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PERFORMANCE EVALUATION OF FOXTAIL MILLET VARIETIES IN RAINFED ALFISOLS

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ABSTRACT

The field experiment was conducted to study the suitability of foxtail millet varieties for Alfisols of scarce rainfall zone under rainfed conditions for two years during *Kharif* 2014-15 and 2015-16 at Agricultural Research Station, Ananthapuramu. The treatments consisted of six varieties *viz.,* Narasimharaya, Krishnadevaraya, Srilakshmi, SiA 3085, Prasad and Suryanandi. The results revealed that SiA 3085, Narasimharaya and Srilakshmi produced significantly higher grain yield when compared to the remaining tested varieties. Narasimharaya and Krishnadevaraya can be recommended for dual purpose (both for grain and straw) followed by Srilakshmi variety. SIA - 3085 variety has to be recommended for grain production on commercial basis as its potential for production of straw is low.

Keywords: Alfisols, Foxtail millet, Rainfed varieties

INTRODUCTION

Millets offer nutritional security and there is a need for promoting millets as they are highly nutritious. Millets are rich in protein, fibre, iron, minerals, B-complex vitamins and calcium. Consumption of millets reduces risk of heart disease, protects from diabetes, improves digestive system, lowers the risk of cancer and detoxifies the body (Nitya Sharma and Keshavan Niranjan, 2017). The most widely grown millets are finger millet, proso millet and foxtail millet especially wherever annual rainfall is below 350 mm, perhaps no other cereal crop can be grown under such moisture stress (Srikanya *et al.,* 2020). In India, in the four decades since 1961, the area under millets declined by nearly 50 percent from about 18 million hectares to about 9 million hectares. During this time, production of millets declined from about 8.8 million tons to about 7.2 million tons with a decline of 18 percent (Annual Progress Report: 2018-19, ICAR-AICRP on Small Millets, Bengaluru). Five-yearly analysis of data indicated a steady decline in the area of small millets from 7.56 m ha during 1951-55 to 0.5 m ha during 2017-18 (Annual Progress Report: 2018-19, ICAR-AICRP on Small Millets, Bengaluru).

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Foxtail millet is one of the oldest small millets cultivated for food and fodder. It is known for its drought tolerance and can withstand severe moisture stress and also suits to wide range of soil conditions. It is of shortest duration and low cost consumptive crop, nutritionally superior, providingprotein, minerals and vitamins and forms of staple food for the poorer sections of the society. In India, Andhra Pradesh (4,79,000 ha), Karnataka (2,32,000 ha) and Tamil Nadu (20,000 ha) are the major foxtail millet growing states contributing about 90 percent of the total area under cultivation (Agricultural Statistics, 2020). Andhra Pradesh is a major foxtail millet growing state with an area contributing about 79 per cent of the total area. However, the yield per unit area is less as the crop is mainly grown by small and marginal farmers on poor shallow and marginal soils under rainfed conditions besides lacking of high yielding varieties.

In Ananthapuramu district of Andhra Pradesh, except sorghum, pearlmillet and fingermillet, no other millet have showed any improvement in their cultivable area. Ananthapuramu district is the second most drought affected district of India. It receives 550 mm rainfall annually. The agriculture is predominantly dependent on rainfall which is very erratic and uncertain. Being located in the scarce rainfall zone of Andhra Pradesh it does not get the full benefit of either the south-west or north-east monsoon. In this region, local varieties of foxtail millet often cultivated under unmanured and unfertilized conditions has resulted in reduced returns.Hence, by keeping all the points in view, the study was carried out to study the performance of newly developed foxtail millet varieties in rainfed alfisols.

