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STUDIES ON GENETIC VARIABILITY AND COMPONENT ANALYSIS IN RAGI (*ELEUSINE CORACANA* GAERTN.)

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ABSTRACT

Forty genotypes of ragi were evaluated for productivity related traits. Him Ragi 20, Him Ragi 23, GE 624 and GE 2675 were high yielders. Phenotypic coefficients of variability were slightly higher than the corresponding genotypic ones. Grain yield/plant, harvest index, biological yield/plant, 1000-grain weight, finger length, fingers/ear, tillers/plant and leaf area were controlled by additive gene action. Dominance and epistatic effects were of considerable value for inheritance of days for maturity and flowering. Nonadditive gene action was important for plant height and grains/ear. Grain yield/plant was found to be positively associated with all the traits except flowering days. Path analysis revealed positive and direct effect of biological yield, harvest index and maturity duration on grain yield.

Key words: *Eleusine coracana*, genetic variability, genetic components, gene action, evaluation.

Ragi is an important crop of wet temperate and, cold and dry temperate region of Himachal Pradesh. It is grown on about 7 thousand hectares with total production of 1.6 thousand tonnes [1]. Attempts have been made to examine the genetic variability by evaluating the exotic and indigenous germplasm collected from different parts of the country [2–4]. However, systematic studies for genetic amelioration of ragi have not been undertaken to cater the requirement of the agroclimatic conditions in relation to Himachal Pradesh. This stimulated evaluation of the germplasm collected locally and received from different parts of the country with a view to select the genotypes suitable for direct or indirect use. The information on genetic variability and component analysis can be of great help in formulating appropriate breeding strategy for genetic upgradation of ragi.

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MATERIALS AND METHODS

Fourty genotypes of ragi collected from different parts of the country were grown in randomised block design with three replications. Each genotype was grown in two-row plots, 2 m long, with 22.5 x 15 cm spacing. The recommended agronomic practices were followed to raise the crop.

Observations were recorded on five random plants in each entry per replication for 12 quantitative traits (Table 1). The character means of the genotypes for each replication were analysed following the linear model [5]. Various parameters of phenotypic and genotypic variability were estimated [6], phenotypic and genotypic correlation coefficients were computed [7], and direct and indirect path coefficients were calculated as described by Dewey and Lu [8].

RESULTS AND DISCUSSION

Analysis of variance indicated significant differences among lines for all the traits studied, indicating thereby the presence of wide range of variability. The average grain yield/plant ranged from 2.4–14.0 g, and crop duration from 98–130 days (Table 1). Out of

Table 1. Parameters of variability for twelve traits in ragi

Trait	Range	Mean ± SE	Coefficients of variation (%)		Heritability (%)	Genetic advance (% of mean)
			PCV	GCV		
Grain yield/plant, g	2.4–14.0	9.3 ± 0.3	33.8	33.3	97.0	67.6
Harvest index, %	11.7–44.6	23.6 ± 2.2	27.5	22.0	64.1	36.3
Biological yield/plant, g	18.8–56.4	40.2 ± 2.7	30.8	28.5	85.5	54.2
1000-grain weight, g	1.6–7.3	4.5 ± 0.1	31.6	31.3	98.2	64.0
Grains/ear	1036.7–3488.3	2303.2 ± 321.8	41.3	27.9	45.7	30.9
Finger length, cm	3.6–12.1	6.4 ± 0.2	32.7	32.4	97.9	66.0
Fingers/ear	2.8–7.3	5.6 ± 0.2	21.9	21.3	94.8	42.9
Tillers/plant	2.2–7.4	5.7 ± 0.2	23.1	21.8	89.2	42.4
Plant height, cm	61.1–100.9	83.7 ± 4.9	14.0	9.6	47.2	13.6
Leaf area, cm^2	10.8–48.2	27.0 ± 2.3	37.0	34.0	84.0	64.1
Days to maturity	98.0–130.0	112.5 ± 0.8	7.8	7.7	97.4	16.3
Days to flowering	59.7–96.0	75.4 ± 0.9	12.4	12.2	97.4	24.8

40 lines, Him Ragi 20 was the highest yielder. Him Ragi 23, GE 624 and GE 2675 had comparable performance with Him Ragi 40. Their maturity period was also comparable to that of Him Ragi 20. Therefore, genotypes GE 624 and GE 2675 were potential genotypes both for direct and indirect use in Himachal Pradesh. KM 1 was the only genotype which combines reasonably high grain yield/plant (11.0 g) and early maturity (108 days). This genotype can be used in hybridization programme with other high yielding but late maturing genotypes to combine high yield with earliness.

