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AGRONOMIC PERFORMANCE AND CORRELATION ANALYSIS OF FINGER MILLET (*Elusine corocana* L.) GENOTYPES

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ABSTRACT

Considering the context of climate change and food security issues of the poor, marginalized and vulnerable farmers; there is urgent need of characterization of the traits and its correlation in the different genotypes of finger millet for development of elite variety in Nepal. A field research was carried out at agronomy field at hill crop research program (HCRP), kabre, Dolakha from June to November, 2017in order to identify the phenotypic variability of the trait in different Nepalese landraces and create to promote the production and stability of neglected crops, finger millet. The field experiment was conducted in random complete block design with two replications. The result revealed that the finger millet genotypes showed the significant differences for days to 50 % heading, plant height, plant stand per square meter, bearing head per square meter, number of finger per head, thousand grain weight and grain yield. The genotypes ACC#513 (3.68 t/ha) fallowed by ACC#2303(3.65 t/ha), ACC#2275 (3.57 t/ha) and ACC#5434 (3.39 t/ha) produces highest grain yield. Correlation analysis revealed that plant height fallowed by plant stand per square meter, bearing head, number of finger per head and straw yield with minimum lodging percentage were most yield determinative traits and simultaneous selection for these traits might brining an improvement in finger millet grain yield.

KEYWORDS

Finger millet, Characterization, Correlation, Grain yield

1. INTRODUCTION

Finger millet is thought to be have originated from Uganda or neighboring Ethiopian highlands where wide diversity of the genus Eleusineexists [1]. There was confliction about origin of the Eleusinecoracana either from the E. indica or from the E. Africana or from the cross of two diploid species. Nepal has diverse climate, topography and altitude which make diverse in crops. Finger millet (Elusinecorocana (L.) Gaertn.) ranks 4th in the world among mostly grown cereals after the sorghum, pearl millet and foxtail millet and 4th in Nepal in case of area of production (2,66,799 hectare), total production (3,02,397M tons) and productivity after paddy, maize and wheat [2]. It is an annual hardy cereal crop grown in the tropical, subtropical areas of world. Nepal is rich in finger millet genotypes, grown upto 3150 m [3]. About 790 accessions have been collected from various parts of Nepal [4]. Large diversity within Eleusinecoracana, two wild species—E. indicaand E. aegyptica—was found [5]. It's productivity has depend on wide range of environments and growing conditions, from southindia to the foothills of the Himalayas in Nepal and throughout the middle-elevation areas of Eastern and Southern Africa [6,7]. Gandaki, Bagmati, Sagarmatha and Lumbini zones are major finger millet producing zones in Nepal [8]. Thus, finger millet diversity in Nepal is rich at both varietal and population levels and this diversity could be used for variety improvement [9].

Finger millet can be ground and cooked into cakes, puddings or porridge. The grain is made into fermented drink or beer in Nepal and in many parts of Africa. In central terai of Nepal, it is used as tiffin, for making haluwa, roti and chokha. It is also assumed to be a good diet for pregnant women and for treatment of animal diarrhea [10]. Finger millet protein has a favorable amino acid spectrum that includes cystine, tyrosine, tryptophan and methionine [11]. The increase global temperature leads climate change directly effects in the production of the crops and increase in hunger and malnutrition in world people, but finger millet can minimize the hunger and malnutrition because it can withstand in the drought condition and have number of macro and micro nutrients. Nutritional values of finger millet contain, moisture 13.24%, protein 7.6%, carbohydrate 74.36%, fiber 1.52%, minerals 2.35%, fat 1.35%, energy 341.6 cal/100g [12].

Therefore, diversity in inter population and intra population in the finger millet could save the world from the scarcity of food. Mostly people are concerning to develop only handful cereals crops like maize, wheat, rice etc. in these days may cause food insecurity within few years because of increase in population of world and depletion of area of production. Development of elite variety and hybrid variety can be produced once the genetic and its phenotypic variability of character are assessed in land races. The research has main focused on the characterization of the trait and its correlation in the different traits. The research will identify the phenotypic variability of the trait in different Nepalese landraces and create to promote the production and stability of neglected crops, finger millet.

