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Studies on Intercropping in Rainfed Littlemillet (*Panicum sumatrense*)

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A B S T R A C T

Field experiment was conducted to investigate the relative performance and the effects of legume intercropping system on productivity of little millet with two different row ratios (4:1 and 6:1) during *kharif* seasons 2016, at the Centre of Excellence in Millets, Athiyandal, Tiruvannamalai District. Among the intercropping system, little millet +pigeonpea- horsegram (6:1) or little millet+pigeonpea-mothbean (6:1) sequence produced plant height, DMP, productive tillers / plant, thousand grain weight, grain yield, stover yield and little millet grain equivalent yield (LMGEY). Among the two intercrops studied, pigeonpea and lablab yield per hectare was comparatively higher at 4:1 ratio. Sequential crop (horsegram and mothbean) yield was also highly influenced by pigeonpea intercropping. Both horsegram (757 kg / ha) and mothbean yield (658 kg / ha) was higher in 6:1 ratio when intercropped with pigeonpea. The highest gross return (Rs. 86,379 / ha), net return (Rs. 48,209 / ha) and benefit cost ratio (2.26) were recorded by little millet intercropped with pigeonpea at 6:1 ratio with horsegram / mothbean as sequence crop.

Introduction

Little millet (*Panicum sumatrense*) is one of the small millets and is a staple food grain crop for the poor people in the tribal areas of India. It is an annual grass, with culm height of 30-90 cm. height, rather slender, erect or base geniculate, simple or branched, leaves linear, 15 to 50 cm or more in length, 12 to 25 mm broad, gradually tapering from a broad base, glabrous or finely hairy. The crop is well known in Tamil Nadu and grown quite extensively in many parts of the state. Under the present system of cultivation the land and other resources are underutilized. The land use efficiency can be increased efficiently by adopting intercropping system. Intercropping of legumes with cereals is a recognized practice for economizing the use of nitrogenous fertilizers and increasing the productivity and profitability per unit area and time.

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 (Patil, 2003). The present experiment, therefore was planned to study the competitiveness of short duration little millet with long duration pigeonpea and lablab crops grown in intercropping systems with sequential crops of horsegram and moth bean.

Materials and Methods

A field experiment was conducted at Centre of Excellence in Millets, Athiyandal, Tiruvannamalai district during 2016. The soil of the experimental field was sandy clay loam in texture, medium in organic carbon (0.50 %), and low in available nitrogen (285 kg / ha) low in available phosphorous (11.0 kg / ha) and available potassium (89.0 kg / ha) with alkaline reaction (pH 8.3).

The experiment was comprised of 10 treatments, *viz*., T_1: Littlemillet sole crop - Horsegram, T_2: Littlemillet sole crop - Mothbean, T_3: Littlemillet + Pigeonpea (4:1) - Horsegram, T_4: Littlemillet + Pigeonpea (4:1) - Mothbean, T_5: Littlemillet + Pigeonpea (6:1) - Horsegram, T_6: Littlemillet + Pigeonpea (6:1) - Mothbean, T_7: Littlemillet + Lablab (4:1) - Horsegram, T_8: Littlemillet + Lablab (4:1) - Mothbean, T_9: Littlemillet + Lablab (6:1) - Horsegram, T_{10}: Littlemillet + Lablab (6:1) -Mothbean. The experimental was laid out in randomized block design with three replications, the little millet variety Co (*Samai*) 4, was sown with Pigeonpea (Co (Rg) 7), lablab (Co 13) followed by sequential crops of horse gram (Paiyur 2) and moth bean (TMV (Mb) 1) pulses crops.

Basal application of 44:22:0 kg NPK / ha was given for base crop of little millet uniformly to all the plots at the time of sowing and no additional dose of fertilizers was used for intercrops. For comparison between treatments, the yields of all intercrops were converted into little millet equivalent yield on price basis.

Results and Discussion

Growth and yield attributes

Growth attributes like plant height and dry matter production was significantly affected by intercropping. Plant height of littlemillet was found to be higher at all the stages under the treatment, little millet + pigeonpea - horsegram at 6:1 ratio (T_5) (129.5 cm at harvest) followed by littlemillet + pigeonpea - mothbean at 6:1 ratio (T_6) (127.6 cm at harvest) (Table 1). Among the various intercrops, littlemillet + pigeonpea-horsegramat 6:1 ratio (T_5) intercropping system produced higher dry matter production (6543 kg / ha) followed by littlemillet + pigeonpea - mothbean at 6:1 ratio (T_6) (6352 kg / ha). Similar results were also obtained by Kaushik and Sharma (2017) in wheat based intercropping system.

The yielding ability of a crop is reflected through its yield attributing characters. The yield attributes of littlemillet like number of productive tillers per hill and test weight is found to be increased when intercropped with pigeonpea at 6:1 ratio (Table 1). This might be due to development of better complementary relationship and non-renewable resources like water, nutrients and incoming sunlight. Tripathi and Kushwaha (2013) also reported that plant height and number of leaves per plant of pearl millet under intercropping system were either higher or statistically at par with sole pearl millet, which might be due to better utilization of space and light interception coupled with nutrient contribution of leguminous crop to cereal crop.

Yield and system productivity

The grain yield of little millet was significantly influenced by various intercrops at harvest and the grain yield ranged from 803 to 1602 kg / ha (Table 2).

