RESEARCH ARTICLE

YIELD POTENTIAL ASSESSMENT OF FINGER MILLET GERMPLASM ACCESSIONS IN BASTAR PLATEAU AGROECOLOGICAL ZONE

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Abstract: A preliminary grain yield evaluation trial involving 100 germplasm accessions of finger millet was conducted at Research cum Instructional Farm, SG College of Agriculture and Research Station, Jagdalpur, IGKV, Raipur, Chhattisgarh during *Kharif* 2018-19 crop season. The tillers number per plant arrayed between 1 to 4.4 (adjusted mean of five random plant average) over the test accessions and 1.8 to 2.2 among the check varieties. Genotype GEC147(4.4 tillers) followed by GEC127 (4.3), GEC352 (4.0), IC0477591 (3.7) and IC0477601 (3.5) were identified as high tillering accessions. Length of longest finger varied from 3.52 to 13.27cm among test accessions whereas, its distributed between 7.23 to 11.52cm among check varieties.In pursuance of DUS descriptors, 34% of genotypes exhibited long fingers, 51% medium length fingers and remaining had short finger size. The finger width at widest point had range between 0.41 to 1.33cm among all the test accessions, which were basically germplasm, but in case of established cultivars (or local checks) it was relative stable i.e., 0.96 to 1.07cm. Comparison of percent grain yield superiority over best check revealed that only one genotype GEC132 out yielded (423.5g) the best check variety GPU67 (418.3g), but the value was non-considerable i.e., 1.24%. However, statistical comparison of critical difference (CD = $p \leq 0.05$) showed that seven genotypes had similar performance as that of best check. These were GEC132, GEC11, GEC122, IC0476378, IC0477650, IC0477591 and IC0477406 and therefore, can be concluded as findings of the present work.

Keywords: Upland agriculture,Genotypic effect**,** Grain yield, Finger millet, Germplasm

INTRODUCTION

Millets are among the key cereal crops in the developing Nations particularly in semi-arid tropical regions of Asia and Africa where they serve dual purpose i.e., human food and livestock feed (Pradhan *et al*., 2010; Bath *et al*., 2018). Millets represents highly variable small seeded grasses, except pearl millet (large seeded), adopted mainly in marginal environments (Khatoon and Singh, 2016). Among the millets, pearl millet, finger millet [*Eleusine coracana* (L.) Gaertn], foxtail millet [*Setariaitalica*(L.) P. Beauvois], Japanese barnyard millet [*Echinochloaesculneta* (A. Braun) H. Scholz], Indian Barnyard millet [*Echinochloafrumentacea* Link], kodo millet [*Paspalum scrobiculatum* L.], little millet [*Panicum sumatrense* Roth ex Roem. &Schult.] and proso millet [*Panicum miliaceum* L.] are the traditionally recognised crop species (Tedele, 2016). Later, on the basis of genetic closeness two more crop were included in millets, namely Tef [*Eragrostis tef* (Zucc.) Trotter] in First Small Millets Workshop held in 1986 at Bangalore, India (Seetharam, 1989); and another fonio or acha (*Digitariaexilis* (Kippist) Stapf and *D. Iburua*Stapf] by international agricultural organizations in the mid-1990s (Anonymous, 1996). Due to presence of considerable variability millets were further bifurcated into two subfamilies i.e., Panicoideae (included pearl millet, foxtail millets, Japanese barnyard millet and Indian millet) and Chloridoideae (included finger millet and tef, and eight genera) (Tedele, 2016). This indicates that finger millet which is normally grouped under millet is more closely related to tef than to other millets (Cannarozzi*et al*., 2014).

