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EVALUATION OF FOXTAIL MILLET (*Setaria italica* L.) BASED INTERCROPPING SYSTEMS UNDER LATE SOWN CONDITIONS

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ABSTRACT

A field experiment was conducted during late *kharif,* 2016 at S.V. Agricultural College Farm, Tirupati, ANGRAU with three different times of sowing of foxtail millet (first fortnight of August, second fortnight of August and first fortnight of September) in combination with four intercropping systems (foxtail millet + pigeonpea (5 : 1), foxtail millet + castor (5 : 1), foxtail millet + black gram (3 : 3) and foxtail millet + cowpea (3 : 3)). The results of the experiment revealed that among the three times of sowing, first fortnight of August sowings recorded higher stature of growth, yield attributes and yield of foxtail millet and intercrops. The above parameters were at their lower value with first fortnight of September sowings. Intercropping system of foxtail millet + pigeonpea (5 : 1) resulted in higher growth and yield of foxtail millet while, they were found to be at their lower values with foxtail millet + cowpea (3 : 3) intercropping system. Sowing of foxtail millet + pigeonpea (5 : 1) intercropping system during first fortnight of August proved to be viable risk minimizing strategy under late sown conditions.

KEYWORDS: Foxtail millet, times of sowing, intercropping system, growth, yield.

Millets have been called ¨Nutri grains¨ since they are rich in micro nutrients like minerals and B complex vitamins. Small millets have gained their attention owing to their inherent capacity of early maturity, higher yields due to C_4 plant type, capacity to yield even in poor soil under low rainfall and poor management conditions; hence they are popularly known as ¨climate resilient¨ crops in Indian agriculture. Small millets provide much needed food and fodder security of the nation. Among minor millets, foxtail millet and barnyard millet have low glycemic index. Consumption of these grains has demonstrated positive health benefits among the diabetics and they are known as ¨wonder grains¨.

Foxtail millet can be planted when it is too late to plant most other crops. It keeps growing with 300 – 400 mm annual rainfall also in semi arid areas. As it is a climate resilient crop because of the potential abiotic stress tolerance, it can ensure ecological security also. To stabilize crop production and to provide insurance against aberrant weather situations in rainfed agriculture, intercropping of millets with pulses such as pigeonpea could be a viable risk minimizing agronomic means of sustainable venture. Especially the information on promising intercropping systems under delayed monsoon conditions has been lacking which is required for contingency planning. Hence, promising foxtail millet based intercropping systems were tested for their response to different times of sowing to evaluate their yield potentiality.

MATERIAL AND METHODS

A field experiment was carried out during late *kharif*, 2016 at S.V. Agricultural College Farm, Tirupati. The experimental soil was sandy loam in texture, slightly acidic in reaction (pH 6.1), medium in organic carbon (0.52 per cent) and low in available nitrogen (185 kg ha^{-1}), high in available phosphorus (28 kg ha^{-1}) and medium in potassium (204 kg ha^{-1}). The experiment was laid out in split-plot design with twelve treatment combinations and replicated thrice. The treatments comprised of three times of sowing (first fortnight of August, second fortnight of August and first fortnight of September) and four intercropping systems (foxtail millet + pigeonpea (5 : 1), foxtail millet + castor (5 : 1), foxtail millet + black gram (3 : 3) and foxtail millet + cowpea (3 : 3)). Foxtail millet as well as intercrops were sown in lines, 30 cm apart by adopting all the standard package of practices. Recommended dose of fertilizer (50 kg N 30 kg P_2O_5 and 20 kg K_2O) was applied to foxtail millet only in all the treatments. The scheduled nitrogen was applied in two equal splits *viz.,* first half at the time of sowing as basal and remaining half as top dressing at 30 DAS.

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Table 1. Growth parameters of foxtail millet at harvest as influenced by times of sowing and intercropping systems

Treatments	Plant height (cm)	Leaf area index	Number of tillers m^{-2}	Dry matter production (kg ha^{-1})
Times of sowing				
T_1 : I Fortnight of August	102.8	1.43	3.8	2975
T_2 : II Fortnight of August	93.5	1.15	3.0	2787
T_3 : I Fortnight of September	88.7	1.11	2.5	2723
SEm±	2.19	0.033	0.10	46.9
CD (P=0.05)	8.6	0.13	0.4	183
Intercropping systems				
C_1 : Foxtail millet + pigeonpea (5 : 1)	106.3	1.52	3.4	3119
C_2 : Foxtail millet + castor (5 : 1)	103.0	1.38	3.4	3090
C_3 : Foxtail millet + black gram (3 : 3)	88.7	1.11	2.9	2560
C_4 : Foxtail millet + cowpea (3 : 3)	81.9	0.90	2.7	2544
SEm±	3.67	0.079	0.16	44.3
CD (P=0.05)	10.9	0.23	0.4	132
Interaction				
C at T				
SEm±	4.39	0.066	0.20	93.7
CD (P=0.05)	NS	NS	NS	NS
T at C				
SEm±	5.93	0.123	0.28	81.3
CD (P=0.05)	NS	NS	NS	NS

RESULTS AND DISCUSSION

Effect of times of sowing on growth and yield of foxtail millet

Among the three different times of sowing evaluated, taller plants, maximum leaf area and higher total number of tillers $hill^{-1}$ and dry matter production of foxtail millet were noticed with first fortnight of August sowing and was significantly superior to rest of the two times of sowing, which were comparable with each other. Lower values of these growth parameters were registered when the sowing was done during first fortnight of September (Table 1).

