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Yield performance and Adaptability of Finger millet landrace in North Western Tigray, Ethiopia

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ABSTRACT

Finger millet (*Eleusine coracana* L. Gaertn.) is a stable food crop with inherent hardy nature and quality nutritional grain in majority of drought prone areas in several East African and South Asian countries in the world. The experiment was conducted with objectives of determining the effect of genotype, environment and their interaction for grain yield and to identify the most stable finger millet genotypes in north western Tigray, Ethiopia. Forty one finger millet genotypes were grown at three sites in northwestern Tigray, Ethiopia at two season (2015/16 and 2016/2017). The experiment was laid down in RCBD with three replications. The combined ANOVA for grain yield revealed highly significant (P<0.01) for genotypes, environments and their interactions. This indicated that the environments were diverse and variability among the genotypes. The significant interaction showed the genotypes respond differently across the different environments. The mean grain yield value of genotypes averaged over environments indicated that MyARC coll 44 and Tessema had the highest (2599 kg/ha) and lowest (1154 kg/ha) grain yield respectively. The best genotype with respect to site of Tselemti on station was genotype MyARC coll 44; for Tselemti Maiani also MyARC coll 61 and MyARC coll 61. Generally, the result revealed the existence of variability for the characters studied in finger millet landraces. Hence, this is a potential character of interest which could be used in the genetic improvement of finger millet through hybridization and/or selection by involving breeders and farmers' knowledge. Farmers also opined that the new variety has better grain and fodder yield potential and lodging resistance and they would adopt them in future.

***Keywords*:** Grain yield, Stability, Genotype x Environment, finger millet

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1. INTRODUCTION

Finger millet (*Eleusine coracana* (L.) Gaertn.) is a small seeded cereal grown in low rain fall areas of the semi arid tropics of the world. It is hardy crop capable of providing reasonable grain yield under circumstances where most crops give negligible yield. Finger millet is staple food crop in drought prone areas of the world and often considered as component of food security strategies. Its annual world production was about 30.5million tons: 12.4 million tons were produced in Africa mainly eastern and southern African (FAOSTAT, 2015; http://Faostat.fao.org).

Finger millet (*Eleusine coracana* L. Gaertn., 2n = 4x = 36) belongs to the family *Poaceae*. Among millets it ranks third in importance after sorghum and pearl millets. Its wide adaptability to diverse environments and cultural conditions makes it a potential food crop. The yields of finger millet are low in Ethiopia due to different production problems including: shortage of improved varieties, little research emphasis given to the crop, non adoption of improved technologies, poor attitude to the crop, disease like blast which is the most serious disease, lodging and moisture stress in dry areas, threshing and milling problem are some of most serious production constraints in finger millet production in Ethiopia (Tsehaye and Kebebew, 2002; Degu *et al*., 2009; Hillu 1996, 1979; Wet 1084; Doesthale 1970).

Fig. 1. Finger millet (*Eleusine coracana* (L.) Gaertn.)

Millet is a collective term referring to a number of small-seeded annual grasses that are cultivated as grain crops, primarily on marginal lands in dry areas in temperate, subtropical and tropical regions. The most important species are pearl millet, finger millet, proso millet and foxtail millet. Finger millet (*Eleusine coracana* (L.) Gaertn.) is widely produced in the cooler, higher altitude region of Africa and Asia (International crop Research Institute for the semi- Arid Tropics/ FAO,1996) . Among the millets of the world, Finger millet ranks fourth in importance after sorghum, pearl millet and foxtail millet. In Ethiopia, finger millet is the 6th important crops after ten, wheat, maize, sorghum and barley. It comprises about 5 percent of the total land devoted to cereals. It is produced on 406,592 ha of land, from which 599963 tons are obtained at national level. There are three dominant and widely occurring varieties (black, brown and white) in Ethiopia. The black seeded variety, as described by the farmers, it suited for making local drinks, and has a better fermentation quality, storability and straw quality. The farmers' perception on the ability to tolerate bird attack may be some association with high tannin content of black seeded varieties. On the other hand, the white seeded variety, with no detectable tannin is reported to be highly preferred by birds (Yemane *et al*., 2006).