Finger millet is hardy and resilient crop against extreme climatic and edaphic factors prevailing in the semi-arid lands of Africa and Asia and is suitable for inadequate moisture availability where most of major crops are difficult to harvest. In addition, it has capability to escape and tolerate terminal drought, normally occurs late in the growing season. Similar to maize and sorghum, finger millet possesses a C_4 photosynthesis system (Warner and Edwards, 1988; Brutnell*et al*., 2010); hence, they prevent photorespiration and, as a consequence, efficiently utilize the scarce moisture present in the semi-arid regions. Since C_4 plants are able to close their stomata for long periods, they can significantly reduce moisture loss through the leaves. In addition to its tolerance to drought, finger millet is tolerant to water logging especially in poorly drained soils where other crops such as maize and wheat could not survive. Evaluation of genetic diversity, variability and phenological traits among adapted, elite germplasm can provide predictive estimates of genetic variation among segregating progeny for pure-line cultivar development (Mohammadi *et al*. 2012; Joshi *et al*., 2018) and selection of elite parental line as well for recombination and transgressive breeding. When new germplasm is in a plant improvement program, sufficient material is often not available for planting more than one experimental plot or unit of the new variety at a single location; in some cases, it may be undesirable to lay out more than one experimental unit for the treatment under consideration. For this purpose,

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numerous statistical approaches have been devised like adjustment of control (Papadakis,1935), honeycomb method (Fasoulas, 1973) and augmented method (Federer (1961) and Federer and Ragavarao (1975) to enable the breeder to perform a valid statistical analysis despite the large number of new selections.

MATERIALS AND METHODS

A preliminary grain yield evaluation trial involving 100 germplasm accessions of finger millet (listed in Table 03), was conducted at Research cum Instructional Farm, SG College of Agriculture and Research Station, Jagdalpur, IGKV, Raipur, Chhattisgarh during *Kharif* 2018-19 crop season. Each entry was directly seeded in paired row of 03-meter length where the inter row distance was maintained at 22.5cm. Three to four seeds were hand placed at the gap of 10cm in each row, which were later subjected to thinning in accordance with physical condition of plant. The experiment was divided into 10 blocks each of which comprised of 10 test entries and four check varieties. Check varieties namely Indira Ragi 01, CG Ragi 02, GPU-28 and GPU-67 were planted at random on paired rows within block in a way that same check varieties appeared in every block. The data was recorded for 17 quantitative and qualitative parameters were recorded, among them tillers per plant, finger length, finger width and grain yield per plot (g) are being discussed in current manuscript. Tillers per plant were measured at maturity by counting the productive tillers of single plant and productive and non-productive nature were discriminated on the basis of ear producing ability. Similarly finger length and width was measured by scale at maturity by choosing the longest finger of ear and at widest point of finger respectively. In all aforementioned three observations were taken by the method of random five plant selection followed by arithmetic mean calculation. Grain yield was taken after the crop at physiological maturity and hand threshing. After harvesting the crop was left for partial sun drying for better recovery of grains. The raw data was subjected to statistical analysis following the augmented techniques (Federer, 1956; Federer and Raghavarao, 1975).

RESULTS AND DISCUSSION

Mean squares for analysis of variance indicated significant differences among blocks, check and test entries for crop duration, canopy length and fodder weight (Table 01). The presence of significant variation among germplasm accessions expressed the scope of improvement for fodder and its associated parameters. Similarly, the result showed that the checks were extremes of the characters for as long as three important traits are therefore, the efficacy of checks to make different comparisons against new selections could not be ruled out. Saleem *et al*., (2009 and 2013) reported the worth of genetic variability for days to fruiting, number of fruits per plant and single fruit weight for checks. In routine evaluation of germplasm, two disadvantages have been recorded. Firstly, the checks are systematically placed and secondly no provision is made to adjust the mean performance of the traits due to soil or other differences from one part of experiment to another. To overcome these difficulties, four checks were assigned at random to rows within the blocks, with same check genotype appearing in every block. And for managing the soil or other factors, adjusted mean was calculated based on estimating check effect, block effect and genotypic effect. The present study also provides estimates of standard errors of four different comparisons (Table 02) to compute least significant differences. However, the most useful comparison was the difference between adjusted means of selections and a check mean therefore, LSI at 0.05 level of probability using one tailed t-test at 27 degree of freedom (d.f.) for each trait was worked out. The mean of checks and adjusted mean of block differences of new germplasm accessions for all traits undertaken for study are given in Table 03. Any adjusted mean performance of germplasm accessions less than or greater than overall performance (observed mean + LSI) was taken as base criteria to compare each check and test entry.

