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Suryanarayana L
Senior Scientist (Plant Breeding), Regional Agricultural Research Station, ANGRAU, Chintapalle Visakhapatnam, Andhra Pradesh, India

Sekhar D
Senior Scientist (Agronomy), Regional Agricultural Research Station, ANGRAU, Chintapalle Visakhapatnam, Andhra Pradesh, India

Tejeswara Rao K
Senior Scientist (Crop Production), Krishi Vigyan Kendra (DAATTC), Kondempudi, Visakhapatnam, Andhra Pradesh, India

Correspondence
Suryanarayana L
Senior Scientist (Plant Breeding), Regional Agricultural Research Station, ANGRAU, Chintapalle Visakhapatnam, Andhra Pradesh, India

Studies on genetic variability, character association and path analysis in Niger (*Guizotia abyssinica* L.) Genotypes

Suryanarayana L, Sekhar D and Tejeswara Rao K

Abstract
The present investigation was carried out to study the genetic variability parameters and nature of associations among the traits affecting grain yield in twenty eight niger genotypes at Regional Agricultural Research Station, Chintapalle during *kharif*, 2011. High estimates of genotypic coefficient of variation were observed for grain yield and phenotypic coefficient of variation for number of capsules per plant. High heritability coupled with high genetic advance was observed for number of capsules per plant, number of seeds per capsule and grain yield (q/ha) suggesting that they can be improved through direct selection due to predominant additive variation. Correlation studies revealed that number of seeds per capsule exhibited highly significant positive correlation with grain yield both at phenotypic and genotypic level. Path coefficient analysis showed that number of branches per plant had the maximum direct effect on grain yield followed by plant height.

Keywords: genetic variability, heritability, character association, path analysis in Niger

Introduction

Niger (*Guizotia abyssinica* L.) is a minor oilseed crop grown in the marginal and sub marginal lands in India. In India Niger is grown in an area of 2.53 lakh hectares with the production of 0.83 lakh tonnes and the productivity of 326 kg/ha. In the state of Andhra Pradesh it is grown in an area of 7600 ha with the production of 0.04 lakh tonnes and productivity of 459 kg/ha. The crop is mainly grown in hill slopes during *rabi* season by tribal farmers of High Altitude and Tribal Zone of Andhra Pradesh. The production of this crop is low mainly due to the non-availability of improved varieties, non-adoption of production strategies in hill slopes and also due to the weed menace.

Niger crop is important in terms of proteins and quality oil, the oil is used for culinary purposes, manufacturing of paints, soft soaps, lighting and lubrication. The seeds are eaten fried, used as condiment or dried powder and mixed with flour to make sweet cakes. Niger seeds contain about 40% edible oil with fatty acid composition of 75-80% linoleic acid, 7-8% palmitic and stearic acids and 5-8% oleic acid.

The quantum of genetic variability present in the population will determine the breeding strategy to be adopted for crop improvement. In addition to the genetic variability, knowledge on heritability and genetic advance helps the breeder to employ the suitable breeding strategy. Therefore, it is necessary to have knowledge on genetic variability, heritability and genetic advance present in the available genetic material. The correlation studies simply measure the associations between yield and other traits. Whereas, path analysis permits the understanding of cause and effect of related characters.

Material and Methods

The field experiment was conducted at Regional Agricultural Research Station, Chintapalle during *kharif*, 2011. Twenty eight Niger genotypes were raised in Randomized Block Design (RBD) in three replications with spacing of 30 × 10 cm. Each genotype was grown in 10 lines of 3 m length. To raise a healthy crop all the recommended package of practices were followed and observations were recorded for plant height (cm), days to 50% flowering, days to maturity, number of branches per plant, number of capsules per plant, number of seeds per capsule and grain yield (q/ ha).

The data was subjected to statistical analysis to estimate genetic parameters (Panse and Sukhatme, 1964) [11], phenotypic and genotypic coefficients of variation (PCV and GCV) according to Burton and Devane (1953) [4], heritability in broad sense as per Allard (1960). Genetic advance was estimated as per the formula proposed by Lush (1940) [10] and genetic advance expressed as per cent of mean by using the formula suggested by Johnson *et al*. (1955) [7]. Correlation coefficients were worked out using the formula as suggested by Falconer (1960) and was partitioned into direct and indirect causes according to Dewey and Lu (1959) [5].

Results and Discussion

The analysis of variance revealed highly significant differences among the twenty eight genotypes for seven characters indicating the existence of sufficient amount of variability among the genotypes (Table.1) for the characters studied.

The estimates of genotypic coefficient of variation were low for plant height, days to 50% flowering, days to maturity, moderate for number of branches per plant, number of seeds per capsules and it was high for number of capsules per plant and grain yield (q/ha). The phenotypic coefficients of variation were low for days to 50% flowering, days to maturity, moderate for plant height, number of branches per plant, number of seeds per capsule and high for number of capsules per plant and grain yield (q/ha). Similar results were reported by Tiwari *et al.*, (2016) [13], Ahirwar *et al.*, (2017) [1] in Niger.