The yield attributing characters of foxtail millet *viz.,* number of productive tillers $hill^{-1}$, number of panicles m^{-2}, panicle length, panicle weight and grain weight $panicle^{-1}$ were found to be significantly higher with the first fortnight of August sowing and was having significant disparity with that of other two times of sowing, which were on par with each other. Lower values of these yield attributes were produced when sowing was done during first fortnight of September (Table 2). Thousand grain weight of foxtail millet was not significantly influenced by different times of sowing.

First fortnight of August sowings produced significantly higher grain and straw yields of foxtail millet which was significantly superior to that of other two times of sowing, which were on par with each other. While grain and straw yields of foxtail millet were at their lower value with first fortnight of September sowing (Table 2). Superiority of early sown foxtail millet crop in plant height, number of tillers, leaf area has resulted in higher

Table 2. Yield attributes of foxtail millet as influenced by times of sowing and intercropping system

Treatments	Panicle length (cm)	Panicle weight (g)	Grain weight panicle^{-1} (g)	1000 grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Times of sowing						
T_1 : I Fortnight of August	12.6	3.60	2.04	2.60	823	1565
T_2 : II Fortnight of August	10.9	3.35	1.71	2.58	767	1227
T_3 : I Fortnight of September	10.5	3.25	1.56	2.54	753	1063
SEm±	0.39	0.062	0.04	0.03	12.3	69.3
CD (P=0.05)	1.5	0.24	0.2	NS	48	271
Intercropping systems						
C_1 : Foxtail millet + pigeonpea (5 : 1)	12.4	3.79	2.16	2.70	974	1553
C_2 : Foxtail millet + castor (5 :1)	11.8	3.51	1.93	2.60	966	1539
C_3 : Foxtail millet + black gram (3 : 3)	10.8	3.13	1.62	2.50	599	1036
C_4 : Foxtail millet + cowpea (3 : 3)	10.2	3.10	1.52	2.49	587	1012
SEm±	0.32	0.121	0.12	0.04	23.8	66.7
CD (P=0.05)	0.9	0.36	0.3	0.1	71	198
Interaction						
C at T						
SEm±	0.78	0.12	0.09	0.06	24.7	138.6
CD (P=0.05)	NS	NS	NS	NS	NS	NS
T at C						
SEm±	0.63	0.19	0.17	0.07	37.8	121.7
CD (P=0.05)	NS	NS	NS	NS	NS	NS

dry matter accumulation which has contributed to higher values of yield attributes and was reflected in higher grain and straw yields. The results were in conformity with the findings of Rao *et al.* (1991); Jadhav *et al.* (1995) and Ramachandrappa *et al.* (2016).

Effect of intercropping on growth and yield of foxtail millet

Higher expression of all the growth parameters and yield attributes of foxtail millet were observed with the intercropping system of foxtail millet + pigeonpea (5 : 1), which was in parity with foxtail millet + castor (5 : 1) intercropping system. While all these parameters were at their lower value with the intercropping system of foxtail millet + cowpea (3 : 3) (Table 1 & 2).

Significantly higher grain and straw yields of foxtail millet were observed with the intercropping system of foxtail millet + pigeonpea (5 : 1), which was comparable with foxtail millet + castor (5 : 1) intercropping system. While lower grain and straw yields were registered with foxtail millet + cowpea (3 : 3) intercropping system (Table 2).

Higher grain and straw yields with the intercropping of foxtail millet + pigeonpea (5 : 1) might be due to significantly higher plant population of foxtail millet, productive tillers per hill, panicles per m^2, panicle length and grain weight per panicle at 5 : 1 row ratio than that at 3 : 3 row ratio coupled with the better complementary relationship with the intercrop in the system. As pigeonpea and castor are long duration crops, their initial growth was slow providing foxtail millet enough time to grow, establish and achieve higher grain and straw yields. But the growth of cowpea and black gram crops was vigorous in the early stages leading to smothering effect which resulted in lower grain and straw yields of foxtail millet. Similar results were obtained by Shashidhara *et. al.* (2000); Basavarajappa *et al.* (2002) and Padhi *et al.* (2010).

Higher productivity of foxtail millet could be obtained with intercropping system of foxtail millet + pigeonpea (5 : 1) sown during first fortnight of August during *kharif* season, indicating its suitability for cultivation under late sown conditions.

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