Finger millet is a predominant stable food crop of Tigray and has been produced by many small and marginal farmers. There is diversity in agronomic and socio economic requirements of small holders, farmers and consumers. Close cooperation between scientists and farmers in evaluating plant material and establishing plant breeding goal is also a key feature of these strategies, known as of participatory research method. Farmer's participation in the breeding of crop varieties for low resource farmers is regarded by some as necessary help to ensure local adaptation and preference (Gyawali *et al*., 2007; Mekbib, 2006). Even its importance as a stable food of Tigray, Amhara and SNNR still there is a gap between production and need. Despite yield, the other quality parameters like area of adaptation, grain size, ear head shape, grain colour, flouring capacity and cooking quality play an important role in choice of genotype selection.

Objectives of the Study

To select the best high yielding, major diseases and insect pest resistant finger millet genotypes.

2. MATERIALS AND METHODS

The experiment was conducted during 2015 & 2016 main cropping season at Tselemti district of on station and Maiani locations in north western Ethiopia. Forty one finger millet landraces including two standard checks (Tadesse and Tesema) were included in the study. The trial was laid down in randomized complete block design (RCBD) with three replications. To minimize the effect of soil variation on different treatments, both replications were folded to hold 21 accessions .In each experimental plot had three rows of five meter length spaced at 0.4 m with a gross area of 1.2 m^2. Planting was done by hand drilling at seed rate of 15 kg/ha.

Even though finger millet is a hardy crop; moderate fertilizer application enhances its agronomic performance. Hence, nationally recommended fertilizers were applied at the rate of 100 kg/ha of DAP (Nitrogen = 18% and Phosphate = 46%) as a basal dose, and 100 kg/ha of urea (nitrogen = 46%) as top dressing.

Half of the total nitrogen and total phosphorus were applied at the time of planting while the remaining nitrogen was applied at the time of tilling. Data were taken from all the three rows. Weeding and other management practices were done as required. Farmers were participated in evaluation and selection of improved finger millet varieties at maturity stage at maturing by organizing field days and experience sharing. Gene stat software was used to compute ANOVA (gene stat 16th edition).

3. RESULT AND DISCUSSIONS

At Tselemti on station of 2015/16 cropping season , the analysis of variance indicated that there were significant ($P<0.01$) difference among genotypes for number of fingers per plant, days to maturity, plant and finger length, grain and biomass yield. Among genotypes, MyARC coll44 and MyARC coll77 matured early compared to other genotypes which will, best fit the early finger millet production system. MyARC coll62 was late mature type and best fit for late maturing finger millet production system. The mean grain yield value indicated that MyARC coll54 followed by MyARC coll65 gave the highest grain yield (3655 kg/ha) and (3494 kg/ha) respectively while the lowest grain yield was recorded by standard check of Tesema (917 kg/ha). Varieties MyARC coll54 (109.33 cm) and MyARC coll78 (71.8 cm) were the tallest and shortest plant height respectively.

At Tselemti Maiani during season of 2015/2016, the analysis of variance exhibited that there were significant ($P<0.01$) difference among varieties for number of fingers per plant, days to maturity and finger length but non significant for plant height, grain and biomass yield. The highest and lowest grain yield was obtained by varieties MyARC coll 61 (3900 kg/ha) and MyARC coll 46 (2455 kg/ha) respectively.

Finger millet is one of the preferred feed source crops, for its palatable straw (Mulualem and Melak, 2013). Therefore, besides grain yield, biomass yield is among the major criteria for selection of a superior variety. So, the MyARC coll 4(13.6 ton/ha) followed by MyARC coll 4 (13.2 ton/ha) gave the highest biomass yield while the lowest is recorded by MyARC coll 54 (9.3 ton/ha).The mean values of finger length and plant height ranged from 8.7 cm (MyARC coll 4) to 13.8cm (MyARC coll 55) and 87.5 cm (MyARC coll 54) to 156.6 cm (MyARC coll 4) respectively (Table 2). Similar results were reported by Tsehaye and Kebebew, (2002); Bedis *et al*., (2006); Bezaweletaw *et al*., (2006); Andualem, (2008); Chrispus, (2008). They stated the presence of genetic variability in yield and yield related traits of finger millet germplasm.

At Tselemti on station of 2nd season 2016/17, the analysis of variance exhibited that there were significant ($P<0.01$) difference among genotypes for days to maturity, number of tillers per plant and biomass yield. The highest and lowest grain yield was obtained by varieties Tesema (4332 kg/ha) and MyARC coll 61 (137 kg/ha) respectively. The MyARC coll 61 (10.1 ton/ha) gave the highest biomass yield while the lowest is recorded by Tadesse (4.5 ton /ha). Among genotypes, MyARC coll 44 and MyARC coll 43 matured early compared to other genotypes which will, best fit the early finger millet production system (Table3).

