Evaluation of Cropping System for Rain Fed Agriculture

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Abstract— *Erratic and inadequate rainfall is one of the important factors for crop production under rain fed conditions. Crop grown as sole crop 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. Mothbean and pearlmillet are important arid crop. So it is necessary to find out its intercropping proportion to resuce the risk of failure of sole crop. Therefore, an experiment was conducted at Dry Farming Research Station, Sardarkrushinagar Dantiwada Agricultural University, Radhanpur to evaluate of cropping system for rainfed agriculture in kharif season during 2010-11 to 2022-23. Significantly higher pearlmillet equivalent yield (3466 kg/ha) was recorded under Sole Mothbean which remained at par with pearl millet + moth bean (1:3) intercropping (3305 kg/ha).*

Keywords— *Rainfed, Equivalent yield and Intercropping.*

I. INTRODUCTION

Rainfed area occupies 58% of net cultivatable area in the India, have diverse farming systems, different potentials and constraints, which can only be addressed through development and application of location specific. Sole cropping is very risky in rainfed area because of erratic pattern and uncertainty of rainfall, there is a possibility of failure of sole crop. Researchers and farmers are developing different crop production systems to increase productivity and sustainability which includes intercropping, mix cropping, relay cropping and crop rotation since the Vedic times. There are several factors like variety, seeding ratios, planting pattern and competition between crop which affect the growth of species in mix cropping and intercropping.

Moth bean as arid legumes and Pearl millet as arid millets are largely grown in arid region. Due to the risk of failure of sole crop it is necessary to build up an insurance against total crop failure. So that the study on inter cropping of moth bean with pearl millet under rain fed condition is essential to find out the proportion of intercropping of moth bean and pearl millet and to increase the income by sowing the main crop with inter crop. Another objective of intercropping in rainfed area are to produce an additional crop by optimize the use of natural resources and to stabilize the yield of crops and to overcome the risk.

II. MATERIAL AND METHOD

A field experiment was conducted at Dry Farming Research Station, Sardarkrushinagar Dantiwada Agricultural University, Radhanpur to evaluate suitable cropiing system for rainfed agriculture during 2010-11 to 2022-23. But due to delayed monsoon accompanied with prolonged intermittent dry spells one or more treatment were failure in many years. So here successful four seasons *i.e.* 2011, 2016, 2020 and 2022 are considered for pooled results. The experiment was laid out in randomized block design with four replications. There were total eight treatments in which five intercropping of mothbean in pearlmillet *viz.,* pearlmillet + mothbean (1:2), pearlmillet + mothbean (2:1), pearlmillet + mothbean (1:3), pearlmillet + mothbean (3:1), pearlmillet + mothbean (2:2), two sole crop treatment (sole pearlmillet and sole mothbean) and one mix cropping taken for

study. Both the crop sown with 45 cm row spacing in all the treatments and 1:1 seed ratio is used in mix cropping treatment. Normal crop husbandry practices were followed for the successful raising of crop. Pearlmillet equivalent yield (PEY) was calculated in terms of pearlmillet yield of all intercropping treatments on the basis of prevailing market prices (Rs. kg^{-1}). It was calculated using formula suggested by Lal and Ray (1976). Pearlmillet Equivalent Yield (Kg ha^{-1}) = [Seed yield of mothbean (kg ha^{-1}) x Price of mothbean (Rs kg^{-1}) / Price of pearlmillet (Rs kg^{-1})] + Seed yield of pearlmillet (kg ha^{-1}). The statistical analysis of data of various characters studied in the investigation was done using analysis of variance techniques as suggested by Panse and Sukhatme (1985). The critical differences for comparing treatment means were worked out at 5 per cent level of significance.

III.   RESULTS

Plant height, number of tillers per plant and length of ear head were unaffected by different intercropping systems. It might be due to no annidation effect were take place between intercrop and main crop with 45 cm row spacing. While Pealmillet grain yield (1021 kg/ha) were found significantly higher in sole pearlmillet. The reduction in grain yield of pearlmillet in the intercropping system was mainly due to replacement type of intercropping system was followed in the present study so reduction in plant stand of pearlmillet in different intercropping treatment. Pearlmillet fodder yield (2515 kg/ha) were found significantly higher with intercropping of pearl millet + moth bean (3:1) which remained at par with sole pealmillet cropping in pooled result.

TABLE 1
EFFECT OF INTERCROPPING ON GROWTH AND YIELD ATTRIBUTES OF PEARLMILLET UNDER RAINFED
CONDITION (POOLED RESULTS)

Treatment	Plant height (cm)	Number of tillers per plant	Number of earhead per plant	Length of earhead (cm)	Grain yield (kg/ha)	Fodder yield (kg/ha)
Pearlmillet + Mothbean (1:2)	151.46	2.56	1.74	18.93	442	1267
Pearlmillet + Mothbean (2:1)	150.16	2.58	2.09	18.49	679	1927
Pearlmillet + Mothbean (1:3)	150.19	2.58	1.8	18.29	427	1075
Pearlmillet + Mothbean (3:1)	151.3	2.59	1.89	17.75	771	2515
Pearlmillet + Mothbean (2:2)	150.59	2.55	1.79	18.48	544	1743
Sole Pearlmillet	149.81	2.53	1.84	18.03	1021	2274
Mix Cropping	149.55	2.53	1.93	18.49	710	1689
S.Em.±	2.8	0.08	0.08	0.4	114.8	159
C.D. at 5 %	NS	NS	0.22	NS	341	473
Y X T	NS	NS	NS	NS	Sig.	Sig.
C.V. %	8.06	13.19	16.12	8.97	14.98	14.4

No significant effect was recorded in plant height (cm), number of branches per plant, pod per plant, pod length (cm) and seed per pod in mothbean by different intercropping systems. It might be due to no annidation effect were take place between intercrop and main crop with 45 cm row spacing. Sole Moth bean found significantly the highest moth bean seed yield (739

kg/ha) in pooled results. Mothbean fodder yield (3586 kg/ha) were found significantly the highest with sole moth bean in pooled results. The reduction in seed yield of mothbean in the intercropping system was mainly due to replacement type of intercropping system was followed in the present study so reduction in plant stand of mothbean in different intercropping treatment.