The rate of tillering varies depending upon the variety and environmental conditions, nutrition, cultural practices, availability of water, day length, plant density etc. In addition, significant variation also exists for number of days taken for emergence of secondary and tertiary tillers when compared to primary tillers simplifies the importance of strategies to evolve optimum tillering millet varieties with higher number of primary tillers (Chandramahonan*et al*., 2014; Pawar *et al*., 2016). The tillers number per plant ranged from 1 to 4.4 (adjusted mean of five random plant average) over the test accessions and 1.8 to 2.2 among the check varieties. GenotypeGEC147 recorded maximum 4.4 tillers followed by GEC127 (4.3), GEC352 (4.0), IC0477591 (3.7) and IC0477601 (3.5) were identified as high tillering accessions. Other genotypes, GEC106 (3.4), IC0477328 (3.3), GEC144 (3.3), GEC5 (3.2), GEC266 (3.2), GEC280 (3.1), GEC517 (3.1), GEC294 (2.9), IC0476864 (2.8), GEC187 (2.8), GEC313 (2.8), IC0477304 (2.8), GEC11 (2.5) and GEC23 (2.5) also categorised in promising category. Among check varieties maximum tillers were seen in variety GPU 67 (2.2) followed by CG Ragi 02 and GPU 28 (2.0) and IR-01 (1.8). For yield improvement of finger millet, early research efforts were made to select large ear size as the tiller number was not a constraint (Anjum *et al*., 2020). Probably, selection for ear size with time, the tiller numbers might have compensated with ear size and resulted in selection of shy tillering genotypes. It is clearly evident in the popular variety GPU-28 which has only 2 to 2.5 tillers hill^{-1} (Prakasha*et al*., 2018). In recent years, it was observed that the major yield attributes in finger millet are the productive tillers (contributes to 54 % of yield), followed by ear weight and test weight although it is genotypic character (Anon., 2015). Therefore, functional tillers should be taken into consideration.

Finger length and width is a determinant of ear size in finger millet and is considered to be quite critical, as it harbours the grains over it, and determines the sink strength of a genotype. Among test accessions, length of longest finger ranged from 3.52 to 13.27cm whereas, its distribution varied between 7.23 to 11.52cm among check varieties. GEC5 had maximum finger length with 13.27cm followed by GEC400 (12.51cm), IC0477047 (12.21cm), GEC517 (11.71cm), IC0477043 (10.39cm), IC0477304 (10.16cm), GEC223 (10.12cm), GEC453 (10.04cm) and others. In case of check varieties, IR 01 had longest fingers (11.52cm) followed by CG Ragi 02 (10.05cm), GPU 28(8.46cm) and GPU 67 (7.23cm).In pursuance of DUS descriptors, 34% of genotypes exhibited long fingers, 51% medium length fingers and remaining had short finger size. The experimental mean for the trait were 9.32cm and 6.72cm for test entries and check varieties respectively.The finger width at widest point had was distributed from 0.41 to 1.33cm among all the test accessions, which were basically germplasm, but in case of established cultivars (or local checks) it was relative stable i.e., 0.96 to 1.07cm. A total number of 21 genotypes outranged the best check variety with respect to the trait., these were IC0477787 and IC0476495 (1.33cm), GEC233 (1.31cm), IC0477678 (1.26cm), GEC274, GEC223, GEC55 and IC0476838 (1.23cm), GEC23, IC0476299 and IC0477602 (1.18cm), IC0476663, GEC297 (1.16cm), IC0476669-X, IC0476921, IC0477601 and GEC144 (1.13cm), GEC371 and IC0477591 (1.11cm) and GEC53 (1.08cm). These genotypes displayed 0.93 to 24.30% higher finger width over the best check. Following general regression theorem, finger length and finger width are directly governing factors to eventual grain yield, therefore selection parents can be used as donor parents for incorporation in cultivated plant type. According to Anjum *et al*. (2020), under optimal input conditions the source size (leaf area index) and source activity (rate of photosynthesis) in not a limiting factor in finger millet but, sink parameters such as productive tillers per plant and ear size (length x width) could be the limitations for higher productivity (Bezaweletaw*et al*., 2006; Assefa *et al*., 2013; Dineshkumar*et al*., 2014; Maobe*et al*., 2014; Jadhav *et al*., 2015; Madhavilatha and Subbarao, 2015; Simbagije, 2016). The tillers count can be increased either by introgression or increasing the plant density however, sometimes, grain yield doesn't increase significantly despite of positive correlation between the both. In contrast case, negative correlation is also in literature between tiller number and grain yield. The major factor for both the above unparallel relationship among the tiller number, ear characteristics and grain yield are the significant decreased ear size (Jyothsna*et al*., 2016), which is maintained and enhanced by finger characteristics described in the study.