Table 1. Yield and yield related traits performance of the Finger millet genotypes at Tselemti on station-2016

Genotype	DM	PHt	FL	FN/plant	Tiller/ plant	GY kg/ha	BY kg/ha
MyARC coll 4	113	92.47	10.27	7.4	5.2	3027.78	16900
MyARC coll12	113.33	85.27	10.4	7.53	4.93	2188.89	11950
MyARC coll19	112.33	89.33	10.67	7.27	4.87	2666.67	12216.67
MyARC coll21	113	96.73	10.8	7.8	4.87	1961.11	11905.56
MyARC coll24	111.67	83.33	10.2	7.33	4.47	2788.89	13600
MyARC coll28	113	88	10.4	7.13	4.87	2244.44	10777.78
MyARC coll33	111.67	83	9.6	8.33	5.33	2250	13222.22
MyARC coll35	113	89.73	9.8	7.4	5.07	1644.44	12466.67
MyARC coll36	111	85.4	9.67	6.33	4.33	2083.33	12516.67
MyARC coll37	112	101.27	11	7.53	5.33	3161.11	14722.78
MyARC coll43	113	90.87	11.2	7.4	4.73	2255.56	11576.67
MyARC coll44	110.67	89.6	10.2	7.27	4.93	3072.22	13450
MyARC coll45	111.67	91.67	10.07	7.07	4.67	2155.56	9655.56
MyARC coll46	114.33	79.53	8.33	5.2	4.53	1461.11	6188.89
MyARC coll48	114	87.93	9.73	8.33	4.8	1927.78	7333.33
MyARC coll49	116.67	95.8	10.33	6.33	4.93	2588.89	11661.11
MyARC coll50	112.33	85.6	9.8	7	4.73	2666.67	12822.22
MyARC coll52	111.67	85.4	9.93	6.67	4.73	2050	9155.56
MyARC coll53	114	98.8	10.07	7	4.93	3388.89	14861.11
MyARC coll54	113.33	109.33	11.2	7.87	5.27	3655.56	14122.22
MyARC coll55	113.67	91.8	11.73	7.87	5.27	3033.33	12166.67
MyARC coll57	111.33	87.2	10.07	7.27	5	2672.22	9222.22
MyARC coll58	114	82.8	10	6.73	4.93	3038.89	13405.56
MyARC coll59	111.33	94.13	11.87	6.93	5.33	2416.67	12211.11
MyARC coll60	112.67	86.07	9.87	7.13	4.27	2850	13238.89
MyARC coll61	114	83.8	9.87	7.13	4.53	2205.56	10111.11
MyARC coll62	118	87	8.53	7.53	4.47	1966.67	12783.33
MyARC coll64	114	94.47	11	6.93	4.67	3205.56	12444.44

MyARC coll65	111.33	101.73	11.33	7.53	5.6	3494.44	10866.67
MyARC coll66	112.67	87.6	10.2	7.33	4.6	2511.11	11588.89
MyARC coll67	114	86.53	9.93	7.27	5.13	2422.22	14166.67
MyARC coll69	114	79.2	11	7.4	4.8	1844.44	10772.22
MyARC coll70	111.33	94.8	9.8	7.4	4.53	2511.11	11344.44
MyARC coll72	114.33	83.53	11.33	7.2	5.13	1738.89	12116.67
MyARC coll73	113.33	81.53	9.53	7.2	5.27	1811.11	8444.44
MyARC coll76	111.67	84	10.27	7.33	4.4	2161.11	10755.56
MyARC coll77	111	80.73	11.33	7.27	4.2	2077.78	8922.22
MyARC coll78	117	71.8	8	6.67	4.53	1133.33	7500
MyARC coll79	115.67	74.07	8.6	6.53	4.4	1344.44	8894.44
Tadesse	116	82.93	9.2	6.73	4.13	2177.78	9500
Tessema	113	72.87	7.93	5.8	4.33	916.67	5211.11
Mean	113.22	87.88	10.11	7.14	4.81	2356.85	11369.37
Lsd(0.05)	2.1	17.6	1.5	1.08	1.09	1083.8	4955.9
CV	1.1	12.3	9.2	9.3	14	28.3	26.8
F-test	**	ns	**	**	ns	**	**

Table 2. Yield and yield related traits performance of the Finger millet genotypes Tselemti Maini in 2016

