



Genetic variability among some genotypes of opium poppy (*Papaver somniferum L.*)

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Abstract: The 40 germplasm of opium poppy were evaluated for fourteen characters to indicate the genetic variability present in the selected germplasm. The estimate of heritability, genetic advance and genetic advance in percent of means were worked out. The genotype ND-8 has the maximum plant height (134.80 cm) followed by ND-42 (131.70 cm) with general means 113.84 cm. For number of leaves per plant the highest number of branches/plant was noted for ND-8 (21.17). The high estimates of phenotypic (PCV), genotypic (GCV) and environmental (ECV) coefficient of variation was observed for plant height (PCV-112.99, GCV-107.64 and ECV-5.35) and moderate for days to 1st flowering (PCV-16.14, GCV-15.45 and ECV-0.69), days to 50% flowering (PCV-12.25, GCV-11.52 and ECV-0.72), leaf length (PCV-5.32, GCV-5.08 and ECV-0.24), peduncle length (PCV-5.76, GCV-5.44 and ECV-0.32) and number of leaves/plant (PCV-3.43, GCV-3.15 and ECV-0.29). The highest estimate of heritability was recorded by leaf width (96.13%) followed by leaf length (95.52%), days to 50% flowering (95.74%) and plant height (95.26%) whereas, the minimum heritability were noted for number of branches per plant (38.80).

Key words: Opium poppy, Germplasms, GCV, PCV, ECV, Heritability, Genetic Advance (GA) and Genetic Advance in percent of mean.

Introduction

Opium poppy (*Papaver somniferum L.*) is one of the important medicinal plants and belongs to family papaveraceae. It was introduced in India as early as in 7th century. The cultivation of opium poppy was started in India only during 16th century. The opium gum extracted after lancing of mature capsule and seed are economically important. Its latex contains about 40 alkaloids. The seed of opium poppy is consumed by mankind. Seed contains 60% - 65% oil. In European countries it is cultivated as oil seed crop. The seed of opium poppy is also used as spices similar results were found by (Sharma, 1981 and Sharma *et al.*, 1981). It is supposed to have originated in the western Mediterranean region and from there it has spread through the Balkan Peninsula to Asia Minor and India. Since antiquity, its cultivation has been in vogue in Italy, Greece and Asia Minor. It was during the 15th century that the herb was introduced in India. First it was cultivated along the sea coast and later penetrated into the interior of the Peninsula similar report is given by (Khanna and Singh, 1975; Sharma and Singh, 1983).

Its cultivation is under restriction imposed by central bureau of Narcotics. In India it is cultivated in only three states namely Uttar Pradesh, Madhya Pradesh and Rajasthan. In Uttar Pradesh it is cultivated in Faizabad, Barabanki, Bareilly, Lucknow, Badaun and Shahjahanpur districts. The yield potential of opium poppy with regards to seed yield has deteriorated over time under cultivation. Although opium poppy is cultivated in India since long back, but the work on its improvement has started recently. Being an often cross pollinated crop enough variability is expected in natural population. There is need to collect and evaluate the variability to isolate suitable genotype for different morphological and economical traits. Keeping in view

above the present investigation was taken with objective to work out the variability and their trans miscibility of some selected genotypes.

Materials and Methods

To work out the genetic variability and the mean performance, the forty genotype namely ND-4-1, ND-4-2, ND-6, ND-7, ND-8, ND-9, ND-10, ND-11, ND-12, ND-16, ND-17, ND-20, ND-21, ND-22, ND-24, ND-25, ND-26, ND-28, ND-29, ND-31, ND-32, ND-35, ND-36, ND-37, ND-38, ND-42, ND-43, ND-44, ND-45, ND-46, ND-47, ND-48, ND-89, ND-208, JA-16, UOP-79, UOP-80, UOP-285, JOP-540 and NOP-4 were chosen and planted in randomized block design in three replications at Horticultural Research Station N.D.U.A.T., Kumarganj, Faizabad, India during rabi 2013-14. Each genotype was sown in a plot size of which 4 × 0.6 m. having spacing 30 cm row to row and within row 10 cm apart. The recommended cultural practices were followed. The ten plants from each plot were randomly chosen for recording the observations. The observations were recorded for the character, viz., days to first flowering, days to 50% flowering, branches per plant, plant height (cm), number of leaves per plant, leaf length (cm), leaf width (cm), peduncle length (cm), capsule length (cm), capsule width (cm), capsule weight plant (g), number of stigmatic rays, seed yield per plant (g) and husk yield per plant (g).

