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Studies on genetic parameters, correlation and path analysis for yield and yield components in Niger (*Guizotia abyssinica* L.)

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Abstract
An investigation was carried out to assess the genetic variability parameters and nature of associations among the characters affecting the grain yield in thirty Niger genotypes at Regional Agricultural Research Station, Chintapalle during *rabi*, 2010. High estimates of GCV and PCV waere observed for grain yield (q/ha). High heritability coupled with high genetic advance was observed for number of capitula per plant and grain yield (q/ha) suggesting that they can be improved through direct selection due to predominant additive gene action. Correlation studies revealed that number of capitula per plant followed by number of seeds per capitula exhibited highly significant positive correlation with grain yield both at phenotypic and genotypic level. Path coefficient analysis showed number of capitula per plant followed by number of seeds per capitula had the maximum direct effects on grain yield.

Keywords: genetic parameters, correlation and path analysis in Niger

Introduction
Niger is an annual dicotyledonous herb commonly grown for its seed and oil. Niger oil is slow drying used in foods, paints and soaps as an illuminant. 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. However, the keeping quality of Niger oil is poor due to high content of unsaturated fatty acids. In India it is cultivated mainly in hill slopes by the tribal farmers in an area of 2.53 lakh hectares with the production of 0.83 lakh tonnes and the productivity of 326 kg/ha. Productivity of this crop is low mainly due to the non availability of improved varieties, non adoption of production strategies in hill slopes.

Niger is a self-incompatible cross pollinated crop and assessment of genetic variability is required to judge its potential as base material for its improvement. In addition to the genetic variability, knowledge on heritability and genetic advance helps the breeder to employ the suitable breeding strategy. The traits influencing yield are understood through correlation studies to determine the nature and extent of relationships between yield and other yield attributing traits. Therefore, correlation analysis of a particular trait with other trait attributing to yield is of great importance for selecting lines for higher yield. Path coefficient analysis helps in partitioning the correlation coefficient into its direct and indirect effects. Thus the present study was aimed at gathering information on existing genetic variability, nature and magnitude of association among seven attributes in thirty Niger genotypes.

Material and Methods
The experimental material consists of 30 genotypes of Niger were evaluated in Regional Agricultural Research Station, Chintapalle during *Rabi*, 2010. They 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. All the recommended package of practices were followed to raise a healthy crop, observations were recorded for days to 50% flowering, days to maturity and grain yield (q/ ha) on per plot basis and plant height (cm), number of branches per plant, number of capitula per plant and number of seeds per capitula from five randomly selected plants.

The phenotypic and genotypic coefficients of variation (PCV and GCV) were computed according to the methods suggested by Burton and Devane (1953) [3], heritability in broad

sense as per Allard (1960) [2], genetic advance as per Johnson *et al*. (1955) [6]. Correlation coefficients were worked out using the formula as suggested by Falconer (1960) and were partitioned into direct and indirect causes according to Dewey and Lu (1959) [4].

Results and Discussion

The analysis of variance revealed highly significant differences among thirty genotypes for seven characters (Table 1). The estimates of genotypic coefficient of variation were low for plant height, days to 50% flowering, days to maturity, number of branches per plant, number of seeds per capitula, these are in consonance with the results of Khuntey *et al.,* (2015) [7]. Whereas, moderate GCA was observed for number of capitula per plant and high for grain yield (q/ha). The phenotypic coefficient of variation was low for days to 50% flowering, days to maturity, moderate for plant height, number of branches per plant, number of seeds per capitula, number of capitula per plant and high for grain yield (q/ha). Similar results were reported by Suryanarayana *et al.,* (2018) [10], Tiwari *et al.,* (2016) [11], Ahirwar *et al.,* (2017) [1] in Niger. Generally the estimates of phenotypic coefficient of variation were higher than the genotypic coefficient of variation indicates the variation was not only due to genotype but also due to the influence of environment. Heritability estimates were ranged from 57.82 (Plant height) to 86.77 (Grain yield), moderate heritability estimates were reported for plant height, whereas it was high for days to 50% flowering, days to maturity, number of branches per plant, number of capitula per plant, number of seeds per capitula and grain yield (Table 2).

Genetic advance as percent of mean ranged from 3.45 (Days to maturity) to 46.20 (Grain yield), the estimates of genetic advance were low for days to 50% flowering, days to maturity, medium for plant height, number of branches per plant, number of seeds per capitula and high for number of capitula per plant and grain yield.

The estimates of heritability and genetic advance can be utilised for the prediction of genetic gain, which indicates the genetic improvement that would results from the selection of best individual. High heritability coupled with high genetic advance was observed for number of capitula per plant and grain yield. Hence, improvement of these traits can be made through direct selection. Similar results were reported by Suryanarayana *et al.,* (2018) [10], Tiwari *et al.,* (2016) [11], Patil, *et al.,* (2013) [9], Kumar and Bisen (2016) [8] in Niger.