Table.1 Effect of intercropping on growth and yield attributes of littlemillet

	Treatments	Plant height (cm) (At harvest)	Dry matter production (kg / ha)	Number of tillers / hill	No. of grains per panicle	Test weight (g)
T_1	Little millet sole crop - Horsegram	108.0	5700	9	242	2.41
T_2	Little millet sole crop - Mothbean	110.3	5689	8	234	2.40
T_3	Little millet + Pigeonpea (4:1) Horsegram	113.9	4714	9	235	2.39
T_4	Little millet + Pigeonpea (4:1) - Mothbean	111.6	4686	9	234	2.38
T_5	Little millet + Pigeonpea (6:1) - Horsegram	129.5	6543	10	250	2.43
T_6	Little millet + Pigeonpea (6:1) - Mothbean	127.6	6352	10	248	2.43
T_7	Little millet + Lablab (4:1) - Horsegram	107.8	4365	9	242	2.39
T_8	Little millet + Lablab (4:1) - Mothbean	106.8	4165	8	230	2.37
T_9	Little millet + Lablab (6:1) - Horsegram	119.4	5421	9	243	2.42
T_{10}	Little millet + Lablab (6:1) - Mothbean	120.3	5162	9	242	2.41
	SEd	5.80	281	0.7	19.45	0.19
	CD (P=0.05)	12.11	588	NS	NS	NS

*Significant at P 0.05; NS- Non Significant at P > 0.05

Table.2 Economics of littlemillet as influenced by intercropping (2016-17)

Treatments		Littlemillet yield(kg / ha)		Yield of intercrops (kg / ha)	Little millet Grain equivalent yield (GEY)	Yield of sequential crops (kg / ha)	Gross income (Rs / ha)	Net income (Rs/ha)	B:C ratio
		Grain	Straw						
T_1	Little millet sole crop - Horsegram	1340	4259	-	-	804	66,263	27,887	1.73
T_2	Little millet sole crop - Mothbean	1365	4148	-	-	860	63,957	24,808	1.63
T_3	Little millet + Pigeonpea (4:1) Horsegram	924	3637	295	1463.5	612	64,294	29,168	1.83
T_4	Little millet + Pigeonpea (4:1) - Mothbean	955	3574	308	1519.8	621	63,018	27,332	1.77
T_5	Little millet + Pigeonpea (6:1) - Horsegram	1602	4774	231	2025.7	757	86,379	48,209	2.26
T_6	Little millet + Pigeonpea (6:1) - Mothbean	1584	4656	224	1995.5	658	79,540	40,683	2.05
T_7	Little millet + Lablab (4:1) - Horsegram	811	3233	1471	1154.3	561	53,462	9,610	1.22
T_8	Little millet + Lablab (4:1) - Mothbean	803	3096	1395	1128.2	609	50,365	5,953	1.13
T_9	Little millet + Lablab (6:1) - Horsegram	1163	4044	682	1321.8	549	59,042	16,090	1.37
T_{10}	Little millet + Lablab (6:1) - Mothbean	1168	3852	693	1329.9	573	56,749	15,873	1.39

The highest grain and straw yields were recorded little millet + pigeonpea - horsegram at 6:1 ratio (T_6) (1602 kg / ha grain yield and 4774 kg / ha straw yield, respectively) and it was on par with littlemillet + pigeonpea - mothbean at 6:1 ratio (T_6) (1584 kg / ha grain yield and 4656 kg / ha straw yield, respectively). Higher grain yield of pigeonpea in 6:1 row ratios could be attributed to higher yield attributes and least competition due to better planting arrangement. These results are in close conformity with the findings of Rathore and Gautam (2003) revealed significant increase in yield components when foxtail millet was intercropped with pigeonpea at 5:1 ratio as compared to 1:1 row ratio.

Horsegram and mothbeanyield were significantly higher in littlemillet -horsegram/ mothbean sequence than horsegram/mothbean relayed in littlemillet + pigeonpea or lablab in 4:1 or 6:1 row ratios, but it was on par with horsegram/mothbean relayed in littlemillet + pigeonpea in 6:1 row ratio. Similar finding was reported by Kumar *et al.,* (2008).

Little millet equivalent yield (GEY) (Table 2) was calculated for comparing different intercropping combinations. The highest little millet grain equivalent yield (2025.7 kg / ha) was recorded in 6:1 row ratio of little millet + pigeonpea -horsegram sequence which was closely followed by 6:1 row proportion of little millet + pigeonpea -mothbean sequence (1995.5 kg / ha). Ansari *et al.*, (2011) reported that pearl millet intercropped with pigeonpea recorded significantly higher pearl millet equivalent yield as compared to sole stand of component crops. It was due to almost similar yield of intercropped pearl millet as that of its sole stand and additional yield of pigeonpea as a bonus in intercropping system. Kumar *et al.,* (2008) reported that the higher little millet grain equivalent yield in 6:2 row ratio and horsegram sequence was due to higher yield of little millet and pigeonpea coupled with better utilization of the natural resources by the component crops in intercropping system.

Economics of intercropping

The highest gross return (Rs. 86,379 / ha), net return (Rs. 48,209 / ha) and benefit cost ratio (2.26) were recorded by little millet intercropped with pigeonpea at 6:1 ratio with horsegram as sequence crop during 2016 (Table 2). Little millet intercropped with pigeonpea at 6:1 ratio with mothbean as sequence crop was found to be the second best. According to Seran and Brintha (2009) the intercropping system provides higher cash return to smallholder farmers than growing the monocrops.

Based on these results, it may be summarised that to increase the productivity per unit area in littlemillet intercropping system under rainfed conditions of Tiruvannamalai district, growing of little millet and pigeonpea in 6:1 row ratio with horsegram or mothbean in sequence have been found superior over other intercropping systems and also growing sole crop of little millet alone.

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