The analysis of variance was carried out following the procedure suggested by Panse and Sukhatme (1967). The genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and heritability in broad sense (h^2) were computed following the method suggested by Burton and De Vane (1953) and genetic advance was calculated according to procedure given by Jhonson *et al.* (1955).

Results and Discussion

The list of selected germplasm is given in the table 1. The analyses of variance for fourteen characters are presented in table 2. The highly significant differences were observed among the genotypes for all the characters, it indicates that enough variability is present in the chosen genotypes, and there is sufficient scope for selection. The mean performances of genotypes for various characters are presented in table 3. Table 3 clearly revealed that the genotype ND-8 have the maximum plant height (134.80 cm) followed by ND-42 (131.70 cm) and ND-48 (130.67 cm) and the minimum for ND-7 (90.83 cm) with general mean 113.84 cm. For number of leaves per plant, the highest number of branches/plant was observed for genotype ND-8 (21.17) than ND-45 (20.57) and ND-31 (20.47). The maximum leaf length was noted for ND-45 (26.92 cm) followed by ND-11 (21.53), UOP-285 (21.51 cm) and the minimum were recorded for ND-26 (12.96). The maximum leaf width measured for genotype ND-4-1 (14.66) followed by NOP- (13.65 cm) whereas, minimum for ND-9 (8.00 cm). In the genotype ND-28 observed the highest peduncle length (33.47 cm) and minimum for ND-20 (23.87 cm). The maximum capsule length was found for genotype ND-89 (4.20 cm) followed by ND-4-1 (4.17 cm) and the ND-9 (3.25 cm) responsible for lowest length. Highest capsule width was found in Nop-4 (4.66 cm) and the minimum for ND-9 (3.46 cm). The maximum number of branches was noted for ND-22 (1.73) followed by ND-8 and the minimum for JA-16 (0.60). The highest number of days taken for first flowering by ND-47 (110.00) and days to 50% flowering by JA-16 (117.00) and the minimum days taken to first flowering and 50% flowering both for ND-38 (91.00 and 98.67 respectively). The maximum husk yield/capsule was measured for ND-208 (2.96 g) and the minimum for JA-16 (1.74 g). The maximum seed yield/capsule was noted for ND-21 (3.96 g) followed by ND-31 (3.79 g) and the minimum found for ND-11 (2.44 g). The highest number of stigmatic rays were counted in the genotype ND-42 (15.07) followed by ND-43 and ND-45 (15.00) and the minimum in ND-4-1 (11.00). Maximum capsule weight were recorded for the genotype ND-21 (6.62 g) followed by ND-208 (6.41 g) and the minimum evaluate for JOP-540 (4.11 g) same report was given by (Singh *et al.*, 1999).

The genetic variability is most essential for plant breeding industry on which selection act to evolve desirable genotype. The greater amount of variation presents for a particular trait in the breeding materials invites greater the scope for its improvement through selection. The estimate of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense, genetic advance and genetic advance in percent of mean are present in Table 4. The high estimates of phenotypic (PCV), genotypic (GCV) and environmental (ECV) coefficient of variation was observed for plant height (PCV- 112.99, GCV- 107.64 and ECV- 5.35) and moderate for days to 1st flowering (PCV-16.14, GCV-15.45 and ECV- 0.69), days to 50% flowering (PCV-12.25, GCV-11.52 and ECV- 0.72), leaf length (PCV-5.32, GCV-5.08 and ECV- 0.24), peduncle length (PCV-5.76, GCV-5.44 and ECV-0.32) and number of leaves/plant (PCV-3.43, GCV-3.15 and ECV-0.29).

The remaining characters namely number of branches per plant, leaf width, capsule length, capsule width, husk yield, seed