High heritability coupled with low genetic advance for days to 50% flowering and days to maturity revealed predominance of non additive gene action. Thus hybridization followed by selection is useful for the improvement of these traits. High heritability coupled with moderate genetic advance was observed for plant height, number of branches per plant and number of seeds per capitula revealed the role of both additive and non additive gene action in inheritance of these traits and can be improved by population improvement methods. Whereas, high heritability coupled high genetic advance was reported for number of capitula per plant and grain yield indicates predominance of additive gene action. Moderate heritability coupled with moderate genetic advance for days to maturity suggesting that environment played major role in character expression.

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. Days to 50% flowering, days to maturity, plant height, number of branches per plant, number of capitula per plant, number of seeds per capitula exhibited highly significant positive correlation with grain yield at phenotypic and genotypic level (Table 3). Hence, selection for these characters would possibly helpful in improving the yield potential of this crop. Similarly, Suryanarayana *et al.,* (2018) [10] reported the significant positive association of number of seeds per capitula, number of capitula per plant, number of branches per plant and plant height to seed yield, Kumar and Bisen (2016) [8] reported the significant positive association of number of capitula per plant and days to flowering to seed yield.

Path coefficient analysis showed that number of capitula per plant had maximum direct effect on grain yield (q/ha) followed by number of seeds per capitula, plant height, days to 50% flowering and days to maturity (Table 4). Days to 50% flowering and number of branches per plant showed negative effect with grain yield buts its correlation with grain yield is positive. Significant positive estimates of number of capitula per plant to grain yield was due to high positive direct and indirect effects *via.,* plant height, days to maturity and number of seeds per capitula. Hence, number of capitula per plant and number of seeds per capitula should be given emphasis in yield improvement. Similarly, path analysis showing the highest positive direct effect on seed yield/plant was exerted by number of capitula/plant reported by Kumar and Bisen (2016) [8] and number of branches per plant, plant height, number of seeds per capitula and number of branches per plant by Suryanarayana *et al.,* (2018) [10].

Table 1: Analysis of variance for seven characters in 30 genotypes of Niger

Source of variation	Df	Mean squares						
		Plant Height (cm)	Days to 50% flowering	Days to maturity	No of branches per plant	Number of capitula per plant	Number of seeds per capitula	Grain yield Q/ha
Replication	2	76.77	0.14	1.34	0.09	1.20	0.70	0.17
Treatments	29	406.07**	16.81**	14.38**	1.56**	149.49**	26.95**	8.47**
Error	58	79.42	0.83	1.85	0.23	9.23	4.19	0.41

Table 2: Estimates of genetic variability parameters for grain yield and its attributes in 30 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 (cm)	85.73	131.4	109.32	9.54	12.55	8.15	57.82	16.34	14.95
Days to 50% flowering	42.00	51.00	45.65	5.05	5.43	2.00	86.46	4.42	9.68
Days to maturity	98.66	106.67	101.62	2.01	2.41	1.33	69.30	3.50	3.45
No of branches per plant	6.33	9.46	7.8	8.45	10.44	6.12	65.57	1.12	14.10
Number of capitula per plant	31.70	64.20	50.80	13.45	14.72	5.98	83.50	12.87	25.33
Number of seeds per capitula	25.69	38.86	31.70	8.69	10.82	6.45	64.43	4.55	14.37
Grain yield Q/ha	3.33	9.61	6.80	24.07	25.84	9.40	86.77	3.14	46.20

Table 3: Estimates of phenotypic (Above diagonal) and genotypic (Below diagonal) correlation coefficients for 7 characters in 30 Niger genotypes

	Plant height (cm)	Days to 50% flowering	Days to maturity	No of branches per plant	Number of capitula per plant	Number of seeds per capitula	Grain yield Q/ha
Plant height (cm)	1.0	0.199	0.136	0.537**	0.273**	0.222**	0.373**
Days to 50% flowering	0.296**	1.0	0.910**	0.365**	0.512**	0.068	0.366**
Days to maturity	0.256*	1.035**	1.0	0.314**	0.442**	0.087	0.349**
No of branches per plant	0.730**	0.569**	0.513**	1.0	0.612**	0.099	0.484**
Number of capitula per plant	0.415**	0.593**	0.581**	0.816**	1.0	0.093	0.685**
Number of seeds per capitula	0.100	0.124	0.192	-0.023	0.144	1.0	0.503**
Grain yield Q/ha	0.476**	0.439**	0.426**	0.609**	0.790**	0.615*	1.0

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

	Plant Height (cm)	Days to 50% flowering	Days to maturity	No of branches per plant	Number of capitula per plant	Number of seeds per capitula	Grain yield Q/ha
Plant height (cm)	0.218	-0.150	0.103	-0.061	0.3187	0.046	0.373**
Days to 50% flowering	0.064	-0.510	0.419	-0.048	0.455	0.057	0.366**
Days to maturity	0.055	-0.527	0.405	-0.043	0.445	0.089	0.349**
No of branches per plant	0.159	-0.290	0.208	-0.084	0.626	-0.010	0.484**
Number of capitula per plant	0.090	-0.302	0.235	-0.068	0.767	0.067	0.685**
Number of seeds per capitula	0.021	-0.063	0.077	0.001	0.110	0.465	0.503**

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