Genotype	DM	PHt	FL	FN/plant	Tiller/plant	GY kg/ha	BY kg/ha
MyARC coll 4	117.3	104.1	12.9	7.7	8.8	3838.9	13611.1
MyARC coll12	115.3	108.9	13.1	7.9	8.8	2861.1	11611.1
MyARC coll19	114.7	102.0	12.8	7.7	8.4	3200.0	10722.2
MyARC coll21	117.7	101.1	12.9	7.6	6.9	2777.8	10277.8
MyARC coll24	113.7	95.1	12.1	7.6	7.5	3744.4	12000.0
MyARC coll28	116.0	100.2	11.5	8.1	7.6	3022.2	11222.2
MyARC coll33	115.3	96.0	11.5	7.9	7.9	3383.3	10388.9
MyARC coll35	116.7	95.6	11.3	8.2	7.7	3050.0	11055.6
MyARC coll36	117.7	98.9	11.9	8.1	7.7	3583.3	10611.1

MyARC coll37	116.3	97.1	12.2	8.0	7.5	2772.2	10611.1
MyARC coll43	117.0	100.6	11.9	7.3	6.9	2466.7	9611.1
MyARC coll44	119.0	92.0	12.0	7.5	7.0	3350.0	10611.1
MyARC coll45	116.7	95.6	11.6	7.4	6.7	3050.0	10500.0
MyARC coll46	117.7	109.1	8.7	5.8	6.3	2455.6	10277.8
MyARC coll48	117.0	95.8	11.9	9.1	6.7	2644.4	10833.3
MyARC coll49	118.3	94.9	11.0	8.1	7.3	2922.2	10166.7
MyARC coll50	115.3	91.1	10.9	7.9	7.5	3500.0	10833.3
MyARC coll52	116.0	95.9	10.2	7.0	7.5	2894.4	10055.6
MyARC coll53	117.7	91.5	11.7	7.6	7.1	3283.3	10611.1
MyARC coll54	115.3	87.5	10.6	8.2	6.6	2950.0	9388.9
MyARC coll55	114.3	95.2	13.8	7.4	6.7	3261.1	10583.3
MyARC coll57	116.7	101.3	11.8	7.3	7.1	3605.6	10833.3
MyARC coll58	116.3	96.9	11.7	7.5	7.5	3411.1	10944.4
MyARC coll59	115.7	104.5	12.9	8.4	7.1	3350.0	11055.6
MyARC coll60	116.3	98.9	11.8	8.3	7.5	3805.6	12388.9
MyARC coll61	117.0	103.2	13.3	8.2	6.7	3900.0	13055.6
MyARC coll62	116.3	156.6	9.5	8.7	6.9	3861.1	12611.1
MyARC coll64	116.0	103.3	12.7	8.4	6.3	3472.2	10944.4
MyARC coll65	117.0	112.3	13.0	8.5	7.0	3222.2	11500.0
MyARC coll66	115.3	108.9	12.9	7.8	7.0	2983.3	11944.4
MyARC coll67	116.7	94.7	11.2	7.6	6.2	2961.1	10166.7
MyARC coll69	116.3	111.1	11.0	6.8	6.9	3077.8	10777.8
MyARC coll70	117.3	95.7	11.5	7.3	8.2	2850.0	11000.0
MyARC coll72	116.7	108.7	13.0	7.7	7.1	3227.8	11722.2
MyARC coll73	117.0	103.6	13.7	6.9	7.3	2983.3	11833.3
MyARC coll76	117.0	111.1	13.7	8.4	6.6	3861.1	13166.7
MyARC coll77	116.3	106.1	11.8	6.5	7.7	2755.6	10000.0
MyARC coll78	117.7	104.9	13.5	8.2	7.5	3388.9	11944.4
MyARC coll79	119.0	98.9	11.4	8.3	7.4	3183.3	12055.6
Tadesse	117.3	104.7	12.1	7.7	6.5	3316.7	12055.6

Tessema	118.3	111.2	10.3	6.4	6.8	2644.4	10777.8
Mean	116.6	103.0	11.9	7.7	7.2	3191.3	11147.9
Lsd(0.05)	3.1	26.5	1.8	1.3	1.4	904.5	2802.2
CV	1.6	16	9	10.3	11.7	17.4	15.5
F-test	ns	ns	**	**	*	ns	ns

Table 3. Yield and yield related traits performance of the Finger millet genotypes in Tselemti Maiani, 2017