The grain yield per plot displayed a typical difference between the released cultivars and germplasm accessions with an extensive variation right from 4.5g up to 423.5g per plot against the check varieties, 325.5 to 418.3g per plot. The maximum yield among test accessions were recorded in GEC132 (423.5g) followed by GEC11 (374.5g), GEC122 (366g), IC0476378 (36.75g), IC0477650 (359.75g), IC0477591 and IC0477406 (358g), GEC322 (342.5), IC0476495 (338.25g), GEC371 (333.75g), IC0476838 (321.25g), IC0477556-X (308.25g), GEC352 (299.25g) and others. Comparison of percent grain yield superiority over best check revealed that only one genotype GEC132 outyielded (423.5g) the best check variety GPU67 (418.3g), but the value of non-considerable i.e., 1.24%. However, statistical comparison of critical difference (CD = $p \leq 0.05$) revealed that seven genotypes had similar performance as that of best check. These were GEC132, GEC11, GEC122, IC0476378, IC0477650, IC0477591 and IC0477406 and can be promoted for replicated yield evaluation trials. Photosynthetic rate is an imperative physiological course under rainfed conditions for production of overall biomass and grain yield (Anjum *et al*., 2011; Gautham *et al*., 2020; Kumar, 2020) and certainly genotypic difference are there for photosynthetic rate determination (Subramanya, 2000; Nanja Reddy *et al*., 2020). Furthermore, finger millet being a C_4 species would maintain higher photosynthetic rate (Ueno *et al*., 2006; Sage and Zhu, 2011; Kumar *et al*., 2016)however, this is invariably affected by associated traits possessed by the genotypes like ear head weight and size, harvest index, test weight, productive tillers and straw weight (Gupta *et al*., 2011; Nanja Reddy*et al*., 2019).

CONCLUSION

Early efforts on yield improvement of finger millet were basically through selection for large ear size, wherein productive tillers per hill was not a constraint. Next stage of improvement was through plant breeding efforts for blast resistance combined with adoption of improved management practices. In recent years, finger millet yield has reached a plateau. Among the cultivated varieties, mostly popular varietiesare a shy tillering type with relatively a large ear size. In contrast, present day selections and breeding materials have shown good potential regarding tillering habit but negative association with finger parameters finally results in lowered productivity. Therefore, choice of trait specific genotypes and their *perse* and long utilization in crop improvement activity should be the changing goal of researchers. Based on associated traits and performance genotypes GEC132, GEC11, GEC122, IC0476378, IC0477650, IC0477591 and IC0477406 are concluded promising for grain yield potential. Regarding associated traits GEC147, GEC127, GEC352, IC0477591 and IC0477601 for tillering capability; GEC5, GEC400, IC0477047, GEC517 for finger length; and IC0477787, IC0476495, GEC233 and IC0477678 for finger width; are suggested to utilize for further improve the genotype by conventional and molecular approaches.

Table 1. Mean squares for analysis of variance for check and test entries.

