Genetic Variability Studies in Italian Millet (*Setaria italica* (L.) Beauv) Varieties under Rainfed conditions in Scarce Rainfall Zone of Andhra Pradesh

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ABSTRACT

Six varieties of Italian Millet (*Setaria italica* (L.) Beauv) were evaluated at Agricultural Research Station, ANGRAU, Ananthapuram, Andhra Pradesh during *Kharif* 2014 and *Kharif* 2015. The present study was conducted to assess the magnitude of genetic variability, heritability in broadsence and genetic advance as per cent of mean. Complete randomized block design with three replications was used at each season. In general phenotypic coefficients of variation (PCV) estimates were higher than genotypic coefficients of variation (GCV) estimates for all the eight characters studied displaying the influence of environment effect on the studied characters. The combined results for heritability and genetic advance as per cent of mean showed that the high estimates were scored for panicle weight fallowed by panicle length indicating that these characters were under the control of additive genetic effects. In a combined study over the two years the variety SIA 3085 is identified with highest grain yield (891 kg/ha) with earliness (55days to flowering and 85 days to maturity) fallowed by the variety Narasimharaya for grain yield (717 kg/ha) but it scored highest straw yields (2150 kg/ha) with late maturity (97 days to maturity).

Key words: *GCV, Heritability and Genetic advance, Italian Millet Varieties,PCV, Variability.*

Italian Millet (*Setaria italica* (L.) Beauv) is one of the important small grain crops that come up well in drylands, which are characterized by high temperature, low fertile soil and poor management by resource poor farmers. Italian Millet is also known as Foxtail millet, German millet, Chinese millet and Hungarian millet. In India it is majorly grown in Madhya Pradesh, Orissa, Bihar, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Gujarat and Uttar Pradesh. In Andhra Pradesh it is commonly known as "Korra". It is one of the world's oldest cultivated crops. Its domestication and cultivation is estimated to have occurred over 4000 years ago. Wide adaptation, easy cultivation, free from major pests and diseases and drought tolerance has made this crop an indispensable component of dry farming areas. Like sorghum and pearl millet, fox tail millet is not only staple food for the farming community but also provide substantial quantity of palatable fodder for cattle. It is nutritionally rich and particularly low in Phytic acid and rich in iron and calcium.

Italian millet ranks second in the world total production of millets and is an important staple food for millions of people in Southern Europe and Asia (Brunda *et al*., 2014). It is well adopted to temperate, subtropical and tropical Asia. In addition to that its grains are rich in protein, fiber, â – carotene, minerals *viz.,* calcium, iron, potassium, magnesium, zinc, antioxidants and vitamins (Rai 2002). The grains with husk intact have long shelf life which is a preferable attribute (Ravi *et al*., 2010). Millet based dietary fiber improves glucemic control, decreases hyperinsulinemia and lowers plasma lipid concentrations in patients with type 2 diabetes (Jali *et al*., 2012).

The present investigation was carried out to find out the best varieties for high grain and fodder yield among six released italian millet varieties suitable for cultivation under rainfed situation in red sandy loam soils or low depth soils. Agricultural Research Station, ANGRAU, Ananthapuram region comes under scarce rainfall region in the state of Andhra Pradesh and is highly prone to scanty and unevenly distributed rainfall and hence it is always drought – prone. High wind speed, low soil depth and low nutrient status in the soils further exaggerates the deleterious effects of drought at this place. The frequency of prolonged dry spells during the season also very high in this region.

The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) indicates the phenotypic and genotypic variability present in the trait and heritability estimates aid in determining the relative amount of heritable portion. In fact, heritability in broadsence [h^2 (bs) (%)] would be reliable, if accompanied by high genetic advance. Hence here an attempt has been made to analyze the magnitude of variation and genetic parameters to find out the effectiveness of selection for different traits in foxtail millet.

MATERIAL AND METHODS

In the present investigation, the trail material consisted of six italian millet varieties namely Narasimharaya, Krishnadevaraya, Srilakshmi, SIA 3085, Prasad and Suryanandi. The source of seed material was obtained from RARS, ANGRAU, Nandyal. The trail was laid out in Completely Randomized Block Design with three replications. Each plot consisted of six rows of 5m length and with a spacing of 22.5 cm apart from row to row and 10 cm apart from plant to plant.

The study was conducted at Agricultural Research Station, ANGRAU, Ananthapuram, Andhra Pradesh during *kharif* 2014 and *kharif* 2015 under rainfed situation. Standard crop production practices were followed to raise healthy crop. The data were recorded on eight growth and yield related characters *viz.,* Days to 50% flowering, Days to maturity, Plant height at maturity (cm), Number of effective tillers per plant, Panicle length (cm), Panicle weight (g), Grain yield (Kg / ha) and Straw yield (Kg / ha). The data on days to 50% flowering and days to maturity, grain yield and straw yield were recorded on whole plot basis where as the data on plant height, number of effective tillers per plant, panicle length and panicle weight were recorded on five randomly selected plants in each plot.