Generally the estimates of phenotypic coefficients of variation were higher than the genotypic coefficients of variation, it indicates the variation was not only due to genotypes but also due to the influence of environment. Heritability estimates were ranged from 37.92 (days to maturity) to 93.47 (grain yield), moderate heritability estimates were reported for plant height, days to maturity, number of branches per plant, where as it was high for days to 50% flowering, number of capsules per plant, number of seeds per capsule and grain yield (Table. 2). Genetic advance as percent of mean ranged from 1.69 (days to maturity) to 45.24 (grain yield), high estimates of genetic advance were reported for number of capsules per plant, number of seeds per capsule and grain yield. High heritability coupled with high genetic advance was observed for these traits, suggesting that they can be improved through direct selection due to predominant additive variation. Similar results were reported by Tiwari *et al.*, (2016) [13], Patil, *et al.*, (2013), Kumar and Bisen (2016) in Niger.

High heritability coupled with low genetic advance for days to 50% flowering revealed predominance of non-additive gene action. Moderate heritability with low genetic advance was observed for days to maturity suggesting that environment played major role in character expression. Whereas, high heritability coupled high genetic advance was reported for number of capsules per plant, number of seeds per capsule and grain yield indicates predominance of additive gene action.

Correlation analysis revealed that the genotypic correlation coefficients in most cases were higher than their phenotypic correlation coefficients indicating the association is largely due to genetic reason. Plant height, number of branches per plant, number of capsules per plant, number of seeds per capsule exhibited highly significant positive correlation with grain yield at phenotypic and genotypic level (Table. 3). A selection for these characters would possibly be helpful in improving the yield potential of this crop. Whereas, days to 50% flowering and days to maturity have significant negative correlation with grain yield at phenotypic and genotypic level.

Path coefficient analysis showed that number of branches per plant had the maximum direct effect on grain yield (q/ha) followed by plant height, number of seeds per capsule and days to maturity (Table. 4). Days to 50% flowering showed negative correlation with yield along with direct negative effect. Days to maturity showed positive effect on grain yield but its correlation with yield is negative. Therefore, these traits may be considered as the principal traits while selecting for seed yield and selection indices may be formed by considering all these characters for improvement of seed yield. Similar results were reported by Patil *et al.*, (2013) [12], Khuntey *et al.*, (2015) [8], Ahirwar *et al.*, (2017) [1] in niger.

Table 1: Analysis of variance for seven characters in 28 genotypes of Niger

Source of variation	Df	Mean squares						
		Plant height	**Days to 50% flowering**	**Days to maturity**	**No of branches per plant**	**Number of capsules per plant**	**Number of seeds per capsule**	**Grain yield Q/ha**
Replication	2	24.96	0.107	0.905	1.414	1.430	7.44	0.126
Treatments	27	222.75**	15.78**	9.310**	2.741**	205.986**	69.185**	4.386**
Error	54	41.18	2.132	3.287	0.568	12.373	8.79	0.10

Table 2: Estimates of genetic variability parameters for grain yield and its attributes in 28 genotypes of Niger

Character	Range		Mean	Coefficient of variation			Heritability h^2 (b)	Genetic advance	Genetic advance as percent of mean
	Min	**Max**		**GCV**	**PCV**	**ECV**			
Plant height	83.17	120.53	94.14	8.26	10.71	6.82	59.51	12.36	13.13
Days to 50% flowering	43.33	51.33	46.93	4.55	5.51	3.11	68.10	3.62	7.72
Days to maturity	104.00	110.00	106.23	1.33	2.17	1.71	37.92	1.79	1.69
No of branches per plant	6.47	9.93	7.83	10.87	14.51	9.62	56.08	1.31	16.76
Number of capsules per plant	25.27	53.40	36.96	21.74	23.73	9.52	83.91	15.16	41.01
Number of seeds per capsule	27.93	46.13	37.50	11.96	14.34	7.91	69.58	7.70	20.55
Grain yield Q/ha	3.15	8.07	5.26	22.72	23.50	6.01	93.47	2.38	45.24

Table 3: Estimates of phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients for 7 characters in 28 Niger genotypes

	Plant height	Days to 50% flowering	Days to maturity	No of branches per plant	Number of capsules per plant	Number of seeds per capsule	Grain yield Q/ha
Plant height	1	0.276*	0.015	0.191	0.326**	0.198	0.281**
Days to 50% flowering	0.43**	1	0.477**	0.016	-0.067	-0.151	-0.217*
Days to maturity	0.092	0.44**	1	-0.051	-0.14	-0.152	-0.054
No of branches per plant	0.323**	-0.036	-0.079	1	0.778**	0.424**	0.301**
Number of capsules per plant	0.355**	-0.119	-0.226*	1.024**	1	0.548**	0.452**
Number of seeds per capsule	0.324**	-0.26*	-0.261*	0.557**	0.624**	1	0.523**
Grain yield Q/ha	0.396**	-0.283**	-0.104	0.413**	0.541**	0.647**	1

Table 4: Path coefficient analysis showing direct and indirect effects.

	Plant height	**Days to 50% flowering**	**Days to maturity**	**No of branches per plant**	**Number of capsules per plant**	**Number of seeds per capsule**	**Grain yield Q/ha**
Plant height	0.482	-0.203	0.002	0.335	-0.358	0.137	0.281**
Days to 50% flowering	0.207	-0.473	0.010	-0.037	0.119	-0.110	-0.217**
Days to maturity	0.044	-0.208	0.024	-0.082	0.228	-0.111	-0.054**
No of branches per plant	0.155	0.016	-0.001	1.037	-1.032	0.236	0.301**
Number of capsules per plant	0.171	0.056	-0.005	1.062	-1.008	0.265	0.452**
Number of seeds per capsule	0.156	0.122	-0.006	0.577	-0.629	0.424	0.523**

Residual effect 0.72

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