Table-1: The list of opium poppy germplasm collection

Name of germplasm	Collection from
ND-4-1	Uttar Pradesh
ND-4-2	Uttar Pradesh
ND-6	Uttar Pradesh
ND-7	Uttar Pradesh
ND-8	Uttar Pradesh
ND-9	Uttar Pradesh
ND-10	Uttar Pradesh
ND-11	Uttar Pradesh
ND-12	Uttar Pradesh
ND-16	Uttar Pradesh
ND-17	Uttar Pradesh
ND-20	Uttar Pradesh
ND-21	Uttar Pradesh
ND-22	Uttar Pradesh
ND-24	Uttar Pradesh
ND-25	Uttar Pradesh
ND-26	Uttar Pradesh
ND-28	Uttar Pradesh
ND-29	Uttar Pradesh
ND-31	Uttar Pradesh
ND-32	Uttar Pradesh
ND-35	Uttar Pradesh
ND-36	Uttar Pradesh
ND-37	Uttar Pradesh
ND-38	Uttar Pradesh
ND-42	Uttar Pradesh
ND-43	Uttar Pradesh
ND-44	Uttar Pradesh
ND-45	Uttar Pradesh
ND-46	Uttar Pradesh
ND-47	Uttar Pradesh
ND-48	Uttar Pradesh
ND-89	Uttar Pradesh
ND-208	Uttar Pradesh
JA-16	Madhya Pradesh
UOP-79	Rajasthan
UOP-80	Rajasthan
UOP-285	Rajasthan
JOP-540	Madhya Pradesh
NOP-4	Uttar Pradesh

Table-2: The ANOVA for fourteen characters of opium poppy (*Papaver somniferum* L.)

Characters	Mean Square			F-Value
	Replication's Treatment's Error's			
	d.f.:2	39	78	
Plant Height (cm)	17.200	328.280**	5.354	61.325
No. of Leaves/ Plant	0.009	9.731**	0.286	43.003
Leaf Length (cm)	0.305	15.469**	0.238	64.907
Leaf Width (cm)	0.005	5.411**	0.072	75.589
Peduncle Length (cm)	0.176	16.655**	0.320	52.069
Capsule Length (cm)	0.005	0.157**	0.009	17.586
Capsule Width (cm)	0.003	0.194**	0.008	23.496
No. of Branches/ Plant	0.069	0.197**	0.068	2.902
Days to First Flowering	1.858	47.052**	0.687	68.450
Days to 50% Flowering	0.908	35.302**	0.720	49.010
Husk yield (g)/Capsule	0.011	0.267**	0.007	36.628
Seed yield (g)/Capsule	0.049	0.308**	0.017	18.23
No. of Stigmatic Rays	0.019	3.372**	0.086	39.357
Capsule Weight (g)	0.077	0.819**	0.033	25.082

Note :- ***** Significant at 1% probability level

Table-3: Mean performance of 40 genotypes of Opium poppy (*Papaver somniferum* L.) for 14 characters during (2013-14)

