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Genetic divergence studies in niger (*Guizotia abyssinica* L.) genotypes

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Abstract

The genetic divergence among 28 niger genotypes was assessed by employing Mahalanobis D^2 analysis based on 7 characteristics. The genotypes were grouped into nine clusters. Cluster I was the largest with 14 genotypes followed by cluster II, III, IV, V, VI, VII with two genotypes in each cluster and cluster VIII and IX are solitary with single genotype in each cluster.

The highest inter cluster distance was observed between cluster VIII and cluster IX followed by cluster VI and VIII suggesting more variability in genetic makeup of the genotypes included in these clusters. Cluster VIII had highest mean values for plant height, no of branches per plant, number of capsules per plant, number of sees per capsule and grain yield per hectare. Whereas, cluster IX had high mean value for days to 50 percent flowering and low mean value for grain yield per hectare. Cluster IV had highest value for days to maturity. Grain yield per hectare has contributed more towards the genetic divergence followed by number of capsules per plant.

Keywords: Genetic divergence, D^2 -statistics, cluster analysis in Niger

Introduction

Niger is an important oilseed crop cultivated in India in an area of 2.53 lakh hectares with a production of 0.83 lakh tonnes and productivity of 326 kg/ha. In Andhra Pradesh it is mainly cultivated in Visakhapatnam district in hill slopes by tribal farmers of High Altitude and Tribal Zone during rabi season in an area of 7600 ha with the production of 0.04 lakh tonnes and productivity of 459 kg/ha. 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.

Genetic diversity analysis helps to identify the genetically diverse genotypes for their utilization in breeding programme. Crosses between divergent parents usually produce greater heterosis than those between closely related ones. Mahalanobis' generalized distance estimated by D^2 statistic (Rao, 1952) [1] is a unique tool to quantify the magnitude of genetic diversity among the germplasm. The present investigation aims to determine the genetic diversity among 28 niger genotypes using cluster analysis.

Material and Methods:

The experimental material used for the present study consisting of 28 niger genotypes were raised in Randomized Block Design (RBD) with three replications. Each genotype was grown in 10 rows of 4 m length with a spacing of 30 cm between rows and 10 cm within a row. All the recommended package of practices were followed to raise the healthy crop. Observations were recorded on five randomly selected plants for plant height (cm), number of branches per plant, number of capsules per plant, number of seeds per capsule and observations on per plot basis were recorded for days to 50% flowering, days to maturity and grain yield q/ ha.

The genetic divergence among the genotypes was computed by means of Mahalanobis' D^2 -statistics (1936) [2]. Intra and inter cluster distance, cluster means and contribution of each trait to the divergence were estimated as suggested by Singh and Chaudhary (1985) [6].

Results and Discussion:

All the 28 genotypes used in the present study were grouped into nine clusters based on D^2 statistics (Table 1). The distribution of 28 genotypes into nine clusters was at random with maximum number of 14 genotypes grouped in cluster I followed by Cluster II, III, IV, V, VI, VII with two genotypes in each cluster, cluster VIII and IX are solitary with single genotype in each cluster.

The intra and inter cluster distances revealed that inter cluster distance was greater than intra cluster distance (Table 2). The maximum intra cluster distance was recorded in cluster I (53.05) followed by cluster VII (16.68), cluster VI (15.12), cluster V (12.66), cluster IV (7.97),

cluster III (3.73 and cluster II (2.94). The intra cluster distance in cluster I was highest (53.05) indicating the presence of wide genetic diversity among the genotypes present within this cluster. The inter cluster D^2 values ranged from 8.31 (between cluster II and III) to 377.09 (between cluster VIII and IX). Based on the intra and inter cluster distances among the groups it is suggested to make crosses between the genotypes of cluster II and cluster VIII or IX to evolve transgressive segregants for yield and yield components.

The knowledge on characters influencing divergence is an important aspect to a breeder. The per cent contribution towards genetic divergence by seven contributing characters is presented in Table 3. The maximum contribution towards genetic divergence was displayed by grain yield q/ha (63.7566%) followed by number of capsules per plant (16.4021), number of seeds per capsule (13.2275), days to maturity (3.7037), plant height (1.8519), number of branches per plant (0.5291) and days to 50% flowering (0.5291) respectively. Parameshwarappa *et al.*, (2009 and 2011) [11] and Shwetha and Parameshwarappa (2016) reported plant height, number of capitula per plant and seed yield per plant are major contributors to genetic diversity. Kumar and Bisen

(2017) [8] in a study of genetic diversity in niger reported seed yield per plant, 1000 seed weight, number of capitula per plant contributed maximum to genetic divergence. Bisen *et al.*, (2016) [1] reported seed yield, days to maturity, number of capitula per plant and 1000 seed weight contributed maximum towards genetic divergence.