The recorded data was analyzed using WINDOWSTAT software of WINDOWS VISTA version. Analysis of variance (ANOVA) was performed as described by Singh and Chowdary (1985). The variability parameters, genotypic and phenotypic coefficient of variation (GCV and PCV) were worked out following Burton (1952). The method suggested by Lush (1940) was adopted to work out the estimates of broad sense heritability.

The expected genetic advance was calculated as suggested by Johnson *et al.,* (1955). The mean data of five plants over three replications were used for statistical analysis.

RESULTS AND DISCUSSION

The performance of six italian millet cultivars for eight yield and its related characters during *kharif* 2014 and *kharif* 2015 at Agricultural Research Station, ANGRAU, Ananthapuram was shown in Table-1. The variety SIA 3085 is early in nature, while the variety Krishnadevaraya is late with lowest and highest values respectively for days to 50% flowering and days to maturity in both the years as well as in combined study. The variety SIA 3085 produced highest grain yield of 819 kg / ha in combined study followed by 717 kg / ha by Narasimharaya variety. The variety Narasimharaya was given highest dry fodder / straw yield of 2150 kg / ha followed by Krishnadevaraya (1966 kg / ha) over the two years of study. The variety Srilakshmi had showed plants with tall plant height (102.5 cm) and lengthy panicles (16.8 cm) among the six varieties studied over the two seasons. Whereas more values for the character panicle weight was recorded by the variety SIA 3085 over the two seasons.

In general, for all the characters involved in this study, the PCV is greater than GCV (Table-2). This indicates little influence of environment on the expression of characters studied. In the present study of Italian Millet varieties high PCV and GCV values were observed for the most economic traits grain yield, straw yield and panicle weight per plant in both the seasons as well as in combined analysis. The moderate PCV and GCV values were observed for rest of the characters *viz.,* days to maturity, plant height at maturity, number of effective tillers per plant, panicle length and panicle weight per plant except for one character *i.e.,* days to 50% flowering which expressed low values of GCV and PCV in both the seasons as well as in combined study. These results are in consonance with Lakshmana and Guggari (2001), Nirmalakumari and Vetriventhan (2010), Prasanna *et al.,* (2013) and Brunda *et al.,* (2014).

Heritability which is the heritable portion of phenotypic variance is a good index of transmission of characters from parents to

Table 1. Mean Performance of six Italian Millet Varieties for eight yield related traits evaluated at ARS, ANGRAU, Ananthapuram under rainfed situation during *kharif* 2014 and *kharif* 2015

S. No.	Varieties	Days to 50% Flowering			Days to Maturity			Plant height (cm)			Number of Panicles per plant		
		Kharif 2014	Kharif 2015	Combined	Kharif 2014	Kharif 2015	Combined	Kharif 2014	Kharif 2015	Combined	Kharif 2014	Kharif 2015	Combined
1	Narasimharaya	61	60	60	98	95	97	99.2	89.1	94.2	5.5	3.7	4.6
2	Krishnadevaraya	61	61	61	107	104	106	98.1	83.7	90.9	5.9	4.1	5.0
3	Srilakshmi	62	61	61	98	96	97	104.7	100.2	102.5	5.1	4.3	4.7
4	SIA 3085	56	54	55	86	84	85	95.4	81.7	88.6	3.7	3.3	3.5
5	Prasad	59	58	58	90	90	90	104.7	96.4	100.6	5.2	5.2	5.2
6	Suryanandi	58	55	56	86	85	86	83.1	72.7	77.9	5.6	4.3	5.0

S. No.	Varieties	Panicle length (cm)			Panicle weight per plant (g)			Grain yield (kg/ha)			Straw yield (kg/ha)		
		Kharif 2014	Kharif 2015	Combined	Kharif 2014	Kharif 2015	Combined	Kharif 2014	Kharif 2015	Combined	Kharif 2014	Kharif 2015	Combined
1	Narasimharaya	15.2	11.7	13.5	8.7	7.1	7.9	770	664	717	2494	1805	2150
2	Krishnadevaraya	15.6	11.9	13.8	7.2	8.2	7.7	753	487	620	2710	1222	1966
3	Srilakshmi	17.5	16.0	16.8	7.7	9.4	8.6	438	815	626	2469	1294	1882
4	SIA 3085	17.3	14.8	16.1	15.3	9.1	12.2	942	697	819	2191	1367	1779
5	Prasad	16.6	13.3	15.0	13.5	7.5	10.5	495	313	404	2222	1210	1716
6	Suryanandi	13.2	10.5	11.9	7.0	6.5	6.8	835	547	691	1611	1045	1328

offspring. In this study heritability in broadsence values ranged from low (6.5 per cent for number of effective tillers per plant) to high (97.6 per cent for panicle weight per plant) in combined analysis for both the seasons (Table-2). The characters which exhibited high heritability estimates are days to maturity, days to 50% flowering, plant height at maturity and panicle length. Likewise, the heritability in broadsence values are moderate for the two economic characters grain yield and straw yield. Similar findings were observed by Lakshmana and Guggari (2001), Nirmalakumari *et al.,* (2008), Nirmalakumari and Vetriventhan (2010), Prasanna *et al.,* (2013) and Brunda *et al.,* (2014).