Genotype	DM	PH	NF	NT	FL	BY_kg/ha	GY_kg/ha
MyARC coll 4	115.33 bcdefg	83.73	8.333	5.87 bc	10.33	6333 ef	826
MyARC coll12	119.00 hi	96.47	7.733	8.50 a	12.93	6889 de	2026
MyARC coll19	112.67abcd	100.2	9.067	4.27 bcde	12.53	9000 abcd	2369
MyARC coll21	114.00 abcde	96.53	8.6	5.20 bcde	12.73	7778 bcde	1761
MyARC coll24	114.67bcdef	90.73	8.4	5.73 bc	11.33	8333 abcde	2062
MyARC coll28	113.33 abcde	90.4	8.333	4.00 bcde	12.47	8111 abcde	2313
MyARC coll33	113.33 abcde	86.67	9.067	4.67 bcde	11.87	7889 abcde	1706
MyARC coll35	114.00 abcde	97.6	8	4.40 bcde	12.47	7889 abcde	1749
MyARC coll36	115.67cdefgh	92.13	10.2	5.00 bcde	12.73	7889 abcde	2155
MyARC coll37	116.00 defghi	92.2	8.467	5.47 bcd	12.07	8444 abcde	2036
MyARC coll43	112.00 ab	93.87	8.267	5.67 bcd	12.07	6667 de	2255
MyARC coll44	110.67a	91.87	8.533	5.07 bcde	12.67	6333 ef	2367
MyARC coll45	114.00 abcde	95.33	8.067	4.20 bcde	12.53	7889 abcde	1936
MyARC coll46	114.00 abcde	92.73	7.733	4.20 bcde	12.33	7000 cde	1497
MyARC coll48	116.00 defghi	91.07	8.333	4.40 bcde	12.93	6667 de	1726
MyARC coll49	115.00bcdef	89.47	8.733	5.20 bcde	13.73	7000 cde	2009
MyARC coll50	112.33 abc	89.67	8.2	5.13 bcde	13.73	7778 bcde	1950
MyARC coll52	114.33 bcde	96.13	7.8	5.00 bcde	13.4	8444 abcde	1936
MyARC coll53	115.33 bcdefg	95.07	9.067	5.27 bcde	13.4	7222 cde	1673
MyARC coll54	116.00 defghi	102.13	8.4	4.93 bcde	14.13	7556 cde	1791
MyARC coll55	116.00 defghi	91	7.933	4.07bcde	41.93	8333 abcde	2148
MyARC coll57	115.00 bcdef	87.93	7.8	5.13 bcde	12.07	7778 bcde	2067

MyARC coll58	112.67abcd	88.53	7.733	5.73 bc	10.53	7889 abcde	2376
MyARC coll59	114.00 abcde	87.47	7.667	5.00 bcde	11.8	8222 abcde	2333
MyARC coll60	115.33 bcdefg	88	7.8	4.33 bcde	11.33	7667 bcde	2010
MyARC coll61	113.67abcde	89.6	9.267	4.80 bcde	11.6	8222 abcde	137
MyARC coll62	119.33i	83.13	8.2	3.73 cde	9.93	8889 abcd	1378
MyARC coll64	113.67 abcde	89.4	7.133	3.93bcde	11.73	7333 cde	1881
MyARC coll65	115.67 cdefgh	85.73	8	4.60 bcde	11.47	8111 abcde	2174
MyARC coll66	115.00 bcdef	85.47	7.467	5.53 bcd	13.07	8333 abcde	2279
MyARC coll67	115.67 cdefgh	87.2	8.133	4.73 bcde	12.67	7667 bcde	2016
MyARC coll69	115.33 bcdefg	91.53	7.8	5.20 bcde	11.4	6889 de	2049
MyARC coll70	116.67 efghi	89.13	7.6	5.00 bcde	11.67	9333abc	2048
MyARC coll72	118.00 fghi	89.87	7.733	4.93 bcde	12.4	8000 abcde	1909
MyARC coll73	116.67 efghi	88.13	7.733	6.07 b	13.07	8889 abcd	2093
MyARC coll76	114.00 abcde	88.8	7.933	5.60 bcd	12.13	7778 bcde	2177
MyARC coll77	116.00 defghi	89.67	8.533	4.27 bcde	11.8	7556 cde	1876
MyARC coll78	118.00 fghi	89	7.667	3.93 bcde	11.13	10111 a	1424
MyARC coll79	116.67efghi	96.73	8.733	3.80 bcde	11.53	9889 ab	1786
Tadesse	118.67 ghi	94.73	6.8	3.40 de	10.27	4556f	591
Tessema	118.00 fghi	95.13	7.7	3.00 e	9.47	7278 cde	4332
Mean	115.16	91.22	8.163	4.85	12.81	7801	1972
Lsd(0.05)	2.908	10.08	1.5887	1.817	13.406	1864.3	1568.8
CV	1.6	6.8	12	23	64.4	14.7	49
F-test	**	NS	NS	**	NS	**	NS