MATERIALS AND METHODS

The field experiment was conducted to study the suitability of foxtail millet varieties for alfisols of scarce rainfall zone under rainfed conditions fortwo years during *Kharif*, 2014-15 and 2015-16 at Agricultural Research Station, Ananthapuramu of Andhra Pradesh. The soil of the experimental site was red sandy loam with shallow depth, low in organic carbon (0.36%) and low in available nitrogen (143 kg ha^{-1}), medium in available phosphorus (28 kg ha^{-1}) and potassium (215 kg ha^{-1}). The experiment was laid out in randomized block design with three replications.The treatments consisted of six varieties *viz.,* T1: Narasimharaya, T2: Krishnadevaraya, T3: Srilakshmi, T4: SiA 3085, T5: Prasad and T6: Suryanandi. The experimental field was prepared by working with a tractor drawn disc plough and then tractor drawn cultivatorwas drawn along the field. The individual plots were laid out according to the layout plan. Sowing was taken up as per the treatments. The seeds were sown by dibbling in furrows at a depth of 3 cm. The furrows were covered immediately after sowing and compacted sufficiently for better germination. Thinning was done at 15 DAS retaining one healthy seedling $hill^{-1}$. The recommended dose of 40 and 20 kg ha^{-1} of N and P_2O_5 was applied at the time of sowing through urea and single super phosphate respectively. Thinning and gap filling was done wherever necessary, weeding and hoeing were taken up depending on the intensity of weeds at critical stages of crop weed competition. Two hand weedings were done with the help of star weeder in inter-rows and with hand hoes in the intra-rows all other cultural practices were kept

normal and uniform for all treatments. At harvest five plants were randomly selected from each treatment for recording growth parameters such as plant height, number of tillers and panicles per plant, panicle length,panicle weight per plant, threshing percent and test weight. At harvest in each treatment grain and straw yield from the net plot (5 m x 5 m) was recorded and expressed in kg $ha^{-1.}$

RESULTS AND DISCUSSION

Growth and yield attributes

During 2014, among the six varieties evaluated the taller plants were produced by the Narasimharaya followed by Prasad, without any significant difference between them. While,shorter plants were produced with Suryanandi. Srilakshmi and Narasimharaya varieties produced significantly taller plants compared to other tested varieties. The pooled data showed that Narasimharaya,Srilakshmi and Prasad varieties were significantly superior over other varieties with respect to plant height (Table 1). These results were contradictory to Karanam Navya Jyothi *et al*. (2016) who reported thatthe taller plants were produced by the variety SiA 3156 followed by SiA 3085, while, the shorter plants were produced with SiA 3088.Number of tillers per plant was also significantly influenced by the tested varieties during the year 2014. Suryanandi recorded significantly higher number of tillers per plant compared to other varieties. During 2015, higher number of tillers per plant (4.5) was produced by the variety Prasad followed by Suryanandi (4.3) without any significant difference between them. While, less number of tillers per plant was produced by SiA- 3085 (3.1).The pooled data revealed that variety Suryanandi recorded higher number of tillers per plant which in turn on par with Prasad and significantly superior to other varieties. These results were contradictory to KaranamNavya Jyothi *et al*. (2016) who reported that the total number of tillers m^{-2} was not significantly influenced by different varieties. The difference in the growth characters may be attributed to the genetic constitution of the varieties.During 2014, the variety Suryanandi produced higher number of panicles per plant which was at par with Prasad variety and significantly superior to other varieties. The variation in number of panicles per plant was not significant during the year 2015 and in pooled analysis.

SiA 3085 variety was outstanding as it recorded maximum panicle length (13.1 cm) but it was at par with Srilakshmi, Prasad and Narasimharaya varieties and significantly superior to Krishnadevaraya and Suryanandi varieties during 2014. Srilakshmi variety recorded higher panicle length (12.2 cm) which was significantly superior over other tested varieties during 2015. The pooled data showed that Srilakshmi and SiA 3085 were comparable to each other and significantly superior over other varieties with respect to panicle length.During 2014, SiA 3085 recorded significantly higher panicle weight per plant (15.3) compared to other varieties. Srilakshmi variety produced maximum panicle weight per plant which was at par with SiA 3085 and significantly superior to other tested varieties during 2015. Pooled data revealed that SiA 3085 produced significantly higher panicle weight compared to other varieties.