There was wide range of variability for all the traits studied. The range values were similar to those reported earlier [9, 10], although actual limits were different for some characters in ragi. Phenotypic and genotypic coefficients of variation (PCV, GCV) were moderate to high for grain yield/plant, harvest index, biological yield/plant, 1000-grain weight, grains/ear, finger length, fingers/ear, tillers/plant and leaf area. For the remaining characters, such as plant height, days for maturity and flowering, PCV and GCV were low (Table 1). Heritability estimates were very high for most of the traits except harvest index, grains/ear and plant height.

In the present study, broad sense heritability was computed which includes both additive and nonadditive gene effects. Therefore, heritability estimates should be considered in conjunction with genetic advance [6, 11]. Based on this consideration, high heritability for grain yield/plant, harvest index, biological yield/plant, 1000-grain weight, finger length, fingers/ear, tillers/plant, and leaf area was associated with high genetic advance, indicating additive genetic control in the inheritance of these traits. In the case of days for maturity and flowering, high heritability was accompanied with low genetic advance, which is apparently due to low PCV, resulting in high broadsense heritability. High heritability and low genetic advance for days for maturity and flowering indicated that dominance and epistatic effects were of considerable value in the inheritance of these traits. The remaining characters such as grains/ear and plant height had low heritability and genetic advance, suggesting nonadditive gene action and consequently low genetic gain is expected from selection in such a situation.

There is ample evidence to show that selection directly for grain yield in plants is not easy. Thus, any morphological character that is associated with higher seed yield or which makes a significant contribution to yielding ability would be useful in the improvement of grain yield. In the present study, grain yield/plant was positively associated with all the traits studied except days for flowering at phenotypic level (Table 2). Similar correlations for these traits have been reported earlier [12–14]. In general, the genotypic associations were of higher magnitude than phenotypic ones, indicating that though there is strong inherent association between the various characters studied, the phenotypic correlation is reduced under the influence of environment. Crop duration had a high positive association with

Table 2. Correlation coefficients at the phenotypic (P) and genotypic (G) levels among twelve traits of ragi

Trait		Grain yield per plant	Harvest index	Biological yield per plant	1000-grain weight	Grains per ear	Finger length	Fingers per ear	Tillers per plant	Plant height	Leaf area	Days to maturity
Harvest Index	P	0.46*										
	G	0.55										
Biological yield/plant	P	0.79*	-0.14									
	G	0.86	0.06									
1000-grain weight	P	0.87*	0.18	0.86*								
	G	0.89	0.22	0.94								
Grains/ear	P	0.42*	-0.06	0.47*	0.53*							
	G	0.65	-0.01	0.73	0.77							
Finger length	P	0.56*	-0.09	0.69*	0.69*	0.44*						
	G	0.58	-0.11	0.76	0.71	0.65						
Fingers/ear	P	0.87*	0.17	0.86*	0.91*	0.45*	0.61*					
	G	0.91	0.23	0.95	0.94	0.73	0.64					
Tillers/plant	P	0.88*	0.26	0.81*	0.91*	0.36	0.59*	0.90*				
	G	0.93	0.33	0.93	0.97	0.62	0.62	0.98				
Plant height	P	0.58*	0.13	0.56*	0.66*	0.41*	0.52*	0.59*	0.62*			
	G	0.86	0.22	0.86	0.98	0.82	0.74	0.88	0.87			
Leaf area	P	0.54*	0.01	0.59*	0.67*	0.42*	0.61*	0.62*	0.59*	0.48		
	G	0.59*	0.09	0.71	0.73	0.73	0.67	0.70	0.75	0.77		
Days to maturity	P	0.91*	0.21	0.87*	0.95*	0.50*	0.65*	0.94*	0.93*	0.64*	0.62*	
	G	0.91	0.24	0.96	0.97	0.73	0.66	0.98	0.99	0.92	0.68	
Days to flowering	P	0.29	0.03	0.34*	0.29	0.10	0.42*	0.37*	0.37*	-0.08	0.53*	0.35*
	G	0.30	0.04	0.37	0.29	0.16	0.43	0.38	0.39	0.37	0.59	0.36

*Significant at 5% level.