Source	d.f.	Mean Sum of squares			
		Tillers per plant	Finger length	Finger width	Grain weight
Block	9	0.80	3.09	0.041	17598.45
Treatment	103	1.51	6.07	0.151	21674.20
Checks	3	0.27	34.94	0.027	25871.03
Test entry	99	0.50	3.45	0.050	10406.72
Check vs Test	1	5.78	179.77	0.523	1124563.98
Error	27	0.66	0.75	0.064	930.57
Total	139	0.58	4.85	0.055	17380.96

Table 2. Standard Errors for various components

Differences	**Tillers per plant**	**Finger length**	**Finger width**	**Grain weight**
Difference between adjusted means of two test entries in different block	1.15	1.22	0.36	43.14
LSD = p ≤ 0.05	2.30	2.45	0.72	86.71
LSD = p ≤ 0.01	3.07	3.27	0.96	115.62
Difference between adjusted means of two test entries in same block	1.28	1.37	0.40	48.23
LSD = p ≤ 0.05	2.57	2.74	0.80	96.95
LSD = p ≤ 0.01	3.43	3.66	1.07	129.26
Difference between means of check varieties	0.36	0.39	0.11	13.64
LSD = p ≤ 0.05	0.73	0.78	0.23	27.42
LSD = p ≤ 0.01	0.97	1.03	0.30	36.56
Difference between adjusted means of a test genotype and check	0.95	1.01	0.30	35.77
LSD = p ≤ 0.05	1.91	2.04	0.60	71.90
LSD = p ≤ 0.01	2.54	2.71	0.79	95.87

Table 3. Mean performance of checks and adjusted mean performance finger millet genotypes

	Tillers per plant			**Finger length**				**Tillers per plant**			**Finger length**		
Treat	Mean	Adj. Mean	Genotypic effect	Mean	Adj. Mean	Genotypic effect	Treat	Mean	Adj. Mean	Genotypic effect	Mean	Adj. Mean	Genotypic effect
IC0476378	3	2	1.15	7.6	7.49	0.68	IC0477317	1.4	2.15	1.3	6.5	6.97	0.16
GEC411	2.4	1.4	0.55	7.2	7.09	0.28	GEC5	2.4	3.15	2.3	12.8	13.27	6.46
IC0477325	1	0	-0.85	5.5	5.39	-1.42	IC0477304	2	2.75	1.9	9.7	10.16	3.36
IC0477890	2.4	1.4	0.55	6.6	6.49	-0.32	IC0476921	1.2	1.95	1.1	7.5	7.97	1.16
IC0588007	2.2	1.2	0.35	6.8	6.69	-0.12	IC0477467	1	1.75	0.9	5.5	5.97	-0.84
GEC371	2	1	0.15	7.8	7.69	0.88	GEC137	1	1.75	0.9	5.5	5.97	-0.84
GEC222	1.4	0.4	-0.45	7.3	7.19	0.38	GEC266	2.4	3.15	2.3	5.8	6.27	-0.54
IC0477043	1.6	0.6	-0.25	10.5	10.39	3.58	GEC470	1.6	2.35	1.5	6.2	6.66	-0.14