2. MATERIALS AND METHODS

2.1 Research site, soil properties and Agro-meteorological condition

The field experiment was conducted on fingermillet research field at NARC, Hill Crop Research Program (HCRP) Dolakha, Nepal, from June to November 2017. The precise location of experimental site was 27° 39' 59.99" N latitude, 86 ° 01' 60.00" E longitudes and at an altitude of 1700 meters above mean sea level. The soil of the experimental plot was acidic sandy to silty loam with pH 4.5 to 6.2 and poor in organic carbon and total N content but medium in soil available P2O5 and K2O.The field were upland from where the water drained easily during rainfall because the finger millet needs the dry but slight moisture condition in soil. The climate of research location is temperate. The maximum temperature recorded was 26.60C in the month of September while the minimum temperature recorded was 8.60C during November. Average rainfall of region is 200-400 mm per annum and relative humidity ranges from 20-60 %. During the experiment period, the field received total 1445 mm of rainfall with maximum rainfall of 2.9 mm in November. The meteorological data were obtained from meteorological station, HCRP Dolakha.

2.2 Plant materials, raising of seedlings, field layout and transplanting

The plant materials tested in the research were 16 elite finger millet genotypes for development of climate resilience high yielding biotic and

abiotic stress tolerance genotypes suitable for hill growing condition for sole cropping system. Dry nursery beds were established for each genotype on 1th July 2017. Each nursery row was 1 m in length and supplied with equal amount of farmyard manure. No chemical fertilizers were applied on nursery beds. The seed rate applied was 8 kg ha-1. The age of seedlings was 27 days during transplanting. The field experiment was conducted in Random complete block design (RCBD). The trial was replicated twice. Each replication comprised sixteen blocks/plots. Randomization of experimental material will be done with the software CROPSTAT. Each plot contains same levels of fertilizers i.e – 50 :30:00 NPK kg ha-1. Half dose of urea and full dose of DAP and applied as basal while remaining half dose of urea was top dressed in split at 30 DAT. Each plot was 2m in length and 2 m in width. Transplanting of 2-3 seedlings per hill was done on 28th November with a spacing of 10cm between rows and 10 cm between hills in each plot. There was a gap of 0.5m between plots and 2 m between within a replication. There was 2.0 m gap between the replication. Bunds were constructed in between plots and replications. Weeds are the major problem in finger millet, especially during 2-3 weeks after sowing. Therefore, weeding or hoeing was done at every 15 days after the 25 days of sowing. And other management practices were done as like those for recommended varieties. Plants was protected against any source of variations other than those included in the treatments. There is no irrigation is required but left to receive natural precipitation. The list of genotypes of finger millet included in the study is presented in Table 1.

Table 1: Names genotypes of finger millets used for research at HCRP (2017)

S. N	Name of genotypes	S.N.	Name of genotypes	S.N.	Name of genotypes
1	ACC#2275	7	ACC#512	13	ACC#6542
2	ACC#2286-1	8	ACC#2844	14	GE-0012
3	ACC#2301	9	ACC#513	15	GE-0480
4	ACC#2303	10	ACC#5434	16	Kabre Kodo-1
5	ACC#2400	11	ACC#6308		
6	Local Variety	12	ACC#6369		

2.3 Data collection

Observation will be taken for the following parameters as such as DTH (50%)= Days to 50 % heading, PH= plant height (cm), PS= Plant stand per square meter, BH= Baring heads per square meter, NF/H= Number of finger per head, LS%= lodging percentage, TGW= thousand grain weight (gram), GY= grain yield (t/ha) and SY= straw yield (t/ha) per the descriptors for finger millet [13]. Data on days to 50% heading, plant stand and baring head and straw yield were recorded on plot basis. Whereas, plant height (cm) and number of finger per head was recorded on five selected representative plants. Thousand kernel weights were measured by counting 1000 grains from the bulk of each plot after shelling and weighed in grams after the moisture was adjusted to 15%. Lodging percentage was measured in scale 1 to 5. Lodging should be recorded on the scale of 1 to 5 indicating 1= 0-20%, 2=20 -40 %, 3= 40-60%,4= 60-80% and 5=80-100%. Grain yield per plot adjusted to 12 % grain moisture and converted to kilogram per hectare on basis by using following formula.

$$\text{Grain yield (kg/ha)} = \frac{\text{GYPP} \times 10000 \times (100 - \text{GMC})}{\text{NHA} \times 88}$$

Where, GYPP = Grain Yield per plot (kg), GMC = grain moisture content at harvest (%), NHA = Net harvested area (m^2).

