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Research Article

Effect of pear millet -based pulses intercropping in rained conditions

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ABSTRACT : A field experiment was conducted during the rainy season of 2007 at Agronomy Instructional Farm, C.P. College of Agriculture, S.D. Agricultural University, Sardar Krushinagar, Gujarat, to study the effect of pear millet - based pulses intercropping in rained conditions. Based on the results, it was concluded that intercropping of pearl millet with green gram at 2:2 pair row ratio was distinctly superior over sole pearl millet and found most profitable by realizing the highest net return and LER.

KEY WORDS : Pearl millet, Pulses, Intercropping, LER

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INTRODUCTION

Abnormal occurrence of monsoon is one of the important factors for crop production under rain fed conditions. The principle rainy season crops, grown as sole crop at times are found to be rather risky due to delayed monsoon accompanied with prolonged intermittent dry spells. A strategy for stabilizing production of dry-land crops through commonly recognized practice of intercropping of compatible crops is considered viable to overcome the situation. The system aimed at increasing productivity per unit area and it guarantee insurance against total crop failure, particularly aberrant weather conditions. Patil and Patil (1989) reported beneficial effects of intercropping principal rainy season legumes with pearl millet and gives additional yield also. Therefore, an experiment pearl millet based on intercropping of pulses.

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EXPERIMENTAL METHODS

A field experiment was conducted at Agronomy Instructional Farm, C.P. College of Agriculture, S.D. Agricultural University, Sardar Krushinagar, Gujarat, during rainy season of 2007. The soil of the experimental field was loamy sand in texture, low in organic carbon (0.35 %), and available nitrogen (173 kg ha^{-1}) medium in available phosphorous (44 kg ha^{-1}) and available potassium (250 kg ha^{-1}) with slightly alkaline reaction (pH 7.4). Total annual rainfall of 574.31 mm in 26 rainy days was received during crop growth period of July to August. The experiment was comprised of 10 intercropping system with sole pearl millet, *viz.*, T_1 (Sole pearl millet), T_2 (Sole green gram), T_3 (Sole cluster bean), T_4 (Sole moth bean), T_5 [Pearl millet + green gram (1:2)], T_6 [Pearl millet + cluster bean (1:2)], T_7 [Pearl millet + moth bean (1:2)], T_8 [Pearl millet pair + green gram pair (2:2)], T_9 [Pearl millet pair + cluster bean pair (2:2)] and T_{10} [Pearl millet pair + moth bean pair (2:2)]. The experimental was laid out in randomized block design with four replications, the pearl millet variety GHB-558, was sown with green gram (Gujarat gram-4), guar (Gujarat guar-2), moth bean (Gujarat moth bean-2) pulses crops. Pearl millet was sown at 45 cm row spacing in

sole as well as in intercropping was 30 cm. The crop received 80 kg N, 40 kg P_2O_5, and 20 kg K_2O ha^{-1}, and no additional dose of fertilizers was used for intercrops. For comparison between treatments, the yields of all intercrops were converted into pearl millet equivalent yield on prices basis (Tomar and Tiwari, 1999). Production efficiency values in terms of kg ha^{-1} were obtained by pearl millet equivalent yield of system divided by total duration of crops in that system.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Effect of intercrops on pearl millet:

Plant height was unaffected by intercropping systems and yield attributing characters, *i.e.* number of total tillers and branches per plant, effective tillers/pods per plant, grains per ear head /seeds per pod, 1000-grain/seed weight (g) was significantly affected by intercropping (Table 1). The effect of different treatments on number of total tillers and effective tillers per plant had significant effect. Significantly the higher numbers of total tillers per plant were produced under pearl millet with green gram, cluster bean and moth bean at 1:2 row ratios and in respect of effective tillers per plant, sole pearl millet and same intercropping with 1:2 row ratio were found identical. This might be due to development of better complementary relationship and non-renewable resources like water, nutrients and incoming sunlight. These results are in close conformity with the findings of Rathore and Gautam (2003).

The data (Table 1) showed that differences in number of grains per ear head and grain yield per ear head were remarkably higher under pearl millet crop grown with green gram; cluster bean and moth bean each at 1:2 row ratio. Whereas, their values were significantly reduced in pearl millet crop sown with green gram, cluster bean and moth bean each at 2:2 pair row ratio, which might be attributed to the decrease competition among plants for moisture, nutrients, space and light as compared to that of under intercropping systems at 2:2 paired row ratio. These results are in accordance with finding of Rathore and Gautam (2003).