TABLE 2
EFFECT OF INTERCROPPING ON GROWTH AND YIELD ATTRIBUTES OF MOTHBEAN UNDER RAINFED CONDITION (POOLED RESULTS)

Treatment	Plant height (cm)	Number of branches per plant	Pod per plant	Pod length (cm)	Seed per pod	Seed yield (kg/ha)	Straw yield (kg/ha)
Pearlmillet + Mothbean (1:2)	43.19	4.44	36.35	3.74	5.19	425	2080
Pearlmillet + Mothbean (2:1)	40.85	4.11	40.04	3.7	5.26	238	1218
Pearlmillet + Mothbean (1:3)	41.78	4.63	38.53	3.69	5.18	523	2223
Pearlmillet + Mothbean (3:1)	40.99	4.13	39.69	3.76	5.3	151	679
Pearlmillet + Mothbean (2:2)	41.81	4.19	38.11	3.84	5.35	322	1488
Sole Mothbean	45.13	4.44	39.39	3.99	5.35	739	3374
Mix Cropping	42.88	4.02	37.94	3.76	5.21	329	1607
S.Em.±	1.3	0.19	1.68	0.08	0.13	60.61	125
C.D. at 5 %	NS	NS	NS	NS	NS	180	371
Y X T	NS	NS	NS	NS	NS	Sig.	Sig.
C.V. %	12.11	16.68	17.38	8.05	10.8	15.09	14.92

Apart from the competitive effects, prevailing price become an additional important factor in choosing the components of intercropping system and so mothbean yields were converted into pearl millet grain equivalent yield added with pearl millet grain yield in all the treatments for better interpretation of the results. Significantly higher pearlmillet equivalent yield (3466 kg/ha) was recorded under Sole Mothbean which remained at par with pearl millet + moth bean (1:3) intercropping (3305 kg/ha). Same way land equivalent ratio (LER) is considered as a measure of the efficiency of economic yield production of the crop mixture, compared with sole crops and based on land use. Here pearl millet + moth bean (1:3) gave higher peralmillet equivalent yield with LER more than one (1.13) which indicate that this intercropping system is beneficial. This is due to higher yield of mothbean and pearlmillet in the pearl millet + moth bean (1:3) intercropping system and thereby envisages effective utilization of the resources. Similar findings have been reported by Yadava *et al.* (2005), Yadava and Beniwal (2006) and Kandpal *et al.* (2015).

TABLE 3
EFFECT OF INTERCROPPING ON PEARLMILLET EQUIVALENT YIELD AND LAND EQUIVALENT RATIO UNDER RAINFED CONDITION

Treatment	Pearlmillet equivalent yield (kg/ha) (Pooled results)	Land Equivalent Ratio (LER)
Pearlmillet + Mothbean (1:2)	2973	1.01
Pearlmillet + Mothbean (2:1)	2421	0.99
Pearlmillet + Mothbean (1:3)	3305	1.13
Pearlmillet + Mothbean (3:1)	2165	1.37
Pearlmillet + Mothbean (2:2)	2629	0.97
Sole Pearlmillet	1589	-
Sole Mothbean	3466	-
Mix Cropping	2845	1.14
S.Em.±	257.66	-
C.D. at 5 %	758	-
Y X T	Sig.	-
C.V. %	9.6	-

* Last year selling price (pearlmillet Rs 20/kg and mothbean Rs 70/kg) was considered for calculation of equivalent yield of all years

Sole mothbean gave maximum net return (Rs. 44480) and BCR (2.44) followed by pearl millet + moth bean (1:3) intercropping (Rs. 35154 and 2.14). This could be due to higher yield of mothbean and peralmillet in pearl millet + moth bean (1:3) intercropping systems as compared to other systems. These results corroborated with the finding of Yadav and Jat (2005).

TABLE 4
ECONOMICS OF DIFFERENT INTERCROPPING SYTEMS UNDER RAINFED CONDITION

Treatment	PEY (kg/ha)	Gross return (Rs./ha)	Total cost of cultivation (Rs./ha)	Net return (Rs./ha)	BCR
Pearl millet + Moth bean (1:2)	2973	59460	30988	28473	1.92
Pearl millet + Moth bean (2:1)	2421	48420	31136	17284	1.56
Pearl millet + Moth bean (1:3)	3305	66100	30947	35154	2.14
Pearl millet + Moth bean (3:1)	2165	43300	31173	12127	1.39
Pearl millet + Moth bean (2:2)	2629	52580	31065	21515	1.69
Sole Pearl millet	1589	31780	31290	490	1.02
Sole Moth bean	3766	75320	30839	44480	2.44
Mix Cropping	2845	56900	30313	26587	1.88

IV.   CONCLUSION

From the forgoing discussion it can be concluded that, rainfed pearlmillet should be grown as pearlmillet : mothbean (1:3) intercropping system with 45 cm spacing instead of sole pearlmillet for getting higher pearlmillet equivalent yield, net profit and insurance against failure of one crop.

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