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Studies on Agro Techniques to Improve the Productivity and Profitability of Samai +Redgram Intercropping System under Rainfed Conditions

K. Sivagamy*, K. Ananthi, P. Kannan, M. Vijayakumar, K. Sharmili, M. Rajesh, A. Nirmalakumari and P. Parasuraman

Department of Agronomy, Centre of Excellence in Millets, TamilNadu Agricultural University, Athiyandal-606603, Tiruvannamalai, TamilNadu, India

**Corresponding author*

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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 redgram intercropping system on productivity of samai with three different row ratios (4:1, 6:2 and 8:2) during kharif seasons 2016, 2017 and 2018 at the Centre of Excellence in Millets, Athiyandal, Dry Land Agricultural Research Station - Chettinad and Regional Research Station – Paiyur. Among the intercropping system, Samai+Redgram- horsegram (8:2) or Samai +Redgram-mothbean (8:2) sequence produced plant height, DMP, productive tillers / plant, thousand grain weight, grain yield, stover yield and little millet grain equivalent yield (LMGEY). Sequential crop (horsegram and mothbean) yield was also highly influenced by redgram intercropping under system. The highest gross returns (Rs. 53798/ ha), net returns (Rs. 28393/ ha) and benefit cost ratio (2.12) were recorded by samai intercropped with pigeonpea at 8:2 ratio with Succeeding crop of horsegram/ mothbean as sequence crop.

Introduction

Little millet (*Panicum sumatrense*) is a minor millet and is a staple food grain crop for the poor people in the tribal areas of India. Little millet cultivation is seen only in about 0.5 million ha (AICSMIP, 2015) in India. The crop is well known in Tamil Nadu and grown quite extensively in many parts of the country. Its colloquial names are kutki, samai, samalu etc., The crop is strongly associated with tribal agriculture and grown as an important catch crop in view of its earliness and resistance to adverse agro climatic conditions. Intercropping is an age old practice being followed by subsistence farmers to achieve their domestic needs.

The main advantage of the intercropping is that the component crops are able to use the growth resources differently and make better overall use of growth resources than grown

separately (Willey, 1979). It was considered as part of holistic farming designed to meet diverse domestic requirement. It is now generally perceived that the main advantage of intercropping is stability and risk aversion. Among food and feed crops, millets as a group figure prominently especially in the dryland farming system. Small millets are often grown mixed with legumes/pulses viz., pigeonpea, dolichos, green gram and black gram and oil seeds like niger, mustard and castor.

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, Dry Land Agricultural Research Station - Chettinad and Regional Research Station – Paiyur district during kharif, 2016, 2017 and 2018. The soil of the experimental field was sandy clay loam in texture of three centres. The experiment was comprised of 9 treatments, viz., T_1-Samai + Redgram (4:1) - Moth bean, T_2-Samai + Redgram (4:1) – Blackgram, T_3-Samai + Redgram (4:1) – Horsegram, T_4-Samai + Redgram (6:2) – Moth bean, T_5- Samai + Redgram (6:2) - Blackgram, T_6- Samai + Redgram (6:2) – Horsegram, T_7-Samai + Redgram (8:2) – Moth bean, T_8-Samai + Redgram (8:2) – Blackgram, T_9-Samai + Redgram (8:2) – Horsegram.

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), moth bean (TMV (Mb) 1C) followed by sequential crops of moth bean TMV (Mb)1, horse gram (Paiyur2) and Black gram (T9).

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

Pooled mean analysis of three centre data of CEM, Athiyandal, DARS Chettinad and RRS, Paiyur during kharif, 2016, 2017 and 2018 were given below. Growth attributes like plant height and dry matter production was significantly affected by intercropping. Plant height of samai was found to be higher at all the stages under the treatment, little millet + pigeonpea - mothbean at 8:2 ratio (T_7) (96.6 cm at harvest) followed by littlemillet + pigeonpea - horsegram at 8:2 ratio (T_9) (94.2 cm at harvest) (Table. 1).

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, panicle height, pani and test weight is found to be increased when intercropped with pigeonpea at 8:2 ratio (Table.1).This might be due to development of better complementary relationship and non-renewable resources like water, nutrients and incoming sunlight.