Combined Analysis of Variance of Yield and Yield Related Traits

The Combined analysis of variance showed that the effect of environments, genotypes and their interactions for grain yield was significant ($p \leq 0.01$) (Table 4). The significant effect of environment is due to their variation in rainfall amount and seasonal distribution, temperature and soil type (Table 4).

Therefore environment played a significant role in influencing the expression of these traits, especially maturity, grain and biomass yield, plant height, finger length and finger number per plant. The genotype by environment was significant only for grain yield while the genotype by environment was not significant for days to maturity, plant and finger height, indicates that genotypes were not significantly interacted with location i.e. possibility of selecting stable and adapted variety based on high mean performance across locations. Thus the highly significant G × E effects suggest that the genotypes may be selected for adaptation to specific environments. This is in harmony with the findings of Aina *et al*. (2009) and Xu Fei-fei *et al.* (2014) in G × E interaction effects of cassava genotypes.

The significant genotype × environment interaction effects demonstrated that genotypes responded differently to the variation in environmental conditions of locations. This is indicative of the necessity of testing finger millet varieties at multiple locations. This also attests to the difficulties encountered by breeders in selecting new varieties for release. An ideal finger millet genotype should have a high mean yield combined with a low degree of fluctuation under different environments (Fentie *et al*, 2013) in rice selection programme. In line with result Lule *et al*. (2014) reported significant genotype by environment interaction for finger millet varieties tested across four locations for two seasons in Ethiopia. One of the most important goals of millet breeders has been to enhance the stability of performance of millet when exposed to stresses (Muhammed.M , 2002).

So, the current study stated MyARC coll 44 and MyARC coll 60 gave the top two high yielding accessions or genotypes with 2599.3 and 2570.6 kg/ha respectively across the three environments and then they were promising genotypes as Yan and Tinker (2005) described the ideal genotypes as having high yield and stable across environments.

Table 4. Combined Mean Performance of finger millet of 2015/16 & 2016/17 at on station and Maiani, 2017

Genotype	DM	PHt	Tiller/plant	FL	FN	GY kg/ha	BY_kg/ha
MyARC coll 4	117.533	94.2	6.2	11.4	7.5	2209	10780
MyARC coll12	114.533	96.3	6.3	12.2	7.9	2118.5	8999.4
MyARC coll19	113.8	96.4	5.8	12.1	7.9	2244.9	9317.8
MyARC coll21	116.067	99.5	5.4	11.9	8.1	1905.1	9109.4
MyARC coll24	114.8	92.1	5.8	11.3	7.9	2458	9882.8
MyARC coll28	115	96.5	5.5	11.5	8	2200.5	9923.9
MyARC coll33	114	90.6	5.5	11	7.9	2279.9	8971.1
MyARC coll35	116.067	93.5	5.4	11.4	7.9	1845	9521.7
MyARC coll36	115	93.1	5.8	11.2	8.2	2216.9	9230
MyARC coll37	115.6	95	5.7	11.8	7.9	2334.8	9667.3
MyARC coll43	114.867	95.5	5.5	11.6	7.9	2016.1	8379.2
MyARC coll44	113.867	91.4	5.6	11.5	7.7	2599.3	9268.3
MyARC coll45	114.667	92.6	5	11.3	7.4	2154	8115.6
MyARC coll46	115.867	95.7	5.2	10.5	7.1	1771.7	7311.7
MyARC coll48	116.8	93	6	11.7	8.4	1782.7	7980