3. STATISTICAL ANALYSIS

The data recorded on different parameters from field were first tabulated and processing in Microsoft excel (MS- Excel, 2010), then subjected GenStat to obtain ANOVA and all values were expressed as mean values. Correlation coefficients of different traits using SPSS program were carried out using the formula given by researchers through a study [14]. P values less than 0.05 and 0.01 were considered statistically significant and statistically highly significant, respectively.

4. RESULTS AND DISCUSSION

The present study genetic diversity among 16 finger millet genotypes was analyzed on the basis of eight agro morphological traits. The result of descriptive analysis (Table 2) showed that lodging had highest variation (32.9) fallowed by straw yield (31.9%), grain yield (20.4) and number of finger per head (11.1). Among traits days to 50 % heading showed the lowest (2.2) fallowed by thousand grain weight (4.8), plant height (8.1). Significant variation among finger millet genotypes for grain yield, thousand grain weight, number of finger per head, baring head per square meter, plant stand per square meter, plant height, days to 50 % heading and lodging percentage. The mean value of observed traits day to 50 % heading (65), plant height(86 cm), plant stand per meter square (87) Baring Head (132), number of finger per head (6) thousand grain weight (1.13), grain yield (2.85 t/ha) and straw yield (8.38 t/ha) as presented in Table 2.The genotypes ACC#513 (3.68 t/ha) fallowed by ACC#2303 (3.65t/ha), ACC#2275 (3.57t/ha) and ACC#5434 (3.39) produces maximum yield whereas genotypes ACC#6308 (1.5 t/ha) and GE-002 (1.6 t/ha) produces minimum yield under study condition.

Table 2: Descriptive statistics of agro morphological traits of 16 finger millet genotypes at HCRP, Kabre, Dolakha (2018)

Name of genotypes	DTH (50%)	PH (cm)	PS	BH	NF/H	lodging%	TGW	GY(t/ha)	SY (t /ha)
ACC#2275	67.5	83.5	66.5	163.5	6.5	1	0.875	3.57	8.55
ACC#2286-1	72.5	84.9	71	110	6.2	1.5	1.04	2.38	6.86
ACC#2301	64	91	89	150.5	6.4	1	1.01	2.83	8.81
ACC#2303	63	90.9	89	118	5.5	1	1.31	3.66	10.74
ACC#2400	66	83.5	74.5	130	5.3	1	1.14	2.93	8.27
ACC#512	64	91.7	79.5	130	5.8	1	1.16	3.14	9.22
ACC#2844	67.5	88.5	85.5	127	5	1	1.25	3.31	8.95
ACC#513	64.5	87.8	87	181.5	5.4	1	1.16	3.68	11.34
ACC#5434	65	95.1	61.5	113	4.8	1	1.305	3.39	10.22
ACC#6308	63	65	68.5	139.5	6	3	1.05	1.5	3.41
ACC#6369	72.5	79.7	75.5	122	6.6	1.5	0.975	2.2	6.24
ACC#6542	67.5	84.5	63.5	107.5	4.95	1	1.335	2.94	8.69
GE-0012	62	75.5	69	133	6.4	3	0.985	1.68	5.7
GE-0480	63	82.9	75	147.5	5.4	2.5	0.97	2.48	5.81
Kabre Kodo-1	64.5	90.9	82	123.5	4.6	1	1.2	2.48	12.55
Local variety	63.5	100.5	72.5	121	4.8	1	1.38	2.7	8.75
Grand Mean	65.62	86	87	132.3	5.6	1.406	1.1325	2.85	8.38
F –test	<.001	0.028	0.206	0.006	0.053	0.002	<.001	0.037	0.211
C.V.(%)	2.2	8.1	13.2	10.8	11.1	32.9	4.8	20.4	31.9
LSD (0.05)	1.09	5.3	7.52	10.7	0.48	0.35	0.06	0.44	2.02

* and **, significant at 5 % and 1 % probability level. DTH (50%)= Days to 50 % heading, PH= Plant height (cm), PS= Plant stand square meter-1, BH= Bearing head square meter-1,NF/H= Number of finger head-1, TGW= Thousand grain weight, GY= Grain yield (t/ha) and SY= Straw yield (t/ha).

