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Assessment of existing genetic variability and yield component analysis in Niger (*Guizotia Abyssinica* Cass)

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Abstract

A study on genetic variability, character association and path coefficient analysis was conducted taking eighteen niger genotypes and six yield attributing traits for effective selection of base population from 2003-2006. Significant population differences existed among the genotypes for all the characters studied except number of branches per plant. High value of phenotypic coefficient of variability (PCV), genotypic coefficient of variability (GCV), heritability and genetic advance as per cent of mean values indicated scope for improvement in days to 50% flowering, plant height, number of capitula per plant and number of seeds per capitulum. The grain yield was found positively and strongly correlated with days to 50 per cent flowering and number of branches per plant at genotypic level and with days to 50 per cent flowering, number of capitula and number of seeds per capitulum at phenotypic level. The grain yield was significant negatively correlated with plant height and number of seeds per capitulum at genotypic level. Path analysis revealed that the significantly positive associations of grain yield per ha with 50 per cent flowering and number of branches per plant were due to high positive direct and indirect effect via days to flowering, respectively. So, due emphasis may be given to days to flowering in yield improvement.

Keywords: Genetic variability: Genotypes; Phenotypes; Oil-seed; Niger.

Abbreviations: Phenotypic coefficient of variability (PCV); Genotypic coefficient of variability (GCV).

Introduction

Niger (*Guizotia abyssinica* (L.f.) Cass. Asteraceae) is an oilseed crop cultivated in Indian subcontinent and East African Countries (Getinet and Sharma, 1996). Niger seeds contain about 40% edible oil with fatty acid composition of 75-80% linoleic acid, 7-8% palmitic and steric acids, and 5-8% oleic acid (Dutta *et al.,* 1994). The meal remaining after the oil extraction is free from any toxic substances but contains more crude fiber than most of the oilseed meal. Niger is a completely outcrossing species with self-incompatibility mechanism. Variability exists for morphological characters (Pradhan *et al.,* 1995); however these characters are not discrete and hence complicate the niger improvement programs. The study of amount of such genetic variability including the important economic traits in Niger can be achieved through mass selection. An assessment of variability is, therefore, required to judge its potential as base material for genetic improvement. Further direct selection for complex traits like grain yield is not effective. Knowledge of association of the simply inherited traits, which are less influenced by environment, is required to have sound selection criteria. Thus the present study was aimed at gathering information on existing genetic variability, nature and magnitude of association among six attributes in eighteen genotypes.

Material and Methods

A biometrical study was undertaken by raising eighteen Niger genotypes in a Randomized Complete Block Design with three replications in Kharif 2003-04, 2004-05, 2005-06 and 2006-07 at Regional Research and Technology Transfer station, (O.U.A.T), Semiliguda, Koraput, Orissa in the Eastern Ghat High Land Zone. Each genotype was sown in ten rows of 5.4m each with the spacing of 30cm within rows and 10cm between plants. The crop was raised under recommended package of practices and prophylactic plant protection measures need based. Observations were

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Table 1. Analysis of Variance for six characters of eighteen Niger genotypes over four environments

Character	Genotype (17)	Environment (3)	GxE (51)	Pooled Error (136)
Days to 50% flowering	71.06**	490.96	11.57	0.96
Plant height(cm)	715.87**	29872.00	352.91	85.73
Branches per plant(no.)	0.67	6.24	0.61	0.39
Capitula per plant(no.)	404.27**	15104.90	315.10	53.36
Seeds per capitulum(no.)	39.64**	368.77	29.14	6.47
Grain yield (Kg/ha)	12219.40**	716226.70	11631.10	7261.67

Table 2. Estimates of parameters of Genetic variability, heritability and genetic advance for various characters in eighteen genotypes of Niger

S. No	Characters	Phenotypic range	Mean ±SE	PCV (%)	GCV (%)	GCV/ PCV	Heritability (h^2%)	Genetic Advance	GAM (% mean)
1	Days to 50% Flowering	56.67-67.67	67.47±0.39	3.8	3.5	0.92	83.8	4.20	6.22
2	Plant Height(cm)	132.64-166.07	157.17±3.78	6.9	3.5	0.51	26.1	5.79	3.68
3	No. of branches per plant	6.00-6.72	6.33 ±0.26	9.9	1.1	0.11	1.3	0.02	0.32
4	No. of capitula per plant	58.13-77.98	68.28 ±2.98	11.4	3.9	0.35	12.2	1.96	2.87
5	No. of seeds per capitulum	26.79-33.20	30.27+1.04	8.9	3.1	0.35	11.9	0.66	2.18
6	Grain Yield (Kg/ha)	506.67-668.74	587.15+ 34.79	14.6	1.2	0.08	0.7	1.18	0.20

taken on plot basis for days to 50% flowering and grain yield (q/ha). Ten randomly selected plants in each entry were taken up for recording data on plant height, number of branches per plant, number of capitula per plant and number of seeds per capitulum. Analysis of variance from four crop season data, was performed following the standard procedures described by Singh and Chaudhury, 1998. The phenotypic and genotype coefficients of variability were computed according to the method suggested by Burton (1952). Heritability (broad sense) and genetic advance were estimated as per Johnson *et al*. (1955). The phenotypic and genotypic correlations were calculated as per the method described by Al-Jibouri *et al.* (1958). Path coefficient analysis was carried out with genotypic correlations following the method of Dewey and Lu (1959).