Characters/ Genotypes	Plant Height	No. of Leaves/ (cm)	Leaf Length Plant	Leaf Width (cm)	Peduncle Length (cm)	Capsule Length (cm)	Capsule Width (cm)	No. of Branches (cm)	Days to First /Plant	Days to 50% Flowering	Husk Yield (g)/ Flowering	Seed Yield (g)/ Capsule	No. of Stigmatic Capsule	Capsule Weight Rays(g)
ND-4-1	104.87	13.97	20.26	14.66	28.27	4.17	4.18	1.30	101.00	106.00	2.57	3.02	11.00	5.59
ND-4-2	113.90	13.17	20.61	10.79	30.35	3.58	4.12	1.40	98.00	104.33	2.64	3.16	11.33	6.14
ND-6	118.10	14.70	18.52	11.21	24.50	3.94	3.78	1.07	105.00	110.33	2.46	3.12	13.20	5.58
ND-7	90.83	16.10	18.90	9.86	29.13	3.25	3.59	1.00	104.33	110.00	2.41	3.46	13.87	5.86
ND-8	134.80	21.17	17.72	10.34	30.01	3.67	3.87	1.67	103.33	107.67	2.46	2.97	14.80	5.43
ND-9	115.43	20.30	15.88	8.00	25.49	3.66	3.46	1.20	107.33	111.00	2.57	3.37	12.80	5.94
ND-10	107.13	17.63	17.52	10.27	29.81	3.64	3.96	1.10	103.33	107.33	2.08	3.35	13.53	5.43
ND-11	118.63	17.57	21.53	11.22	27.86	3.35	3.64	1.10	105.67	112.33	1.86	2.44	12.93	4.30
ND-12	122.40	17.77	17.68	10.30	29.90	4.03	4.15	1.00	98.00	112.67	2.41	3.48	14.07	5.89
ND-16	126.30	18.23	18.37	11.07	30.64	3.66	4.12	1.37	105.33	109.67	2.57	3.09	14.93	5.67
ND-17	103.27	16.80	18.65	11.41	29.76	3.66	4.16	1.47	99.00	105.67	2.23	3.33	14.13	5.57
ND-20	121.40	16.00	18.66	11.15	23.87	3.95	4.01	1.07	99.00	105.00	2.58	3.24	12.53	5.82
ND-21	104.30	17.53	15.94	9.43	26.65	3.60	3.99	1.10	98.00	106.00	2.66	3.96	13.53	6.62
ND-22	123.93	16.43	19.26	9.81	30.59	3.99	3.66	1.73	101.33	108.00	2.50	3.66	15.00	6.16
ND-24	109.13	15.63	19.81	9.89	27.50	4.07	3.83	0.97	104.00	111.00	1.96	2.65	14.13	4.62
ND-25	99.33	16.07	17.33	10.47	28.14	3.65	3.86	1.00	103.33	107.67	2.51	3.31	12.73	5.82
ND-26	104.20	16.70	12.97	9.78	27.90	3.66	3.58	1.13	106.00	111.00	2.46	3.55	13.00	6.01
ND-28	119.50	16.07	19.06	10.87	33.47	4.08	4.11	1.23	94.00	105.33	2.46	3.08	13.73	5.55
ND-29	118.13	17.60	16.80	8.61	25.75	3.68	3.60	1.10	104.67	109.67	2.20	3.07	14.13	5.26
ND-31	121.80	20.47	18.79	11.33	24.11	4.06	3.92	1.13	104.00	109.00	2.18	3.79	14.47	5.97
ND-32	123.17	15.50	17.40	10.44	30.08	3.83	3.72	1.43	107.33	107.00	2.26	3.21	14.00	5.48
ND-35	111.27	18.30	17.15	10.51	24.62	3.79	3.67	1.07	103.00	109.00	2.12	3.44	13.13	5.57
ND-36	106.83	16.30	18.64	11.26	29.78	3.84	3.82	0.80	100.33	103.67	2.11	2.89	12.73	5.01
ND-37	113.77	17.73	18.02	9.66	27.69	3.40	3.86	1.30	100.00	107.00	2.67	2.92	13.20	5.59
ND-38	105.00	16.33	17.41	8.49	30.40	3.80	3.90	0.83	91.00	98.67	2.68	2.80	11.73	5.48
ND-42	131.70	19.23	17.38	11.81	28.99	3.55	4.51	1.20	106.00	111.00	2.50	3.27	15.07	5.77
ND-43	117.13	19.77	21.22	12.00	26.39	3.79	4.01	1.17	104.67	111.33	2.94	2.59	15.00	5.52
ND-44	130.47	16.90	18.62	11.39	30.58	3.80	3.91	1.03	103.33	107.67	2.71	2.90	14.20	5.60
ND-45	119.33	20.57	26.92	12.96	33.12	3.77	4.28	1.20	100.33	106.33	2.61	3.22	15.00	5.83
ND-46	129.30	18.83	19.02	11.84	29.15	4.06	4.03	1.07	104.00	110.67	2.70	3.24	14.00	5.95
ND-47	95.60	18.47	19.57	11.11	28.00	3.69	3.94	0.67	110.00	115.00	2.36	3.27	14.67	5.63
ND-48	130.67	16.03	14.44	8.80	27.66	4.13	4.02	1.37	100.00	106.00	2.11	3.50	14.20	5.60
ND-89	106.67	18.77	19.24	10.42	24.49	4.20	3.96	1.30	103.33	109.00	1.97	2.97	14.93	4.94
ND-208	105.40	17.77	15.99	9.35	26.25	3.87	3.81	0.90	102.67	107.67	2.96	3.45	13.27	6.41
JA-16	108.00	18.40	16.51	10.36	24.43	3.50	3.46	0.60	109.67	117.00	1.74	2.83	14.60	4.57
UOP-79	107.67	15.27	20.55	10.10	28.22	3.78	4.08	0.83	105.00	109.00	2.48	3.19	13.00	5.68
UOP-80	107.63	15.13	17.91	10.41	28.52	3.98	4.20	0.80	100.33	108.67	2.45	3.29	13.87	5.73
UOP-285	107.10	17.17	21.51	12.53	30.06	3.75	3.96	1.60	108.00	114.33	1.83	3.08	14.67	4.91
JOP-540	103.57	17.87	17.34	11.96	27.48	3.95	3.92	1.03	108.33	113.67	1.92	2.66	11.60	4.11
NOP-4	115.73	16.40	20.30	13.65	28.26	4.09	4.66	1.50	103.33	106.00	2.13	3.09	14.07	5.23
Grand mean	113.84	17.27	18.48	10.74	28.20	3.80	3.93	1.15	102.88	108.71	2.38	3.17	13.67	5.55
C.V.	2.03	3.10	2.64	2.49	2.01	2.49	2.31	22.74	0.81	0.78	3.60	4.09	2.14	3.26
SEm±	1.34	0.31	0.28	0.15	0.33	0.05	0.05	0.15	0.48	0.49	0.05	0.08	0.17	0.10
C.D. (5%)	3.76	0.87	0.79	0.43	0.92	0.15	0.15	0.42	1.35	1.38	0.14	0.21	0.48	0.29
Range Lowest	90.83	13.17	12.97	8.00	23.87	3.25	3.46	0.60	91.00	98.67	1.74	2.44	11.00	4.11
Range Highest	134.80	21.17	26.92	14.66	33.47	4.20	4.66	1.73	110.00	117.00	2.96	3.96	15.07	6.62