Table.1 Effect of samai and redgram intercropping on growth and yield attributes

Treatments	Plant height (cm)	Leaf area index	Productive tillers (Nos)	Panicle length (cm)	Grain yield (Kg/ha)	Straw yield (Kg/ha)
T_1-Samai+ Red gram (4:1) - Mothbean	92.3	1.48	6.8	25.3	536	1506
T_2-Samai + Red gram (4:1) - Blackgram	92.6	1.68	6.5	25.0	499	1422
T_3-Samai+ Red gram (4:1) - Horsegram	90.1	1.64	6.9	24.3	502	1441
T_4-Samai+ Red gram (6:2) - Mothbean	92.7	1.63	8.2	24.3	530	1403
T_5-Samai + Red gram (6:2) - Blackgram	93.3	1.68	8.0	25.0	556	1429
T_6-Samai + Red gram (6:2) - Horsegram	95.9	1.53	7.5	24.9	582	1559
T_7-Samai + Red gram (8:2) - Mothbean	96.6	1.54	8.0	24.8	619	1602
T_8-Samai + Red gram (8:2) - Blackgram	93.2	1.61	8.0	24.6	652	1676
T_9-Samai + Red gram (8:2) - Horsegram	94.2	1.51	8.0	25.0	648	1652
S.Em.±	3.2	0.2	0.6	**0.5**	**69**	**72**
CD (P=0.05)	9.7	0.6	**1.7**	**1.4**	**203**	**212**

Table.2 Effect of samai and redgram inter cropping on growth and yield of redgram under rainfed condition

Treatments	Plant height (cm)	No.of pods/plant	No. of seeds/Pod	Seed yield (Kg/ha)	Samai Grain Equivalent Yield (kg/ha)
T_1-Samai+ Red gram (4:1)-Mothbean	124.1	114.1	3.59	169	1044
T_2-Samai + Red gram (4:1)-Blackgram	120.0	119.0	3.69	164	977
T_3-Samai+ Red gram (4:1)-Horsegram	123.8	113.0	3.60	174	1012
T_4-Samai+ Red gram (6:2)- Mothbean	127.0	122.4	3.88	204	1183
T_5-Samai + Red gram (6:2)-Blackgram	130.6	119.9	3.64	210	1237
T_6-Samai + Red gram (6:2)-Horsegram	126.1	117.1	3.77	226	1339
T_7-Samai + Red gram (8:2)- Mothbean	130.5	121.9	3.64	250	1501
T_8-Samai + Red gram (8:2)-Blackgram	131.1	125.7	3.71	233	1424
T_9-Samai + Red gram (8:2)-Horsegram	137.0	127.4	3.89	253	1516
S.Em.±	2.8	3.8	0.09	37.6	150.6
CD (P=0.05)	8.5	11.5	NS	111.2	444.1

Table.3 Effect of samai, redgram intercrop and sequential crop on cost economics under rainfed situation

Treatments	Gross Returns (Rs/ha)	Net Income (Rs/ha)	B:C ratio
T_1-Samai+ Red gram (4:1)- Mothbean	37983	14757	1.64
T_2- Samai + Red gram (4:1)-Blackgram	36768	13045	1.55
T_3Samai+ Red gram (4:1)-Horsegram	39375	15525	1.65
T_4- Samai+ Red gram (6:2)- Mothbean	41122	17007	1.70
T_5- Samai + Red gram (6:2)- Blackgram	43353	18741	1.76
T_6- Samai + Red gram (6:2)- Horsegram	48368	23629	1.95
T_7- Samai + Red gram (8:2)- Mothbean	48998	24217	1.97
T_8- Samai + Red gram (8:2)- Blackgram	48926	23647	1.93
T_9- Samai + Red gram (8:2)- Horsegram	53798	28393	2.12

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). The highest grain and straw yields were recorded little millet + pigeonpea - Blackgram at 8:2 ratio (T8) (652 kg / ha grain yield and 1676 kg / ha straw yield, respectively) and it was on par with littlemillet + pigeonpea - horsegram at 8:2 ratio (T9) (648 kg / ha grain yield and 1652 kg / ha straw yield, respectively).

Higher grain yield of pigeonpea in 8:2 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. Succeeding crop of Horsegram yield were significantly higher at samai + Redgram at 8 : 2 ratio was on par with mothbean sequence relayed in samai + redgram 8:2 row ratios. Similar finding was reported by Kumar *et al.*, (2008). Little millet equivalent yield (LMEY) (Table. 2) was calculated for comparing different intercropping combinations.

The highest little millet grain equivalent yield (1516 kg ha) was recorded in 8:2 row ratio of samai+ redgram-horsegram sequence which was closely followed by 8:2 row proportion of little millet + pigeonpea - mothbean sequence (1501kg / 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 8:2 row ratio and horsegram sequence was due to higher yield of samai and redgram coupled with better utilization of the natural resources by the component crops in intercropping system.

Economics of intercropping

The highest gross returns (Rs. 53798/ ha), net returns (Rs. 28393/ ha) and benefit cost ratio (2.12) were recorded by samai intercropped with pigeonpea at 8:2 ratio with horsegram as sequence crop (Table 2). Samai intercropped with redgram at 8:2 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 little millet intercropping system under rainfed conditions of Tiruvannamalai district, growing of samai and pigeonpea in 8:2 row ratio with horsegram or mothbean in sequence have been found superior over other intercropping systems under rainfed conditions.

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