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Enhancing the Millet System Productivity with Intercrops

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ABSTRACT: A field experiment on intercropping of small millets (Foxtail millet and little millet) with redgram was carried out at Regional Agricultural Research Station, Nandyal for two consecutive years during kharif 2018-19 and 2019-20 to identify the best row proportion to achieve sustainable productivity and higher yields. Based on the results, it was observed that intercropping of small millets with redgram in 6:1 ratio [foxtail millet + Redgram (4498 kg/ha) and little millet + Redgram 3366 kg/ha] recorded significantly higher Millet grain equivalent yield than sole redgram (1641 kg/ha). Almost all yield attributing characters of millets recorded significantly higher in sole crop. Among the ratio of intercropping system 6:1 row ratio recorded higher Millet Grain equivalent yield along with net income than 6:1 row ratio.

Keywords: Randomized block design, Redgram, foxtail millet.

INTRODUCTION

Small millets are the age old crops cultivated in marginal and sub marginal lands for both food and fodder purpose. Small millets are drought tolerant crop, water requirement is very meager compared to other crops with high nutritional benefits and less susceptible to pests and diseases. Due to its wider adaptability it can be grown under varied climatic conditions. Sustainable yields can be expected from the crop even under adverse conditions and are popularly known as climate resilient crops (Hima Sree *et al.,* 2017). Small millets, now a days are gaining importance among farming communities as awareness about nutritional facts of small millets is being familiarized among the consumers. Though the demand in market is higher the availability of produce for consumption is low. Intercropping of small millets with legumes can be a viable option for the introduction of small millets even in non-traditional areas. Hence, there is an urgent need of inclusion of legumes crop in small millet based cropping systems. Initial slow growth of small millets will facilitate the better establishment of intercrops (Manjunath *et al.,* 2018). Moreover growing of intercrops will suppress the unwanted weed growth and produces greater output from unit area than sole crop (Binod Kumar and Pankaj Kumar Ray, 2020). The intercropping system of cereals + pigeonpea/legumes were tested and found to be profitable systems and it was in conformity with the findings of Sriharsha, (2014) ; (Patil *et al.,* 2010). 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). In Kurnool district foxtail millet is grown in an area of 13000 ha with production of 5000 tonnes and productivity of 463 kg/ha. Andhra Pradesh is one of the traditional small millet growing state. Foxtail millet is one of the major staple crop grown in rainfed areas of Kurnool district. Intercropping is common practice seen in this district. Introduction of foxtail millet in intercropping system can serve the purpose of increase in area under foxtail millet cultivation and can reap better yields compared to sole crops. Hence, by keeping all the above points in view this experiment has been taken up to find out the intercropping system that enhances millet system productivity.

MATERIALS AND METHODS

The field experiment was conducted during Kharif 2018-19 and 2019-2020 at Regional Agricultural Research station, Nandyal. The soils are deep vertisols. The experimental site is located at $18^0 29^{'}$N latitude, 78°29'E longitude and at an altitude of 202 above MSL, in the scarce rainfall zone of Andhra Pradesh. The soils are alkaline in reaction (8.2), low in nitrogen (180 kg ha^{-1}), medium in available phosphorous (48.2 kg ha^{-1}) and potassium (366 kg ha^{-1}). The design used for experimentation is Randomized block design (RBD) with total 9 treatments in three replications. The treatments comprises of 6 intercropping systems foxtail millet and little millet with redgram in 4:1, 6:1 and 8:1 ratio with sole crops *viz.,* Sole Redgram, Sole little millet and foxtail millet. The recommended dose of fertilizers was 40 kg N and 20 kg P_2O_5 . Sowing was done during july 2nd FN. The crops were raised by following package of practices. An total amount of 336.4 mm was received in 24 days in 2018-19 and the corresponding figures for 2019-2020 were 913.8 mm in 43 rainy days.

Table 1: Growth and yield of small millets as influenced by intercropping system (2018-19).