Results and Discussion

The analysis of variance revealed significant differences among the genotypes for all the five characters except number of branches per plant (Table 1). The estimates of genetic variability are presented in Table 2. GCV was comparatively high for number of capitula per plant (3.9%), days to 50% flowering and plant height (3.5% each) and number of seeds per capitulum (3.1%). Low GCV / PCV ratio of grain yield (0.08); number of branches per plant (0.11), number of capitula per plant (0.35) and number of seeds per capitulum (0.35) indicated that these characters were highly influenced by environmental factors. High GCV / PVC ratio was recorded for days to 50% flowering and plant height.

High heritability value was recorded for days to 50% flowering (83.8%), plant height (26.1%), number of capitula per plant (12.2%) and number of seeds per capitulum (11.9) which indicated that selection was effective for these traits. Low heritability was observed for rest of the characters. High heritability coupled with high genetic advance as per cent of mean was recorded for days to 50% flowering and plant height, revealing the influence of additive gene action for these traits. Hence the improvement of these traits can be made through direct phenotypic selection. High heritability coupled with low genetic advance as per cent of mean was recorded for number of capitula per plant and number of seeds per capitulum, indicating the effect of non-additive gene action in crop improvement like heterosis breeding may be beneficial.

The estimates of genotypic and phenotypic correlation coefficients for different characters are

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Table 3. Estimate of Genotypic (rg) and Phenotypic (rp) correlation coefficient for six different characters in eighteen Niger genotypes

Characters		Days to 50% Flowering	Plant Height (cm)	No. of branches per plant	No. of capitula per plant	No. of seeds per capitulum	Grain Yield (Kg/ha)
Days to 50% Flowering	rg	1.000	0.590**	0.539**	0.500**	-0.234	0.577**
	rp	1.000	0.235	0.141	0.464	-0.038	0.162
Plant Height(cm)	rg		1.000	0.543	0.488	0.583	-0.562**
	rp		1.000	0.316	0.460	0.243	-0.074
No. of branches per plant	rg			1.000	0.430	0.618	0.693**
	rp			1.000	0.311	-0.029	-0.079
No. of capitula per plant	rg				1.000	0.179	0.064
	rp				1.000	0.206	0.147
No. of seeds per capitulum	rg					1.000	-0.767**
	rp					1.000	0.146
Grain Yield (Kg/ha)	rg						1.000
	rp						1.000

Table 4. Direct (diagonal & bold) and indirect effects of Path Coefficients based on genotypic correlation with grain yield (Kg/ha) in Niger

Characters		Days to 50% Flowering	Plant Height (cm)	No. of branches per plant	No. of capitula per plant	No. of seeds per capitulum	Correlation with grain yield
Days to 50% Flowering	rg	9.224	-6.337	0.478	-1.169	-1.618	0.577**
	rp	0.154	-0.046	-0.012	0.073	-0.006	0.162
Plant Height(cm)	rg	6.028	-9.747	0.279	-1.160	4.038	-0.562**
	rp	0.036	-0.197	-0.026	0.072	0.040	-0.074
No. of branches per plant	rg	13.737	-16.588	0.181	-1.114	4.478	0.693**
	rp	0.022	-0.062	-0.083	0.049	-0.005	-0.079
No. of capitula per plant	rg	15.337	-15.991	0.258	-0.779	1.239	0.064
	rp	0.071	-0.090	-0.026	0.158	0.024	0.147
No. of seeds per capitulum	rg	-2.390	-5.270	0.112	-0.140	6.921	-0.767**
	rp	-0.006	-0.048	0.002	0.032	0.165	0.146

presented in Table 3. The genotypic correlation coefficients were similar in direction but higher in magnitude than phenotypic correlation coefficients for all the traits under study except no. of seeds per capitulum, revealing the influence of environment for expression of that character. Grain yield was found to be positively and significantly associated with days to 50% flowering and number of branches per plant at genotypic level where as significant negative correlation of grain yield was noted with plant height and number of seeds per capitulum. The genotypic and phenotypic correlation with grain yield was further partitioned into direct and indirect effects to establish the cause and effect relationship among the yield and its component characters which is presented in Table 4. Path analysis revealed that the significantly positive associations of grain yield per hectare with days to 50% flowering (0.577) was due to high direct effect (9.224) and with number of branches per plant (0.693) were due to high positive indirect effect via days to 50% flowering (13.737) and number of seeds per capitulum (4.478). It can be inferred from the above study that days to 50% flowering and number branches per plant had greater influence on grain yield (q/ha) which may be given due emphasis in Niger improvement programme.

Conclusion

Genetic variability, character association and path coefficient analysis was studied taking eighteen Niger genotypes and six yield attributing traits for effective selection of base population from 2003-2006. The grain yield was found positively and strongly correlated with flowering and number of branches per plant at genotypic level and number of seeds per capitulum at phenotypic level. The grain yield was significant negatively correlated with plant height and number of seeds per capitulum at genotypic level. Path analysis revealed that the significantly positive associations of grain yield per ha with 50 per cent flowering and number of branches per plant were due to high positive direct

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and indirect effect via days to flowering, respectively.

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