IC0477650	2.6	1.6	0.75	5.1	4.99	-1.82	IC0477152	1	1	0.15	5.5	6.14	-0.67
GEC41	1.6	0.6	-0.25	9.8	9.69	2.88	GEC191	1.4	1.4	0.55	7.2	7.84	1.03
GEC453	2.2	1.7	0.85	9.7	10.04	3.23	GEC296	1.2	1.2	0.35	5.1	5.74	-1.07
GEC322	1.2	0.7	-0.15	4.8	5.14	-1.67	GEC394	1.2	1.2	0.35	8.1	8.74	1.93
IC0477017	1	0.5	-0.35	3.2	3.54	-3.27	IC0477620	2.2	2.2	1.35	6.1	6.74	-0.07
IC0477569	1	0.5	-0.35	4.3	4.64	-2.17	GEC376	1	1	0.15	5.5	6.14	-0.67
GEC11	3	2.5	1.65	9.1	9.44	2.63	GEC108	1.4	1.4	0.55	7.6	8.24	1.43
GEC69	1.6	1.1	0.25	6.1	6.44	-0.37	IC0477951	1.6	1.6	0.75	6.5	7.14	0.33
IC0476786	1.4	0.9	0.05	3.9	4.24	-2.57	IC0476864	2.8	2.8	1.95	6.1	6.74	-0.07
IC0476959-X	1.8	1.3	0.45	3.7	4.04	-2.77	GEC226	1	1	0.15	6.1	6.74	-0.07
IC0476707	2	1.5	0.65	4.8	5.14	-1.67	IC0477507	1.4	0.9	0.05	5.6	5.89	-0.92
GEC92	2.4	1.9	1.05	5.2	5.54	-1.27	GEC280	3.6	3.1	2.25	6.5	6.79	-0.02
IC0477787	1.4	1.15	0.3	5.1	5.41	-1.39	IC0477673	1.6	1.1	0.25	5.8	6.09	-0.72
IC0476495	2	1.75	0.9	5.9	6.22	-0.59	IC0477678	1.2	0.7	-0.15	9.3	9.59	2.78
IC0477556-X	2.2	1.95	1.1	6.2	6.51	-0.29	IC0476663	2	1.5	0.65	6.4	6.69	-0.12
IC0476669-X	1.4	1.15	0.3	5.8	6.12	-0.69	IC0476913	1.4	0.9	0.05	6.5	6.79	-0.02
GEC274	1.8	1.55	0.7	8.1	8.42	1.61	GEC348	1.2	0.7	-0.15	6.3	6.59	-0.22
GEC400	2.2	1.95	1.1	12.2	12.51	5.71	GEC297	2.6	2.1	1.25	6.2	6.49	-0.32
GEC223	1.2	0.95	0.1	9.8	10.12	3.31	GEC535	1	0.5	-0.35	7.5	7.79	0.98
GEC270	1.2	0.95	0.1	5.1	5.41	-1.39	GEC93	1.6	1.1	0.25	7.3	7.59	0.78
GEC55	1	0.75	-0.1	6.8	7.12	0.31	GEC186	1.6	1.85	1	4.5	3.64	-3.17
IC0476838	1.6	1.35	0.5	6.7	7.01	0.21	GEC131	1.2	1.45	0.6	5.1	4.24	-2.57
GEC517	2.8	3.05	2.2	11.7	11.71	4.91	IC0476720	1	1.25	0.4	6.7	5.84	-0.97
GEC23	2.2	2.45	1.6	5.5	5.52	-1.29	GEC122	1.4	1.65	0.8	7.5	6.64	-0.17
IC0476299	1.8	2.05	1.2	4.6	4.61	-2.19	IC0477591	3.4	3.65	2.8	6.4	5.54	-1.27
GEC53	1.8	2.05	1.2	6.6	6.61	-0.19	IC0477406	1.2	1.45	0.6	6.8	5.94	-0.87
GEC249	1.2	1.45	0.6	6.5	6.52	-0.29	GEC135	1	1.25	0.4	5.1	4.24	-2.57
IC0477602	1.2	1.45	0.6	7.3	7.32	0.51	IC0477382	1.6	1.85	1	6.1	5.24	-1.57
IC0477047	1.6	1.85	1	12.2	12.21	5.41	GEC233	1.4	1.65	0.8	6.2	5.34	-1.47
GEC132	1.6	1.85	1	6.1	6.11	-0.69	IC0477328	3	3.25	2.4	5.1	4.24	-2.57
IC0476724	1.4	1.65	0.8	7.3	7.32	0.51	IC0477560	1.8	2.05	1.2	11.3	9.91	3.11
GEC-247	2	2.25	1.4	3.5	3.52	-3.29	GEC294	2.6	2.85	2	5.1	3.71	-3.09
GEC310	1	1.75	0.9	6.5	6.79	-0.02	IC0476539	1.4	1.65	0.8	7.4	6.01	-0.79
GEC187	2	2.75	1.9	5.8	6.09	-0.72	GEC314	1.2	1.45	0.6	6.8	5.41	-1.39
IC0476676	1.4	2.15	1.3	7.2	7.49	0.68	IC0477601	3.2	3.45	2.6	6.5	5.11	-1.69
GEC352	3.2	3.95	3.1	6.3	6.59	-0.22	GEC370	1.6	1.85	1	7.3	5.91	-0.89
IC0477496	1	1.75	0.9	5.8	6.09	-0.72	GEC485	2	2.25	1.4	6.3	4.91	-1.89
GEC62	1	1.75	0.9	4.2	4.49	-2.32	GEC144	3	3.25	2.4	6.4	5.01	-1.79
GEC106	2.6	3.35	2.5	8.5	8.79	1.98	GEC127	4	4.25	3.4	6.8	5.41	-1.39
GEC147	3.6	4.35	3.5	7.5	7.79	0.98	IC0476877	1	1.2	0.4	5.2	3.8	-2.99
GEC254	1.6	2.35	1.5	7.8	8.09	1.28	CG Ragi 02	2		1.15	10.05		3.24
GEC313	2	2.75	1.9	8.5	8.79	1.98	IR 01	1.8		0.95	11.52		4.71
GEC347	1.4	2.15	1.3	6.8	7.27	0.46	GPU 28	2		1.15	8.46		1.65
GEC79	1.2	1.95	1.1	5.5	5.97	-0.84	GPU 67	2.2		1.35	7.23		0.42