Table 3. Estimates of direct (in bold) and indirect effects at phenotypic (P) and genotypic (G) levels in ragi

Trait		Harvest index	Biological yield per plant	1000-grain weight	Grains per ear	Finger length	Fingers per ear	Tillers per plant	Plant height	Leaf area	Days to maturity	Days to flowering
Harvest index	P	**0.52**	-0.07	0.09	-0.03	-0.05	0.09	0.14	0.07	0.00	0.11	0.02
	G	**0.49**	0.03	0.11	-0.01	-0.05	0.11	0.16	0.11	0.00	0.12	0.02
Biological yield/plant	P	-0.10	**0.67**	0.58	0.32	0.47	0.58	0.55	0.38	0.40	0.59	0.23
	G	0.03	**0.53**	0.50	0.39	0.40	0.51	0.50	0.46	0.38	0.51	0.20
1000-grain weight	P	-0.01	**0.05**	-0.05	-0.03	-0.04	-0.05	-0.05	-0.03	-0.04	-0.05	0.02
	G	-0.13	-0.55	**-0.59**	-0.45	-0.42	-0.55	-0.52	-0.57	-0.43	-0.59	-0.17
Grains/ear	P	-0.00	0.02	0.02	**0.04**	0.02	0.02	0.01	0.02	0.02	0.02	0.00
	G	0.00	-0.00	-0.00	**-0.01**	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
Finger length	P	-0.00	0.02	0.02	0.01	**0.02**	0.02	0.01	0.01	0.02	0.02	0.01
	G	0.01	0.03	0.05	0.05	**0.08**	0.05	0.05	0.06	0.05	0.05	0.03
Fingers/ear	P	0.01	0.05	0.05	0.02	0.04	**0.06**	0.05	0.03	0.04	0.05	0.02
	G	0.01	0.06	0.06	0.05	0.04	**0.63**	0.06	0.06	0.04	0.06	0.02
Tillers/plant	P	0.01	0.03	0.03	0.01	0.02	0.03	**0.04**	0.02	0.02	0.03	0.01
	G	-0.08	-0.22	-0.23	-0.14	-0.14	-0.23	**-0.23**	-0.20	-0.16	-0.23	-0.09
Plant height	P	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00
	G	0.05	0.19	0.21	0.18	0.16	0.19	0.19	**0.22**	0.17	0.20	0.08
Leaf area	P	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	**0.02**	0.01	0.01
	G	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.06	**0.07**	0.05	0.04
Days to maturity	P	0.03	0.01	0.13	0.07	0.09	0.13	0.13	0.09	0.09	**0.14**	0.05
	G	0.19	0.75	0.76	0.57	0.51	0.76	0.77	0.72	0.53	**0.78**	0.28
Days to flowering	P	-0.00	-0.02	-0.01	-0.00	-0.02	-0.02	-0.02	-0.01	-0.02	-0.02	**-0.05**
	G	-0.00	-0.04	-0.03	-0.02	-0.05	-0.04	-0.04	-0.04	-0.07	-0.04	**-0.11**
Correlation with grain yield, r	P	0.46*	0.79*	0.67*	0.42*	0.56*	0.87*	0.86*	0.58*	0.54*	0.91*	0.29
	G	0.59	0.86	0.89	0.65	0.58	0.91	0.93	0.86	0.59	0.93	0.30

*Significant at 5% level. Residual effects: P=13; G = 0.03.

grain yield, meaning thereby a remote possibility of selecting high yielding and early maturing line of ragi from this germplasm. Tillers/plant, unlike other crop plants, did not show any substantial genotypic and phenotypic association with grain yield/plant because both productive as well as unproductive tillers were counted which may have diluted its correlation with grain yield.

Path analysis revealed that biological yield/plant had the highest positive and direct effect on grain yield followed by harvest index and days for maturity (Table 3). Besides direct contribution, biological yield/plant also contributed towards grain yield via days for maturity. Among the other traits, grains/ear, finger length, leaf area/plant, plant height and days to flowering contributed towards grain yield through biological yield, whereas indirect contribution of 1000-grain weight, fingers/ear and tillers/plant towards grain yield was through biological yield and days to maturity. In addition, tillers/plant also contributed through harvest index. Biological yield followed by harvest index and days for maturity appeared to be the most important components of grain yield. Thus, these traits can be used as a basis for selection of high yielding lines in ragi.

Him Ragi 20 and Him Ragi 23 collected from Himachal Pradesh were found promising. Besides, genotypes GE 624, GE 2675 and GE 2685 collected from National Screening Nursery for blast and other diseases also performed well. The genotypes selected can be utilized directly and indirectly in ragi improvement programme as well direct introduction into cultivation in different parts of Himachal Pradesh.

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