Variation in threshing percentage was inconsistent among the varieties during the period of investigation. Among the varieties during the year 2014, Suryanandi and Srilakshmi have recorded lower threshing percentage compared to other varieties. The threshing percentage was not significantly influenced by the tested varieties during the year 2015. Similar results were observed with pooled data also.The test weight was not influenced by the varieties during both the years of study. Similar results were observed with pooled data also. However,SiA 3085 produced higher test weight (2.91) and lesser test weight (2.28) was recorded with Prasad variety.

Grain and straw yield

Grain yield was remarkably influenced by the tested varieties during both the years of study. Prasad variety has recorded higher grain yield (529 kg ha^{-1}) during 2014 (Table 2). However, it was at par with Krishnadevaraya, SiA3085 and Suryanandi varieties and significantly superior over Narasimharaya and Srilakshmi varieties.The trend changed during the year 2015, Srilakshmi recorded maximum grain yield (814 kg ha^{-1}) though it was statistically on par with Narasimharaya(664 kg ha^{-1}) and SIA 3085(696 kg ha^{-1}) varieties and significantly superior to other varieties. The Pooled data showed that SiA 3085, Narasimharaya and Srilakshmi produced significantly higher grain yield as compared to the other tested varieties. Difference in yields among the varieties can be attributed to their genetic potentiality to utilize and translocate photosynthates from source to sink.The results were in conformity with the findings of Navyajyothi *et al*. (2015), Karanam Navya Jyothi *et al*. (2016), Sahaja Deva *et al*. (2019), Srikanya *et al*. (2020).

Krishnadevaraya had recorded significantly higher straw yield (2976 kg ha^{-1}) compared to other varieties during the year 2014. The difference in straw yield among the varieties was not significant during the year 2015. However,Narasimharaya produced higher straw yield (1805 kg ha^{-1}) and Suryanandi recorded lesser straw yield (1045 kg ha^{-1}).The pooled data showed that Narasimharaya and Krishnadevaraya have produced significantly higher straw yield compared to the other tested varieties.In 2014, among different varieties tested, significantly highest harvest index was produced by SiA 3085compared to other varieties. During 2015, highest harvest index (0.40) was produced by variety Srilakshmi without any significant difference between them. While,the lowest harvest index was produced by Prasad variety (0.22).The pooled data revealed that variety SiA 3085 recorded higher harvest index (0.32) which was at par with Suryanandi variety and significantly superior to other varieties. This investigation confirms the results reported by Brunda *et al*. (2015),Karanam Navya Jyothi *et al*. (2016), Ramachandrappa *et al*. (2016) and Himasree *et al*. (2017).

Correlation between yield components and yield of foxtail millet varieties

During 2014-15, number of panicles per plant was negatively correlated to number of tillers per plant. Panicle length was negatively correlated to number of tillers per plant but positively correlated with plant height (Table 3). Panicle weight has significant positive

Table 1. Growth and yield components of foxtail millet varieties in rainfed alfisols