Treatments	Plant height of Base crops (cm)	Plant height of intercrops (cm)	Number of tillers of base crops	Days to maturity of base crops	Days to maturity of inter crops	1000 seed weight (gm)	Grain yield of base crop (kg/ ha)	Grain yield of intercrop (kg/ha)	MGEY (Kg/ha)	Gross returns (Rs./ ha)	Net returns (Rs./ ha)	B:C ratio
Foxtail millet + Redgram 4:1	111	123	2.6	72	141.6	2.6	2308	529	3412	81302	55302	3.13
Foxtail millet + Redgram 6:1	113	122	2.0	72	142.6	2.7	2386	644	3730	89218	64168	3.56
Foxtail millet + Redgram 8:1	115	110	2.6	73	143.0	2.7	2137	511	3203	76394	52294	3.17
Little millet + Redgram 4:1	114	106	5.2	82	141.6	2.2	846	552	1997	48749	22749	1.87
Little millet + Redgram 6:1	111	109	5.6	81	142.3	2.3	1104	658	2477	60364	35314	2.41
Little millet + Redgram 8:1	116	119	5.6	81	141.6	2.2	1019	527	2119	51551	27451	2.14
Sole Foxtail millet	109	-	3.2	72	-	2.7	2770		2770	63704	41704	2.90
Sole Little millet	108	-	6.1	82	-	2.3	1293		1293	29742	7742	1.35
Sole Redgram	112		-		143.0	-	1425		1425	68416	39916	2.40
SEm +	2.98	3.77	1.25	1.34	1.10	0.087	95.2	15.18	83.2			
CD @0.05	NS	11.75	3.26	4.12	NS	0.26	291.6	47.29	251.8			

Table 2: Growth and yield of small millets as influenced by intercropping system (2019-2020).

Treatments	Plant height of Base crops (cm)	Plant height of intercrops (cm)	Number of tillers of base crops	Days to maturity of base crops	Days to maturity of inter crops	1000 seed weight (gm)	Grain yield of base crop (kg/ ha)	Grain yield of intercrop (kg/ha)	MGEY (kg/ha)	Cost of cultivation (Rs./ ha)	Gross returns (Rs./ ha)	Net returns (Rs./ ha)	B:C ratio
Foxtail millet + Redgram 4:1	91	144	2.7	75	138	2.70	1324	1160	4466	28000	80394	52394	2.87
Foxtail millet + Redgram 6:1	108	146	3.0	73	139	2.86	1883	1167	5042	26050	90764	64714	3.48
Foxtail millet + Redgram 8:1	98	143	1.7	75	135	2.56	906	958	3502	24100	63035	38935	2.62
Little millet + Redgram 4:1	114	145	2.3	85	137	2.77	948	1146	4051	26000	72918	46918	2.80
Little millet + Redgram 6:1	125	146	2.0	84	134	2.63	1019	1111	4028	25050	72500	47450	2.89
Little millet + Redgram 8:1	119	145	2.7	86	136	2.35	746	917	3228	24100	58109	34009	2.41
Sole Foxtail millet	110		3.6	76		2.87	2456		2456	22000	44214	22214	2.01
Sole Little millet	115		3.9	88		2.60	2288		2288	22000	41176	19176	1.87
Sole Redgram	150				140			2240	1857	38500	109200	70700	2.84
SEm+	6.5	2.06	1.5	1.286	2.46	0.08	58.24	53.95	110.90				
CD (P=0.05)	19.78	NS	4.2	3.93	NS	0.25	178.38	168.08	335.36				

Table 3: Pooled data of Millet Grain Equivalent Yield (kg/ha), Economics for two years (2018-19 and 2019-2020).

Treatments	MGEY (kg/ha)			Gross returns (Rs./ha)			Net returns (Rs./ha)			B:C ratio		
	2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean
Foxtail millet + Redgram 4:1	3595	4466	4031	81302	80394	80848	55302	52394	53848	3.13	2.87	3.00
Foxtail millet + Redgram 6:1	3953	5042	4498	89218	90764	89991	64168	64714	64441	3.56	3.48	3.52
Foxtail millet + Redgram 8:1	3381	3502	3441	76394	63035	69715	52294	38935	45615	3.17	2.62	2.90
Little millet + Redgram 4:1	2189	4051	3120	48749	72918	60834	22749	46918	34834	1.87	2.80	2.34
Little millet + Redgram 6:1	2705	4027	3366	60364	72500	66432	35314	47450	41382	2.41	2.89	2.65
Little millet + Redgram 8:1	2301	3228	2765	51551	58109	54830	27451	34009	30730	2.14	2.41	2.28
Sole Foxtail millet	2769	2456	2613	63704	44214	53959	41704	22214	31959	2.90	2.01	2.46
Sole Little millet	1293	2287	1790	29742	41176	35459	7742	19176	13459	1.35	1.87	1.61
Sole Redgram	1425	1856	1641	68416	109200	88808	39916	70700	55308	2.40	2.84	2.62
SEm+	83.2	110.9	151.68									
CD (P=0.05)	251.8	335.36	379.2									

RESULTS AND DISCUSSION

In intercropping studies when two or more crops are grown together the yields in intercropping systems are comparatively lower than sole cropping system although combined yield may be higher than either of the sole crops (Prasanna Kumar *et al.,* 2009).