MyARC coll49	116.467	90.5	5.3	11.4	7.7	1940.1	8325
MyARC coll50	114.267	88.4	5.7	11.5	7.9	2233.5	8921.7
MyARC coll52	115.4	93	5.8	11.5	7.5	1945.6	8326.1
MyARC coll53	115.933	94.4	5.9	11.7	7.6	2477.7	9709.4
MyARC coll54	115.933	95.5	5.6	11.6	8.1	2243.4	9153.3
MyARC coll55	115	92.3	5.4	18.5	8.2	2118.1	8741.7
MyARC coll57	115.133	93.8	6.2	11.3	7.9	2477.5	8675.6
MyARC coll58	115.4	89.7	6.4	10.8	7.5	2393.5	9502.8
MyARC coll59	114.467	94.3	5.5	12.2	7.8	2255.3	9340.6
MyARC coll60	115.067	92.6	5.8	11	7.4	2570.6	9658.9
MyARC coll61	116.4	90.9	5.7	11.6	8.1	2460.9	9442.2
MyARC coll62	118.467	102.3	5.4	9.6	8.1	2071.7	10511.7
MyARC coll64	115.533	94.6	4.8	11.3	7.6	2304	8745
MyARC coll65	115.333	96.5	6.3	12.1	7.9	2382.6	9153.3
MyARC coll66	115.4	92.5	5.8	11.4	7.6	2084.7	9122.8
MyARC coll67	116.4	89	5.6	11	7.7	2000.4	9301.7
MyARC coll69	115.933	92.2	5.9	11.3	7.4	1987	8435.6
MyARC coll70	115.733	92.9	5.9	11.4	7.4	2005.2	9008.3
MyARC coll72	117.067	90.7	6	11.9	7.4	2050.2	9296.7
MyARC coll73	116.933	92.7	5.8	11.6	7.3	2124.8	8565.6
MyARC coll76	115.733	95.4	5.6	12	8	2336	9760.6
MyARC coll77	116.133	92.5	5.4	11.9	7.4	2005.8	8464.4
MyARC coll78	119.267	86.3	5.4	10.8	7.6	1620.4	8850.6
MyARC coll79	118.2	90.4	5.3	10.6	7.9	1841.1	9055
Tadesse	117.667	95.7	5	10.4	7.3	2485.8	8698.9
Tessema	116.067	87.8	5.3	9.7	6.6	1154.4	5740
Geno	**	ns	ns	ns	*	**	*
year	**	ns	*	ns	**	**	**
Env_t	**	**	**	**	**	**	**
Geno.Year	ns	ns	ns	ns	ns	ns	ns
Geno.Env_t	ns	ns	ns	ns	ns	**	ns
LSD0.05	1.7622	10.12	1.09	3.31	0.75	625.37	1807.89

CV	2.1	15.1	26.9	40	13.5	35.1	28
Mean	115.8	93.2	5.6	11.5	7.7	2139.2	8999.2

Note: *,**, *** significant at 5%, 1% and 0.1% respectively, NS = not significant, DM = days to maturity, FL = finger length, FN = finger number per plant, PHt = plant height, GY = grain yield (kg/ha, BY = biomass yield, MyARC coll = Maitsebri Agricultural Research Center, coll = collection

4. CONCLUSIONS

Finger millet is an important indigenous crop mainly grown in marginal areas, where the climate and interaction varies considerably. The combined analysis of variance revealed significant (P<0.01) for environments, genotypes and genotype by environment interaction. The present study indicated the existence of variability among accessions collected from different localities in terms of their reaction to yield and yield related traits. In the crop improvement programme, yield evaluation trials are very important to know the stable performance of the varieties. The success of genetic improvement in any character depends on the nature of variability present for that character. Hence, an insight into the magnitude of variability present in the gene pool of a crop is of utmost important to a plant breeder for starting judicious plant breeding program. Variability in the population is important for disease resistance, varietal adaptability and effective selection. An effort was made in this study to further substantiate the earlier limited studies that indicated Ethiopian finger millet of having wide variability. Regardless of the magnitude, all characters studied showed wide range of variability. This ensured the existence of ample variability and potential in the landraces to offer a particular character of interest. This could be employed in the genetic improvement of finger millet through hybridization and/or selection. As a result, regarding the major trait of grain yield, almost all of the evaluated genotypes were affected by the genotype × environment interaction effects, so that no genotype had superior performance in all environments. Thus the highly significant G × E effects suggest that genotypes may be selected for adaptation to specific environments. In the present study, the mean grain yield value of genotypes averaged over environments indicated that MyARC coll 44 had the highest (2599 kg/ha) and Tesema the lowest yield (1154 kg/ha), respectively. It is noted that the genotype MyARC coll 44 and MyARC coll 60 showed higher grain yield than all other genotypes over all the environments.

Bibliography

[1] Aina, O O, A G O Dixon, llona Paul and E A Akinrinde. 2009. G × E interaction effects on yield and yield components of cassava (landraces and improved) genotypes in the savanna regions of Nigeria. *African J of Biotech.* vol. 8 (19), pp. 4933-4945.