The cluster mean values for seven characters are presented in Table 4. Highest cluster mean values for plant height, number of branches per plant, number of capsules per plant, number of seeds per capsules and grain yield q/ha were seen in cluster VIII, days to 50% flowering in cluster IX and days to maturity in cluster IV. The lower cluster mean values for plant height (86.57) were found in cluster IV, days to 50% flowering (45.52) in cluster II, days to maturity (104.67) in cluster VII, number of branches per plant (6.77) and number of seeds per capsule (30.10) in cluster II, number of capsules per plant (25.62) in cluster VI and grain yield per hectare (3.15) in cluster IX. The genotypes from cluster VIII and IV/IX with high mean value for the above characters may be used as parents to get novel recombinants in hybridization programme. Parameshwarappa *et al.*, (2011) [7] and Bisen *et al.*, (2016) [1] reported the similar results in niger.

Table 1: Cluster composition of 28 niger genotypes

Cluster No	No of genotypes in each cluster	Cluster members
Cluster 1	14	JNS-503, IGPN-9001, BAU-10-2, DNC-08-9, IGPN-08-9, IGPN-08-66, JNS-508, BAU-10-5, JNS-505, ONS-164, ONS-165, BAU-09-2, DNC-08-2, JNS-502, BAU-09-1
Cluster 2	2	IGPN-8007, BNM-1
Cluster 3	2	JNS-107, DNC-08-5
Cluster 4	2	IGPN-8004, JNS-119
Cluster 5	2	IGPN-08-16, BDNS-1
Cluster 6	2	JNS-501, JNS-253
Cluster 7	2	JNS-206, JN-08-4
Cluster 8	1	JNS-204
Cluster 9	1	ONS-162

Table 2: Average intra and inter cluster D^2 values among nine clusters in niger

	I	II	III	IV	V	VI	VII	VIII	IX
I	53.05 (7.28)	85.32 (9.23)	64.05 (8.00)	69.02 (8.31)	50.46 (7.10)	94.67 (9.73)	47.83 (6.92)	122.56 (11.07)	157.36 (12.54)
II		2.94 (1.71)	8.31 (2.88)	12.57 (3.55)	22.47 (4.74)	10.83 (3.29)	32.80 (5.72)	264.16 (16.25)	33.46 (5.78)
III			3.73 (1.93)	16.51 (4.06)	11.55 (3.39)	12.61 (3.55)	19.28 (4.39)	208.15 (14.42)	34.91 (5.90)
IV				7.97 (2.82)	26.08 (5.10)	16.29 (4.03)	35.17 (5.93)	234.24 (15.30)	58.70 (7.66)
V					12.66 (3.56)	27.03 (5.19)	25.87 (5.08)	185.74 (13.62)	66.05 (8.12)
VI						15.12 (3.89)	46.82 (6.84)	269.56 (16.41)	34.00 (5.83)
VII							16.68 (4.08)	145.02 (12.04)	73.66 (8.58)
VIII								0.00 (0.00)	377.09 (19.41)
IX									0.00 (0.00)

Table 3: Contribution of characters towards genetic divergence

Character	No of times ranked first	% Contribution
Plant height (cm)	7	1.85
Days to 50% flowering	2	0.52
Days to maturity	14	3.70
Number of branches per plant	2	0.53
Number of capsules per plant	62	16.40
Number of seeds per capsule	50	13.23
Grain yield q/ha	241	63.76
Total	378	100

Table 4: Cluster means for seven characters in 28 genotypes of niger.

Cluster No	Plant height (cm)	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
I	94.42	45.52	105.74	8.29	41.42	39.79	5.72
II	88.80	47.67	105.67	6.77	27.17	30.10	4.36
III	93.33	48.67	106.17	7.33	31.00	36.33	4.68
IV	86.57	47.50	109.33	7.37	30.80	30.20	4.49
V	90.93	46.00	105.00	6.83	30.60	39.07	5.09
VI	92.47	48.83	109.00	6.80	25.62	32.93	4.33
VII	98.43	48.83	104.67	7.93	41.15	36.60	5.04
VIII	120.53	50.33	108.33	9.93	51.13	44.00	8.07
IX	92.40	51.33	106.00	7.33	31.27	38.60	3.15

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