4.1 Correlation analysis

Analysis of variance exhibited significant difference among genotypes for different traits. The grain yield had positive significant correlation with plant height fallowed by plant stand per square meter, baring head per square meter, number of finger per head and straw yield and significant negative correlation with lodging percentage. The plant height was found significant positive association with straw yield fallowed by thousand kernel weight where as significant negative association with number finger per head. Thousand grain weight were found significant negative correlation baring head per square meter and number finger per head. Significant positive association between lodging percentage and straw yield and significant negative association between plant height and thousand kernel weight.

Table 3: Pearson's Correlation coefficient among different traits of finger millet under at HCRP, Dolakha (2018).

DTH (50%)	PH	PS	BH	NF/H	TGW	GY	SY
PH	-0.070	1					
PS	-0.182	0.292	1				
BH	-0.294	-0.181	0.322	1			
NF/H	0.278	**-0.531***	-0.017	0.312	1		
TGW	-0.201	**0.602***	0.075	**-0.506***	**-0.825****	1	
GY	0.012	**0.651***	**0.219***	**0.108***	**0.225***	0.385	1
SY	-0.107	**0.769***	0.435	0.022	**-0.559*0.548*0.746***	1	
Lodging%	-0.273	**-0.782****	-0.311	0.099	0.385	**-0.496*-0.803****	**0.814****

Values are significant difference at 5 % level of significance (*) and highly significant at 1 % level of significant (**), DTH (50%)= Days to 50 % heading, PH= Plant height (cm), PS= Plant stand per square meter,BH= Bearing head per square meter,NF/H= Number of finger per head, TGW= Thousand grain weight, GY= Grain yield (t/ha) and SY= Straw yield (t/ha).

In present study there is sustainable genetic variability in different morph-physiological and yield attributing traits of finger millet genotypes. A researcher reported that significance amount of variability in finger millet genotypes for different morph- physiological and yield attributing traits in three environmental conditions over three years [15]. The genotypic variability among finger millet genotypes was not influenced by

environmental condition in characters such as days to heading, finger width, finger length, and days to maturity, culm thickness and grain yield per plant similar result was reported [16]. A group researcher also found variation in the morphological characters such as 63.5% were green plant type accessions from 909 accessions: 92.8% types are erect in growth habits: varies in mean plant height, mean time to 50% flowering, mean inflorescence length and width, mean of panicle exertion ranges from 90-104cm, 65-81 days, 88-104mm, 55-103mm and 75-110mm respectively that showed exist of diversity and which directly affects in yield of finger millet [17]. In a study, reported similar result of variability at intra population level in all quantitative traits and similarly, higher polymorphism observed in 11 qualitative characters (ear shape followed by grain number) and plant stand, finger length, number of finger per head, baring head, finger width and grain yield were distributed in significant skewness [18]. In other study also the researchers observed that grain yield was positively correlated with, finger width baring head, and number of finger per head and he also notified that variation in these traits cause diversity in Intra- and inter population of finger millet [18]. Some researchers also reported that grain yield was positively correlated with plant height [19]. The similar result of positive correlation between plant height number of finger per head with grain yield also reported in a study [20]. In variability analysis among 400 finger millet germplasms was found positive association between grain yield with productive tillers, fingers per ear and finger length and plant height [21]. In other study also, researcher reported similar result as grain yield was positive number of finger per head and baring head [18]. Others, there a researchers also reported that the correlation of grain yield with straw yield and harvest index at genotypic and phenotypic level [22].

5. CONCLUSION

The genetic diversity was observed in different genotypes of finger millet for traits such as grain yield fallowed by days to 50 % heading, plant height, plant stand per square meter, bearing head per square meter, number of finger per head, and thousand grain weight under study condition. Plant height fallowed by plant stand per square meter, bearing head, number of finger per head and straw yield with minimum lodging percentage were most yield determinative traits as revealed from correlation analysis and hence simultaneous selection for these traits might brining an improvement in finger millet grain yield under condition. Thus, presence of high level of diversity among the genotypes of finger millet for grain yield indicated their superior trait value for study condition; these genotypes may be of interest to researcher for further breeding purpose.

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