yield, number of stigmatic rays and capsule weight showed low estimates of PCV, GCV and ECV. The magnitude of genotypic coefficient of variation was lower than phenotypic coefficient of variation.

Heritability estimate provides the assessment of amount of transmissible genetic variability to total variability and happens to be the most important basic factor that determines the genetic improvement of response to selection. However, the degree of

improvement attained through selection is not only depended on heritability but also on the genetic variation present in the breeding population and the extent of selection pressure applied by the breeder. The parameters, genetic advance in percent of mean is a more reliable index for understanding the effectiveness of selection in improving the traits because its estimate is derived by involvement of heritability, phenotypic standard deviation and intensity of selection same report was given by (Khanna and Singh, 1974). Thus

Table-4: GCV, PCV, ECV, heritability (in broad sense), Genetic advance and genetic advance in percent of mean of opium poppy (*Papaver somniferum* L.) germplasm during (2013-14)

Characters	GCV	PCV	ECV	Broad sense heritability (%)	G.A.	Genetic Advance (GA) in % of mean
Plant Height (cm)	107.64	112.99	5.35	95.26	20.86	18.32
No. of Leaves/ Plant	3.15	3.43	0.29	91.67	3.50	20.27
Leaf Length (cm)	5.08	5.32	0.24	95.52	4.54	24.54
Leaf Width (cm)	1.78	1.85	0.07	96.13	2.69	25.09
Peduncle Length (cm)	5.44	5.76	0.32	94.45	4.67	16.57
Capsule Length (cm)	0.05	0.06	0.01	84.68	0.42	11.08
Capsule Width (cm)	0.06	0.07	0.01	88.23	0.48	12.25
No. of Branches/ Plant	0.04	0.11	0.07	38.80	0.27	23.23
Days to 1 st Flowering	15.45	16.14	0.69	95.74	7.92	7.70
Days to 50% Flowering	11.52	12.25	0.72	94.12	6.79	6.24
Husk Yield (g)/Capsule	0.09	0.09	0.01	92.23	0.58	24.51
Seed Yield (g)/Capsule	0.10	0.11	0.02	85.17	0.59	18.66
No. of Stigmatic Rays	1.10	1.18	0.09	92.75	2.08	15.19
Capsule Weight (g)	0.26	0.29	0.03	88.92	0.99	17.93

heritability and genetic advance as percent of mean, in combination, provide clear picture regarding the effectiveness of selection for improving the plant characters.

The highest estimate of heritability was recorded by leaf width (96.13%) followed by leaf length (95.52%), days to 50% flowering (95.74%) and plant height (95.26%) whereas, the minimum heritability were noted for number of branches per plant (38.80). The highest value of genetic advance in percent of mean was noted for the character leaf width (25.09%) followed by leaf length (24.54%), husk yield (24.51%) and number of branches/plant (23.23%) while days to 50% flowering recorded lowest value (6.24%). The maximum Genetic Advance (GA) were observed to the character plant height (20.86) followed by days to first flowering (7.92), days to 50% flowering (6.79) However, the minimum value were recorded for the character number of branches per plant (0.27) same results was reported by (Burton and De vane, 1953). On the basis of above findings; during selection the character leaf width and leaf length should be taken care.

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