	Finger width (cm)			Grain yield per plot (g)				Finger width (cm)			Grain yield per plot (g)		
Treat	Mean	Adj. Mean	Genotypic effect	Mean	Adj. Mean	Genotypic effect	Treat	Mean	Adj. Mean	Genotypic effect	Mean	Adj. Mean	Genotypic effect
IC0476378	1	0.91	0.07	370	363.75	196.96	IC0477317	1.1	1.03	0.2	182	189.75	22.96
GEC411	0.5	0.41	-0.43	202	195.75	28.96	GEC5	0.6	0.53	-0.3	82	89.75	-77.04
IC0477325	1	0.91	0.07	84	77.75	-89.04	IC0477304	1.1	1.03	0.2	64	71.75	-95.04
IC0477890	0.9	0.81	-0.03	286	279.75	112.96	IC0476921	1.2	1.13	0.3	50	57.75	-109.04
IC0588007	1	0.91	0.07	146	139.75	-27.04	IC0477467	1.1	1.03	0.2	184	191.75	24.96
GEC371	1.2	1.11	0.27	340	333.75	166.96	GEC137	0.7	0.63	-0.2	200	207.75	40.96
GEC222	0.8	0.71	-0.13	142	135.75	-31.04	GEC266	0.7	0.63	-0.2	48	55.75	-111.04
IC0477043	1	0.91	0.07	144	137.75	-29.04	GEC470	0.7	0.63	-0.2	88	95.75	-71.04
IC0477650	0.8	0.71	-0.13	366	359.75	192.96	IC0477152	0.8	0.73	-0.1	134	147.5	-19.29
GEC41	1.1	1.01	0.17	172	165.75	-1.04	GEC191	1	0.93	0.1	102	115.5	-51.29
GEC453	1	1.06	0.22	110	100.5	-66.29	GEC296	1	0.93	0.1	284	297.5	130.71
GEC322	0.7	0.76	-0.08	352	342.5	175.71	GEC394	0.9	0.83	0	154	167.5	0.71
IC0477017	1	1.06	0.22	41	31.5	-135.29	IC0477620	0.6	0.53	-0.3	210	223.5	56.71
IC0477569	0.5	0.56	-0.28	14	4.5	-162.29	GEC376	1	0.93	0.1	52	65.5	-101.29
GEC11	0.7	0.76	-0.08	384	374.5	207.71	GEC108	0.8	0.73	-0.1	128	141.5	-25.29
GEC69	0.7	0.76	-0.08	304	294.5	127.71	IC0477951	1.1	1.03	0.2	92	105.5	-61.29
IC0476786	0.5	0.56	-0.28	62	52.5	-114.29	IC0476864	0.8	0.73	-0.1	126	139.5	-27.29
IC0476959-X	0.4	0.46	-0.38	128	118.5	-48.29	GEC226	1	0.93	0.1	74	87.5	-79.29
IC0476707	1	1.06	0.22	138	128.5	-38.29	IC0477507	1	1.06	0.22	201	204.5	37.71
GEC92	1	1.06	0.22	128	118.5	-48.29	GEC280	1.1	1.16	0.32	254	257.5	90.71
IC0477787	1.1	1.33	0.5	70	62.25	-104.54	IC0477673	0.8	0.86	0.02	221	224.5	57.71
IC0476495	1.1	1.33	0.5	346	338.25	171.46	IC0477678	1.2	1.26	0.42	96	99.5	-67.29
IC0477556-X	0.5	0.73	-0.1	316	308.25	141.46	IC0476663	1.1	1.16	0.32	272	275.5	108.71
IC0476669-X	0.9	1.13	0.3	120	112.25	-54.54	IC0476913	0.8	0.86	0.02	100	103.5	-63.29