Heritability variation can be determined with greater accuracy if it is studied with genetic advance and genetic advance as per cent of mean (Johnson *et al.,* 1955). In the study, the traits panicle weight and panicle length expressed high estimates for both heritability in broadsence and genetic advance as per cent of mean, indicating that environment effect may not reduce the inheritance of these characters. This also indicates the major role of additive gene action for these two traits. The characters days to maturity & plant height expressed high heritability coupled with moderate values of genetic advance as per cent of mean indicating that variation are attributable to high level of additive gene effects. Similar reports were published by Chidambaram *et al.,* (1994). Days to 50% flowering showed high heritability coupled with low genetic advance as per cent of mean. Whereas moderate estimates were recorded for both heritability and genetic advance as per cent of mean by the two economic characters grain yield and straw yield (Table-2). This could be due to the presence of non-additive gene effects and high genotypic environment interaction (Panse, 1957). These results are in consonance with the studies conducted by

Table 2. Estimates of variability parameters in six Italian Millet Varieties for eight yield related traits evaluated at ARS, ANGRAU, Ananthapuram under rainfed situation during *kharif* 2014 and *kharif* 2015.

Character	Kharif 2014						Kharif 2015					
	Range		GCV	PCV	h^2 (bs) (%)	GA as % of Mean	Range		GCV	PCV	h^2 (bs) (%)	GA as % of Mean
	Minimum	Maximum					Minimum	Maximum				
Days to 50% Flowering	56	62	3.344	3.852	75.4	5.981	54	61	5.036	5.432	86.0	9.619
Days to maturity	86	107	8.719	9.016	93.5	17.37	84	104	8.137	8.270	96.8	16.491
Plant Height (cm)	83.1	104.7	7.065	10.140	48.6	10.14	73	100	11.416	11.836	93.0	22.681
No. of Panicles per plant	3.73	5.9	5.340	24.419	48.0	2.40	3.3	5.2	9.490	23.231	16.7	7.986
Panicle Length (cm)	13.2	17.5	8.216	13.126	39.2	10.59	10.6	16.0	15.574	16.017	94.5	31.195
Panicle weight per plant (g)	7.0	15.3	35.963	36.420	97.5	73.15	6.5	9.4	14.054	14.592	92.8	27.886
Grain yield (kg/ha)	438	942	21.872	37.378	34.2	26.36	313	815	28.151	33.680	69.9	48.472
Straw yield (kg/ha)	1611	2710	7.750	26.726	8.4	4.63	1045	1805	15.891	25.344	39.3	20.525

Character	Combined					
	Range		GCV	PCV	h^2 (bs) (%)	GA as % of Mean
	Minimum	Maximum				
Days to 50% Flowering	55	62	4.466	4.867	84.2	8.444
Days to maturity	85	106	8.417	8.556	96.8	17.060
Plant Height (cm)	77.9	102.5	9.222	10.479	77.4	16.719
No. of Panicles per plant	3.5	5.2	5.317	20.845	6.5	2.794
Panicle Length (cm)	11.9	16.7	11.773	13.424	76.9	21.269
Panicle weight per plant (g)	6.7	12.3	22.648	22.922	97.6	46.098
Grain yield (kg/ha)	404	717	17.928	27.324	43.1	24.232
Straw yield (kg/ha)	1329	2150	11.875	20.738	32.8	14.608

Lakshmana and Guggari (2001); Nirmalakumari *et al.,* (2008), Sirisha (2008), Lakshmi Prasanna *et al.,* (2013) and Brunda *et al.,* (2014).

In conclusion, based on the *per se* performance of the six italian millet varieties studied over the two years, the variety SIA 3085 (with 819 kg / ha grain yield) is superior in grain yield with earliness in maturity (55 days and 85 days) followed by the variety Narasimharaya (717 kg / ha for grain yield along with highest straw yield but late in maturity (60 days and 97 days). Next to these two varieties, the variety Suryanandi recorded good grain yields (691 kg / ha) with earliness in maturity (56 days and 86 days) but with lowest straw yields. Based on the variability studies among the eight characters studied; the character "panicle weight" recorded highest values for PCV, GCV, heritability in broadsence and genetic advance as per cent of mean, confirming that, inheritance of this character may not be influenced by environment and it is the most useful in selection of breeding material where as the character number of effective tillers per plant recorded lowest values for all the variability parameters indicating that there is high influence of environment in governing this character.

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