S. No.	Treatments	Plant height (cm)			Number of tillers per plant			Number of panicles per Plant			Panicle length (cm)			Panicle weight per plant (g)		
		2014	2015	Mean	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
1.	Narasimharaya	94.6	62.3	78.5	4.2	3.7	3.9	3.0	3.2	3.1	11.1	8.3	9.7	8.7	7.1	7.9
2.	Krishnadevaraya	81.4	59.7	70.6	4.4	4.1	4.3	3.6	3.6	3.6	9.9	9.8	9.9	7.2	8.2	7.7
3.	Srilakshmi	89.7	66.4	78.1	3.4	3.5	3.5	2.8	2.7	2.7	13.1	12.2	12.7	7.7	9.4	8.6
4.	SIA 3085	86.3	53.5	69.9	4.5	3.1	3.8	3.2	2.2	2.7	13.4	9.9	11.7	15.3	9.1	12.2
5.	Prasad	93.3	56.7	75.0	5.6	4.5	5.0	4.4	3.5	4.0	12.5	8.4	10.4	13.5	7.5	10.5
6.	Suryanandi	79.5	57.6	68.6	7.2	4.3	5.8	5.5	3.8	4.6	7.9	8.1	8.0	7.0	6.5	6.7
	SEm±	3.59	2.25	1.32	0.31	0.72	0.38	0.4	0.79	0.47	0.76	0.65	0.59	0.33	0.18	0.18
	CD at 5%	NS	7.18	4.21	0.99	NS	1.21	1.3	NS	NS	2.41	2.09	1.90	1.05	0.57	0.59

Table 2. Threshing %, test weight and yield of foxtail millet varieties in rainfed alfisols

S .No.	Treatments	Threshing %			Test weight (g)			Grain yield (kg ha-1)			Straw yield (kg ha-1)			Harvest Index		
		2014	2015	Mean	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
1.	Narasimharaya	60.9	61.9	61.4	2.40	2.35	2.38	445	664	554	2455	1805	2130	0.15	0.27	0.21
2.	Krishnadevaraya	63.9	53.7	58.8	2.67	2.57	2.62	477	487	482	2976	1222	2099	0.14	0.28	0.21
3.	Srilakshmi	50.1	63.2	56.7	2.30	2.70	2.50	299	814	557	2234	1294	1764	0.12	0.40	0.26
4.	SIA 3085	68.8	59.0	63.9	2.97	2.86	2.91	486	696	591	1191	1367	1279	0.29	0.34	0.32
5.	Prasad	63.6	57.9	60.8	1.85	2.70	2.28	529	313	421	1637	1210	1423	0.24	0.22	0.23
6.	Suryanandi	57.4	56.3	56.8	2.54	2.40	2.47	477	547	512	1935	1045	1490	0.20	0.34	0.27
	S.Em±	2.61	3.7	2.6	0.30	0.23	0.25	22.7	62.6	31.5	83.0	150.0	75.0	0.01	0.04	0.02
	CD at 5%	8.33	NS	NS	NS	NS	NS	72.4	200	100	266.0	NS	241.0	0.04	NS	0.07

Table 3. Correlation coefficient between yield components and yield of foxtail millet varieties in rainfed alfisols during 2014-15

S.No.	Parameter	Plant height	Number of tillers / plant	Number of panicles /plant	Panicle length	Panicle weight /plant	Thresh-ing %	Test weight	Straw yield	Harvest Index	Grain yield
1.	Plant height	1									
2.	Number of tillers/plant	-0.461	1								
3.	Number of panicles/plant	-0.506	0.980**	1							
4.	Panicle length	0.649*	-0.681	-0.702	1						
5.	Panicle weight/plant	0.367	-0.034	-0.126	0.671*	1					
6.	Threshing %	-0.040	0.125	0.033	0.118	0.678*	1				
7.	Test weight	-0.587	-0.107	-0.192	-0.125	0.027	0.367	1			
8.	Straw yield	-0.144	-0.293	-0.190	-0.442	-0.816	-0.331	-0.046	1		
9.	Harvest Index	0.015	0.395	0.285	0.280	0.884**	0.713*	0.169	-0.885	1	
10.	Grain yield	-0.135	0.600*	0.542	-0.271	0.466	0.824**	0.017	-0.286	0.668*	1

**= Significant at 1 % level; * = Significant at 5 % level

Table 4. Correlation coefficient between yield components and yield of foxtail millet varieties in rainfed alfisols during 2015-16