Significantly the highest grain and straw yields (Table 2) were recorded by sole pearl millet than rest of the intercropping treatments, which could be attributed to higher and optimum plant densities in sole cropping system. The lower significant grain and straw yields were noticed under pearl millet with green gram, cluster bean and moth bean at 1:2 row ratio intercropping system. This might be due to lower plant densities of pearl millet and also higher competition offered by intercrops for natural resources like space, plant nutrient, moisture and incoming sun radiation. The results are corroborating with the findings of Baldevram *et al.* (2005) and Kumar *et al.* (2006).

Effect of pearl millet on intercrops:

Plant height was unaffected by intercropping systems. The differences in number of branches per plant, (Table 1) were reduced in both the row ratios of intercropping systems as compared to their sole cropping which perhaps due to the fact that competition offered by pearl millet for natural resources, resulted in poor development of intercrops and also due to less space available for horizontal spread of plants and intra-specific competition for incoming sun radiation.

The seed weights of all intercrops were reduced in both the row ratios of intercropping system than their sole cropping (Table 2). This might due to fact that intra-specific competition for space, soil moisture, plant nutrients and sunlight. Number of pods per plant, seeds per pod and seed yield per plant data

Table 1 : Effect of sole crop and intercropping treatments on final plant height, number of total tillers/ branches per plant, effective tillers/pods per plant and grains per ear head /seeds per pod pearl millet and intercrops

Treatments	Final plant height (cm)		Number of total tillers and branches per plant		Numbers of effective tillers/pods per plant		Numbers of grains per ear head /seeds per pod	
	Pearl millet	Sole or intercrops	Pearl millet	Sole or intercrops	Pearl millet	Sole or intercrops	Pearl millet	Sole or intercrops
T_1 : Sole pearl millet	211.2	-	6.6	-	5.6		1170.4	-
T_2 : Sole green gram		48.2		4.2		13.6		11.4
T_3 : Sole cluster bean		66.5		7.4		33.1		8.8
T_4 : Sole mothbean		38.2		6.1		31.1		6.1
T_5 : Pearl millet + Green gram (1:2)	201.5	49.4	7.9	3.8	6.8	13.2	1375.0	11.1
T_6 : Pearl millet + Clusterbean (1:2)	204.1	68.4	7.9	5.8	6.8	29.8	1381.1	8.2
T_7 : Pearl millet + Mothbean (1:2)	200.2	43.4	8.0	5.8	6.8	28.3	1382.2	5.6
T_8 : Pearl millet + Green gram (2:2)	204.1	55.6	6.3	3.4	5.3	13.4	1117.3	11.2
T_9 : Pearl millet + Clusterbean (2:2)	206.2	72.2	6.3	5.8	5.4	31.2	1135.1	8.5
T_{10} : Pearl millet + Mothbean (2:2)	203.2	45.6	6.4	5.5	5.4	29.6	1130.1	5.9
C.D. (P=0.05)	NS		1.06		0.77		182.67	

Table 2 : Effect of sole crop and intercropping treatments on test weight, grain yield per ear head, seed yield, straw yield, PEY and LER of pearl millet and intercrops

Treatments	1000-grain/seed weight (g)		Grain yield per ear head and seed yield per plant		Grain/seed yield (kg ha^{-1})		Straw/stover yield (kg ha^{-1})		PEY (kg ha^{-1})	LER
	Pearl millet	Sole or intercrops	Pearl millet	Sole or intercrops	Pearl millet	Sole or intercrops	Pearl millet	Sole or intercrops		
T_1 : Sole Pearl millet	7.04	-	8.26	-	1190		2707	-	1190	1.00
T_2 : Sole green gram		47.81		8.38		875		1439	2577	1.00
T_3 : Sole cluster bean		34.33		7.86		836		1672	1958	1.00
T_4 : Sole moth bean		34.75		7.14		791		1279	1993	1.00
T_5 : Pearl millet + Green gram (1:2)	7.21	42.44	9.95	7.46	536	567	1167	914	2205	1.09
T_6 : Pearl millet + Cluster bean (1:2)	7.24	32.82	10.06	6.56	556	535	1214	1060	1809	1.10
T_7 : Pearl millet + Moth bean (1:2)	7.22	31.97	9.98	6.52	547	502	1178	847	1812	1.09
T_8 : Pearl millet + Green gram (2:2)	7.14	45.22	8.05	7.52	771	628	1739	948	2620	1.36
T_9 : Pearl millet + Cluster bean(2:2)	7.16	33.24	8.10	6.98	805	594	1806	1097	2196	1.38
T_{10} : Pearl millet + Moth bean (2:2)	7.13	32.64	8.01	6.64	785	550	1773	892	2170	1.35
C.D. (P=0.05)	NS		1.21		107.97		241.44		225.02	1.03

Note ; PEY=Pearl millet grain equivalents yield LER=Land equivalent ratio

of all intercrops (Table 1 and 2) were reduced in intercropping systems as compared to their sole cropping which might be due to the fact that competition offered by pearl millet for natural resources, resulted in poor development of intercrops and also due to less space available for horizontal spread of plants and intra-specific competition for solar radiation (Kumar *et al.*, 2006).