[2] Degu, E., Adugna, A., Tadesse, T. and Tesso, T. 2009. Genetic resources, breeding and production of millets in Ethiopia, In: New approaches to plant breeding of orphan crops in Africa. Proceedings of an international conference, Bern, Switzerland, 19-21 September 2007

[3] Fentie, M, A Assefa and K Belete. 2013. AMMI analysis of yield performance and stability of finger millet genotypes across different environments. *World J of Agric. Sci.* 9: 231-237.

[4] Lule D., Fetene M., de Villiers S., Tesfaye K. (2014). Additive Main Effects and Multiplicative Interactions (AMMI) and genotype by environment interaction (GGE) biplot analyses aid selection of high yielding and adapted finger millet varieties. *Journal of Applied Biosciences* 76, 6291-6303.

[5] Mekbib, F. (2006). Farmer and formal breeding of sorghum (Sorghum bicolour (L.) Moench) and the implications for integrated plant breeding. *Euphytica* 152, 163-176.

[6] Muhammed, M.N. (2002). Performance of different Peral millet varieties Under Rainfed Condition. *Pakistan J. Agric. Res.* Vol. 17, No. 4

[7] Mulualem T., Melak A. (2013). A survey on the status and constraints of finger millet (Eleusine coracana L.) production in Metekel Zone, North Western Ethiopia. *Direct Research Journal of Agriculture and Food Science* 1, 67-72.

[8] Tsehaye Y, Berg T, Tsegaye B and Tanto T (2006). Farmers' Management of Finger Millet (Eleusine coracana L.) Diversity in Tigray, Ethiopia and Implications for On-Farm Conservation. *Biodiversity and Conservation,* Vol. 15, pp. 4289-4308.

[9] Tsehaye, T. and F. Kebebew. 2002. Morphological diversity and geographic distribution of adaptive traits in finger millet (Eleusine coracana (L.) Gaertn. [Poaceae]) populations from Ethiopia. *Ethiopian J. Biol. Sci.* 1, 37- 62.

[10] Xu Fei-fei, Tanf Fu-fu, Shao Ya-fang, Chen Ya-ling, Tong Chuan, Bao Jing-song. 2014. Genotype × environment Interaction for agronomic traits of rice revealed by association mapping. *Rice Sci.* 21 (3): 133-141.

[11] Yan W., Tinker N.A. (2005). An integrated biplot analysis system for displaying, interpreting, and exploring genotype by environment interaction. *Crop Science* 45, 1004-1016.

[12] Wet, J.M.J., Prasada Rao, K.E., Brink, D.E., Mengesha, M.H. (1984). Systematics and evolution of *Eleusine coracana (Gramineae*). *Am. J. Bot.* 71, 550-557

[13] Hilu, K.W., de Wet, J.M.J., Harlan, J.R. (1979). Archaeobotanical studies of *Eleusine coracana* ssp. *coracana* (finger millet). *Am. J. Bot.* 66, 330-333

[14] Kurien, P.P., Joseph, K., Swaminathan, M., Subrahmanyan, V. (1959). The distribution of nitrogen, calcium and phosphorus between the husk and endosperm of ragi (*Eleusine coracana*). *Food Sci. Mysore* 8, 353-355

[15] Chennaveerajah MS, Hiremath SC (1974). Genome analysis of Eleusine coracana (L.) Gaerth. *Euphytica* 23: 489-495

[16] Doesthale YG, Nagarajan V, Pant KC (1970). Nutrient composition of some varieties of ragi (*Eleusine coracana*). *Ind J Nutr Dietet* 7: 80-84

[17] Doraiswamy TR, Singh N, Daniel VA (1969). Effects of supplementing ragi (*Eleusine coracana*) diet with lysine or leaf protein on the growth and nitrogen metabolism of children. *Brit J Nutr* 23: 737-743

[18] Hilu KW, DeWet JMJ (1976). Domestication of *Eleusine coracana*. *Econ Bot* 30: 199-208

[19] Hilu KW, De Wet JMJ (1976). Racial evolution in *Eleusine coracana* ssp. *coracana* (finger millet). *Amer J Bot* 63(10): 1311-1318

[20] Hilu KW, DeWet JMJ, Harlan JR (1979). Archaeobotanical studies of *Eleusine coracana* ssp. *coracana* (finger millet). *Amer J Bot* 66(3): 330-333