S.No.	Parameter	Plant height	Number of tillers / plant	Number of panicles /plant	Panicle length	Panicle weight /plant	Thresh-ing %	Test weight	Straw yield	Harvest Index	Grain yield
1.	Plant height	1									
2.	Number of tillers/plant	-0.079	1								
3.	Number of panicles/plant	0.045	0.929**	1							
4.	Panicle length	0.527	-0.567	-0.593	1						
5.	Panicle weight/plant	0.186	-0.706	-0.799	0.900**	1					
6.	Threshing %	0.551*	-0.552	-0.582	0.407	0.336	1				
7.	Test weight	-0.334	-0.436	-0.694	0.548*	0.802**	0.081	1			
8.	Straw yield	0.291	-0.467	-0.343	-0.077	0.019	0.590*	-0.255	1		
9.	Harvest Index	0.318	-0.586	-0.449	0.648*	0.462	0.306	0.136	-0.190	1	
10.	Grain yield	0.487	-0.845	-0.686	0.648*	0.541	0.680*	0.089	0.383	0.825**	1

**= Significant at 1 % level; * = Significant at 5 % level

Table 5. Correlation coefficient between yield components and yield of foxtail millet varieties in rainfed alfisols (mean of 2 years data)

S.No.	Parameter	Plant height	Number of tillers / plant	Number of panicles /plant	Panicle length	Panicle weight /plant	Thresh-ing %	Test weight	Straw yield	Harvest Index	Grain yield
1.	Plant height	1.00									
2.	Number of tillers/plant	0.35	1.00								
3.	No. panicles/plant	0.23	0.96**	1.00							
4.	Panicle length	0.63*	-0.26	-0.38	1.00						
5.	Panicle weight/plant	0.45	0.09	-0.07	0.73**	1.00					
6.	Threshing %	0.25	0.11	-0.03	0.28	0.64*	1.00				
7.	Test weight	-0.40	-0.26	-0.37	-0.07	0.03	0.23	1.00			
8.	Straw yield	0.60	0.10	0.07	0.08	-0.27	0.02	-0.22	1.00		
9.	Grain yield	-0.38	-0.27	-0.27	-0.03	0.10	0.41	0.16	-0.29	1.00	
10.	Harvest Index	-0.62	-0.26	-0.23	-0.06	0.22	0.24	0.28	-0.80	0.79**	1.00

**= Significant at 1 % level; * =Significant at 5 % level

relation with panicle length and threshing percent.Straw yield was significantly and negatively correlated with panicle weight. Harvest index has significant and positive relation with panicle weight, threshing percentage and grain yield. Grain yield has significant positive correlation with number of tillers per plant and threshing percentage.

During 2015-16, number of panicles per plant has significant positive correlation with number of tillers per plant (Table 4). Panicle weight showed negative correlation with number of tillers per plant and number of panicles per plant but significant positive correlation with panicle length.Test weight was significantly and positively correlated with panicle length and panicle weight. However, it was negatively correlated to number of panicles per plant. Straw yield was positively correlated with threshing percentage. Grain yield has significant negative relation with number of tillers per plant and number of panicles per plant, but it had significant positive correlation with panicle length and threshing percentage. Harvest index revealed significant positive relation with panicle length and grain yield. It also expressed significant negative relationship with number of tillers per plant.

The pooled analysis showed that there was significant positive correlation between number of panicles per plant and number of tillers per plant (Table 5). Panicle weight per plant has significant positive correlation with panicle length. Panicle length was significantly and positively correlated to plant height. Threshing percent has positive relation with panicle weight per plant. Straw yield has significant positive correlation with plant height. Grain yield was not significantly influenced by any factor. Harvest index was significantly and negatively influenced by plant height and straw yield. However, it has significant positive correlation with grain yield.

CONCLUSIONS

Keeping in view the demand for fodder and grain, Narasimharaya and Krishnadevaraya can be recommended for dual purpose followed by Srilakshmi variety. SIA 3085 variety has to be recommended for grain production on commercial basis as its potential for production of straw is low.

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