35	67.3	3.2	16.05	8.65	522	1486	402	0.27	1434
Little millet + pigeonpea (3:1)	14.0	0.52	20.0	2.73	540	960	0.36	57.6	3.0	13.43	8.47	400	1200	360	0.26	1283
Little millet + pigeonpea (5:1)	16.7	0.59	23.4	2.87	650	1061	0.38	52.0	2.9	12.29	8.39	260	823	298	0.24	1133
Little millet + pigeonpea (4:2)	14.2	0.54	21.2	2.80	510	907	0.36	65.2	3.0	15.97	8.65	515	1466	399	0.26	1466
Little millet + pigeonpea (6:2)	16.5	0.58	22.5	2.83	580	988	0.37	54.4	3.0	13.06	8.40	380	1140	341	0.25	1286
Little millet + relay horsegram	18.9	0.65	26.5	2.90	776	1266	0.38	27.8	2.9	2.09	2.51	350	996	232	0.26	1176
S.E.±	0.7	0.02	0.9	0.12	21	40	0.01	2.3	0.2	0.54	0.38	19	43	15	0.01	43
C.D. (P = 0.05)	2.1	0.06	2.7	NS	74	123	NS	7.2	NS	1.66	NS	58	134	46	0.03	130
Cropping systems																
Sole little millet	19.4	0.67	27.2	2.87	783	1278	0.38	78.3	3.3	19.96	9.11	682	1670	494	0.29	
Relay little millet	18.9	0.65	26.5	2.90	776	1266	0.38	75.0	3.2	17.83	8.86	637	1638	452	0.28	
Intercropped mean	14.9	0.54	21.0	2.79	549	972	0.36	59.3	3.0	14.16	8.51	415	1223	360	0.26	
S.E.±	0.6	0.02	0.7	0.09	30	44	0.01	2.7	0.2	0.62	0.31	25	66	14	0.01	
C.D. (P = 0.05)	2.3	0.07	2.9	NS	116	173	NS	16.5	NS	NS	3.74	NS	151	381	84	

NS-Non significant

The lowest grain yield of little millet was noticed when it was intercropped with pigeonpea in 2:1 row proportion on account of lowest number of effective shoots per meter row length, grain yield per panicle, grain yield per meter row length and ear length. Kalaghatagi *et al.* (1995) also reported higher grain yield of pearl millet in 4:2 row ratio compared to 2:1, 1:1 and 3:3 row ratios of pearl millet + pigeonpea intercropping. The lowest grain yield of little millet in 2:1 row proportion might be due to higher competition offered by pigeonpea for natural resources apart from lower population level.

Effect of intercropping system on the performance of pigeonpea:

Significantly higher grain yield of pigeonpea (682 and 637 kg/ha) was recorded in sole pigeonpeas (60 x 30 and 90 x 20 cm, respectively). Average increase in grain yield of pigeonpea due to sole cropping (60 x 30 cm) was to an extent of 23.46, 24.48, 41.35, 44.28 and 61.88 per cent over 2:1, 4:2, 3:1, 6:2 and 5:1 row proportions, respectively. Singh *et al.* (1994) and Gadhia *et al.* (1993) reported that pure cropping of pigeonpea gave significantly higher grain yield, but drastic reduction in grain yield of pigeonpea was observed when it was intercropped with pearl millet. Kalaghatagi *et al.* (1995) also reported similar results. The result is also in line with the work carried out by Shashidhar *et al.* (2000) in little millet + pigeonpea intercropping. The increased grain yield in sole pigeonpeas can be attributed to better planting arrangement with normal intrarow spacing (30 cm and 20 cm, respectively) which led to least inter and intra row competition.

Further, pigeonpea yield was determined by the yield attributes, such as pods per plant, seeds per pod, seed yield per plant and test weight. All these yield attributing characters were higher in sole pigeonpeas. The extent of average improvement in pods per plant of sole pigeonpea (60 x 30 cm) was 13.43, 16.92, 33.33, 40.94 and 46.15 per cent and grain weight per plant was 16.51, 17.07, 39.24, 43.19 and 52.15 per cent over 2:1, 4:2, 3:1, 6:2 and 5:1 row proportions, respectively. These results agree with findings of Singh *et al.* (1994) and Maitra *et al.* (2001) where in sole pigeonpea recorded significantly higher number of pods per plant than in intercropped pigeonpea with pearl millet.

Stalk yield differed significantly due to different treatments, significantly higher stalk yield (1670 and 1638 kg/ha) was observed with sole pigeonpeas (60 x 30 cm and 90 x 20 cm, respectively) compared to intercropped pigeonpea (1223 kg/ha). This can be attributed to better planting pattern and total dry matter production and distribution into different parts. Among row proportions 2:1 and 4:2 row proportions recorded significantly higher stalk yield (1486 and 1466 kg/ha, respectively) compared to 3:1, 6:2 and 5:1 row proportions (1200, 1140 and 823 kg/ha, respectively). Maitra *et al.* (2001) revealed that sole pigeonpea recorded significantly higher stick yield compared to pigeonpea intercropped with finger millet in 4:1 row proportion.

Growing of pigeonpea in association with little millet resulted in addition of organic matter in the form of litter. The addition of litter (494 and 452 kg/ha) was significantly higher in sole pigeonpeas (60 x 30 cm and 90 x 20 cm, respectively) over intercropped pigeonpea (360 kg/ha). Among intercropping treatments 2:1 and 4:2 row proportions added significantly higher litter (402 and 399 kg/ha, respectively). This implies that pigeonpea has potential to return back the exhausted nutrients through its higher leaf litter in combination with little millet in the field.

Little millet grain equivalent yield (LMGEY):

Little millet equivalent yield differed significantly due to different intercropping and sole crop treatments. Intercropping of little millet with pigeonpea in 4:2 row ratio recorded significantly higher little millet equivalent yield (1466 kg/ha) over all other treatments but was at par with 2:1 row proportion (1434 kg/ha). The extent of increase was 13.57, 19.30, 46.59, 12.48, 22.71, 13.51 and 19.78 per cent over sole pigeonpeas (60 x 30 cm and 90 x 20 cm, respectively), sole little millet, 3:1, 5:1, 6:2 and relay intercropped little millet, respectively. Higher little millet grain equivalent yield in 4:2 and 2:1 row proportions of little millet + pigeonpea intercropping was due to higher yield of pigeonpea and its market price coupled with better utilisation of the resources by the component crops in intercropping system. Gadhia *et al.* (1993) reported that higher pearl millet equivalent yield was observed in pearl millet + pigeonpea intercropping under 2:1 row proportion compared to 3:1 row ratio. Kalaghatagi *et al.* (1995) obtained higher pearl millet equivalent yield under 4:2 row proportion over 2:1, 1:1 and 3:3 row ratios in pearl millet + pigeonpea intercropping. Shashidhar *et al.* (2000) also recorded higher finger millet equivalent yield under 4:2 row proportion in finger millet + pigeonpea intercropping compared to 3:1 and 5:1 row proportions.

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