In case of seed and stover yield per hectare of green gram, cluster bean and moth bean were reduced in intercropping systems in comparison to their respective sole cropping systems (Table 2). Such variation could be ascribed due to decrease in plant densities when grown as intercrops with pearl millet and higher competition among pearl millet and intercrops for natural resources like soil moisture, plant nutrients, space and sunlight responsible for higher photosynthesis rate resulting lower accumulation of dry matter per plant in comparison of sole crop. These results are supported by Tiwana and Tiwana (1995) and Kumar *et al.* (2006).

Effect of different treatments on pearl millet seed equivalent yield:

Apart from the competitive effects, prevailing price become an additional important factor in choosing the components of intercropping system and so intercrop yields were converted into pearl millet grain equivalent yield added with pearl millet grain yield (Table 2). Pearl millet grain equivalent yield was significantly higher in all intercropping combinations than that of sole pearl millet. The highest pearl millet grain equivalent yield was recorded with pearl millet + green gram in 2:2 pair row ratio, because of additional advantage of intercrop yield and higher yield of pearl millet with green gram due to better complementary relationship resulted in highest pearl millet grain equivalent yield. These finding are in conformity with those of Rathore and Gautam (2003), Baldevram *et al.*

Table 3 : Effect of sole crop and intercropping treatments on net return, additional return over sole pearl millet and benefit : cost ratio

Treatments	Gross relization (Rs. ha^{-1})	Total cost of cultivation (Rs.ha^{-1})	Net return (Rs. ha^{-1})	Additional return over sole pearl millet (Rs. ha^{-1})	BCR
T_1 : Sole pearl millet	11394	9651	1743	-	1:1.18
T_2 : Sole green gram	20971	9139	11832	-	1:2.29
T_3 : Sole cluster bean	16803	9002	7801	-	1:1.86
T_4 : Sole moth bean	16472	8946	7526	-	1:1.84
T_5 : Pearl millet + Green gram (1:2)	18641	9449	9192	7449	1:1.97
T_6 : Pearl millet + Cluster bean (1:2)	16011	9357	6654	4911	1:1.71
T_7 : Pearl millet + Moth bean (1:2)	15678	9321	6357	4614	1:1.68
T_8 : Pearl millet + Green gram (2:2)	22291	9500	12791	11048	1:2.34
T_9 : Pearl millet + Cluster bean (2:2)	19484	9432	10052	8309	1:2.06
T_{10} : Pearl millet + Moth bean (2:2)	18961	9404	9557	7814	1:2.01
C.D. (P=0.05)			1376.65		0.29

(2005) and Kumar *et al.* (2006).

Effect of different treatments on land equivalent ratio:

The data on LER (Table 2) indicated that 35-38 per cent higher yield advantage were found in pearl millet with green gram, cluster bean and moth bean each at 2:2 pair row ratio over sole all the crops and pearl millet with intercrops at 1:2 row ratios intercropping systems. This might be due to higher yield of pearl millet in intercropping systems and also intercropping systems gave higher land utilization as compared to sole crop. This was due to extra yield obtained from intercrop and makes the combination higher advantageous over sole crops. This might be due to development of better complementary relationship. These results corroborated with the finding of and Kumar *et al*. (2006).

Economics of different treatments:

Monetary returns (Table 3) as elucidated by net income were significantly higher in different intercropping systems as compared to sole pearl millet. Looking to overall economics all pulses and pearl millet with pulses intercropping treatments gave significantly higher net realization over that of sole pearl millet. This could be attributed to higher yield advantage under sole pulses and intercropping systems. Pearl millet + green gram (2:2) combination gave the highest net return of Rs. 12791 ha^{-1} and benefit cost ratio of 1:2.3 followed by sole green gram which gave net return of Rs. 11832 ha^{-1} with 1:2.2 benefit cost ratio which confirmed the superiority of sole green gram and pearl millet with green gram at 2:2 pair row ratio over other treatments.. The maximum additional return (Rs. 11048 ha^{-1}) over sole pearl millet was obtained when pearl millet crop was sown with green gram at 2:2 pair row ratio, followed by pearl millet + cluster bean (Rs. 8309 ha^{-1}) at 2:2 pair row ratio. This might be due to higher yield advantage under intercropping system. Similar results were also reported by Yadav and Jat (2005).

Thus, it is concluded that intercropping system of pearl millet + green gram at 2:2 pair row ratio and sole green gram was distinctly superior over sole pearl millet and found most profitable.

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