The plant height of base crops was not significantly influenced by the treatments (2018-19). But in 2019-20 the plant height was found to be affected by the intercropping systems. The highest plant height was recorded with sole crops *viz.,* Sole foxtail millet (109 cm), Sole little millet (109 cm) and sole Redgram (112 cm). Similar results were also obtained by Kadalli *et al.,* 1989; Ali *et al.,* 2016. The highest number of productive tillers/plant were found to be with sole crop than the intercropping systems. The same results were reported by Pradhan *et al.,* (2014). The test weight of sole crops were found to be highest in sole crops but was on par with intercropping systems. This was confirmed by Sharmili and Manohara (2018). The grain yield was found to be highest with sole crops compared to intercropping systems[(Sole foxtail millet, 2770 kg/ha., sole little millet, 1293 kg/ha., Sole Redgram, 1425 kg/ha in 2018-19) (in 2019-20 sole foxtail millet, 2456 kg/ha., Sole little millet 2288 kg/ha., Sole Redgram, 2240 kg/ha)]. The increase in grain yield in sole crops might be due to more number of productive tillers and plant population of respective crops in sole crop treatments, this results are in conformity with findings of Islam, *et al.,* 2018. The highest plant height, productive tillers and grain yield in sole crops might due to negligible competition from any other crops (Sharma *et al.,* 2004).

Millet Grain Equivalent Yields (MGEY). The pooled data for two years revealed that significantly higher millet grain yield was recorded with Foxtail millet + Redgram in 6:1 ratio (4498 kg/ha). The next highest MGEY was obtained with Foxtail millet + Redgram in 4:1 ratio (4031 kg/ha). Among little millet intercropping systems the highest MGEY was recorded when little

millet intercropped with redgram in 6:1 ratio (3366 kg/ha) however on par with Little millet + Redgram in 4:1 ratio (3120 kg/ha). This results also supported by Basavarajappa *et al.,* 2003; Biradar *et al.,* S.A 2020. The reason for higher yield might be due to better utilization of resources like sun light, nutrients and moisture. (Choudhary *et al.,* 2012)

Economics. The highest gross returns (89991 Rs./ha), net returns (64441 Rs./ha) and B:C (3.52) ratio were obtained in the intercropping system foxtail millet + Redgram in 6:1 ratio followed by foxtail millet + Redgram in 4:1 ratio. The increased economics in intercropping system was mainly due to higher millet equivalent yield the reason for higher returns and lower cost of cultivation in these treatments. These results are in conformity with findings of Dubey and Shrivas (1997), Patil, N.B *et al.,* (2010), Zade, K.K *et al.,* 2018. The intercropping system provides higher net returns than the traditional monocropping system. The results are in confirmation with findings of Sharmila, K and Manoharan, S (2018). The economics was analyzed taking into account the prices prevailed in local market. Based on these results, it may be summarised that to increase the productivity per unit area in millet intercropping system under rainfed conditions of kurnool district, growing of foxtail millet and pigeonpea in 6:1 row ratio have been found superior over other intercropping systems and also growing sole crop of little millet and foxtail millet alone. Similar results were obtained by Sharmili, K and Parasuram, P (2018).

CONCLUSION

Keeping in view of the result of above experiment, it is concluded that intercropping of foxtail millet+Redgram in 6:1 ratio resulted in higher millet grain equivalent yield (MGEY) with higher gross returns and net returns followed by foxtail millet+Redgram in 4:1 ratio. Among the little millet intercropping systems little millet with redgram in 6:1 was the best row ratio to obtain higher yields.

FUTURE SCOPE

Further research studies on intercropping of small millets with pulses and other crops is highly essential to know the best row proportion so as to enable the small millet cultivation in non-traditional areas to achieve sustainable higher yields in view of increasing demand for millet consumption and to focus on the increase in millet area.

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Conflicts of Interest. The authors declare no conflict of interest.

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