GEC274	1	1.23	0.4	304	296.25	129.46	GEC348	0.9	0.96	0.12	220	223.5	56.71
GEC400	0.8	1.03	0.2	244	236.25	69.46	GEC297	1.1	1.16	0.32	72	75.5	-91.29
GEC223	1	1.23	0.4	236	228.25	61.46	GEC535	0.5	0.56	-0.28	80	83.5	-83.29
GEC270	0.8	1.03	0.2	222	214.25	47.46	GEC93	1	1.06	0.22	99	102.5	-64.29
GEC55	1	1.23	0.4	126	118.25	-48.54	GEC186	1	1.01	0.17	202	202	35.21
IC0476838	1	1.23	0.4	329	321.25	154.46	GEC131	0.9	0.91	0.07	149	149	-17.79
GEC517	0.5	0.48	-0.35	92	75.5	-91.29	IC0476720	0.8	0.81	-0.03	194	194	27.21
GEC23	1.2	1.18	0.35	74	57.5	-109.29	GEC122	0.4	0.41	-0.43	366	366	199.21
IC0476299	1.2	1.18	0.35	138	121.5	-45.29	IC0477591	1.1	1.11	0.27	358	358	191.21
GEC53	1.1	1.08	0.25	156	139.5	-27.29	IC0477406	0.8	0.81	-0.03	358	358	191.21
GEC249	0.5	0.48	-0.35	94	77.5	-89.29	GEC135	0.6	0.61	-0.23	189	189	22.21
IC0477602	1.2	1.18	0.35	106	89.5	-77.29	IC0477382	0.7	0.71	-0.13	126	126	-40.79
IC0477047	1	0.98	0.15	40	23.5	-143.29	GEC233	1.3	1.31	0.47	56	56	-110.79
GEC132	1	0.98	0.15	440	423.5	256.71	IC0477328	0.7	0.71	-0.13	42	42	-124.79
IC0476724	0.5	0.48	-0.35	48	31.5	-135.29	IC0477560	0.7	0.63	-0.2	124	128	-38.79
GEC-247	0.7	0.68	-0.15	120	103.5	-63.29	GEC294	0.5	0.43	-0.4	48	52	-114.79
GEC310	1.1	1.06	0.22	132	143.25	-23.54	IC0476539	1.1	1.03	0.2	70	74	-92.79
GEC187	0.5	0.46	-0.38	52	63.25	-103.54	GEC314	0.5	0.43	-0.4	52	56	-110.79

IC0476676	1	0.96	0.12	70	81.25	-85.54	IC0477601	1.2	1.13	0.3	210	214	47.21
GEC352	1	0.96	0.12	288	299.25	132.46	GEC370	1	0.93	0.1	36	40	-126.79
IC0477496	1	0.96	0.12	76	87.25	-79.54	GEC485	1.1	1.03	0.2	115	119	-47.79
GEC62	1.1	1.06	0.22	38	49.25	-117.54	GEC144	1.2	1.13	0.3	92	96	-70.79
GEC106	1	0.96	0.12	260	271.25	104.46	GEC127	1	0.93	0.1	145	149	-17.79
GEC147	1.1	1.06	0.22	140	151.25	-15.54	IC0476877	0.9	0.8	0	46	50	-116.79
GEC254	1	0.96	0.12	48	59.25	-107.54	CG Ragi 02	1.07		0.24	325.5		158.71
GEC313	0.6	0.56	-0.28	132	143.25	-23.54	IR 01	1.03		0.2	410.1		243.31
GEC347	1	0.93	0.1	60	67.75	-99.04	GPU 28	0.96		0.13	327.1		160.31
GEC79	0.8	0.73	-0.1	186	193.75	26.96	GPU 67	1.07		0.24	418.3		251.51

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