

Pollination Mechanism and Inbreeding Depression in Niger (*Guizotia abyssinica* Cass.)

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Self fertilization resulted in 30 per cent of pollen sterility and 80 per cent of seed sterility in niger. Germination and survival of seedlings resulted from selfed progenies were very low. There was considerable reduction in yield attributes like number of branches and number of capitula which depressed the yield of self pollinated progenies. The inbreeding depression in yield was as high as 91 per cent. In view of the high self incompatibility, sibmating may be resorted to for developing inbred lines. By sib mating it should be possible to develop lines with desired attributes without sacrificing general vigour and production.

Niger (*Guizotia abyssinica* Cass.) a minor oilseed crop is mostly cultivated under rainfed conditions. It is a highly cross pollinated crop. (Howard *et al.* 1919 and Chavan, 1961). Information on floral biology, pollination mechanism and the effect of controlled pollination are meagre in this crop. Hence the present investigation was taken up to study the pollination mechanism, self incompatibility and the extent of inbreeding depression and the results are presented herein.

MATERIAL AND METHODS

With a view to study the effect of different methods of pollination viz., open, sib and self pollination, nine niger varieties viz., Ga.1, Ga.5, Ga.10 (Mysore), Ga.12 (Nagpur), Ga. 23, Ga. 25 (Tamil Nadu), Ga.29 (Ranchi), Ga. 36 (Mysore) and Ga. 39 (Maharashtra) were sown at the Agricultural College and Research Institute, Coimbatore adopting a spacing

of 60 x 60 cm in randomised block design replicated four times. Self pollination was effected through

- i) encasing the capitula with butter paper bags
- ii) mantling whole branches in muslin bags
- iii) rubbing the surface of the capitula gently with the thumb
- iv) actual dusting of the pollen from flowers of a plant of the stigma of the other capitula borne on the same plant.

Sib pollination was effected by deposition of pollen collected in bulk on the capitula of sister plants of the same line and also enclosing branches of unopened capitula of sister plants of a variety inside fine muslin cloth bags.

In order to assess the effects of inbreeding depression eleven seeds in

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each from open, self and sib pollinated heads were sown. The available selfed seeds in all the varieties excepting Ga.5 (which failed to set seed on selfing) and open pollinated in all the varieties and sib pollinated seeds except from the varieties Ga.29 and Ga.39 were raised. (Sib pollinated seeds could not be obtained in Ga.29 and Ga.39). Observations were recorded on germination,

survival and on other metric traits besides yield and the data were statistically analysed.

RESULTS AND DISCUSSION

The data on seed setting percentage under different methods of pollination are presented in Table I. The extent of seed setting found to be highly variable

TABLE I. Percentage of seed setting under different methods of pollination

Variety	Self-pollination				Sib-pollination		
	Open polli- nation	Butter paper bags	Muslin cloth bags (whole branch)	Tripping (butter paper bags)	Dusting pollen from other flower of same plant	Artificial (butter bag)	Natural sib polli- nation (muslin cloth bag)
G.a. 1	57.1	Nil	0.67	Nil	Nil	41.0	1.64
G.a. 5	60.0	Nil	Nil	Nil	Nil	33.1	2.46
G.a. 10	48.2	Nil	1.53	4.45	1.12	5.6	2.75
G.a. 12	48.6	1.24	2.06	0.76	0.81	13.0	0.76
G.a. 23	60.6	1.05	1.25	0.50	1.53	21.4	2.34
G.a. 25	48.5	Nil	1.15	0.33	0.80	18.1	1.35
G.a. 29	62.0	Nil	1.00	Nil	Nil	19.7	*
G.a. 36	64.6	Nil	0.84	Nil	Nil	34.3	0.45
G.a. 39	47.7	1.58	0.11	Nil	Nil	31.3	*
Mean	55.2	0.43	0.95	0.67	0.47	24.1	1.68

* Treatments could not be effected.

'F' Test

	Within self pollination		Within sib pollination
Open vs others **	Butter paper bags vs cloth bags **		Dusting vs artificial **
Self vs sib **	Butter paper bags vs tripping **		Dusting vs natural **
	Muslin cloth bags vs tripping **		Artificial vs natural **

** Significant at 1% level.

TABLE II. Effect of inbreeding : Percentage of germination and percentage survival to the number of seeds germinated

Variety	Open		Self		Sib	
	Percentage		Percentage		Percentage	
	Germination	Survival	Germination	Survival	Germination	Survival
G.a. 1	100	100	36.3	100	82.0	100
G.a. 5	100	100	—	—	72.7	100
G.a. 10	100	100	72.7	75	100.0	100
G.a. 12	100	82	72.7	100	100.0	100
G.a. 23	91	100	9.0	100	91.0	100
G.a. 25	100	91	63.6	100	90.00	100
G.a. 29	100	100	93.6	71.4	—	—
G.a. 36	100	100	36.3	75	54.5	100
G.a. 39	91	100	54.5	83.3	—	—
Mean	98	97	51.1	88.1	73.9	100

F-Test

Germination

Open Vs self **

Open Vs sib **

Self Vs sib *

Survival

NS * Significant 5% level

NS ** Significant 1% level

NS NS: Non-significant

under different methods of pollination studies. Seed setting under open pollination was 55.2 per cent which was significantly superior to sib-pollination (20.4%) and self pollination (0.63%). The results are in confirmity with the reports of Naik and Panda (1968). Under self pollination the setting was negligible or sterility was cent per cent. Among the techniques adopted to effect self pollination, the seed setting was significantly more (0.95%) when the whole branch was covered with muslin cloth bag as against least setting (0.43%) recorded by encasing capitula in butter paper bags. Chavan (1961) and Mohanty (1965) reported similar results. Ga.5 however, failed to produce seeds under any of the methods while maximum setting was registered by Ga.10. In the artificial sib pollination (butter bag)

Ga.1 recorded high seed set (41%) and Ga.10 least (5.6). The negligible seed set under self pollination might be attributed to the self incompatibility of physiological or genetic nature as observed by Mohanty (1965). In sib pollination, the seed set was more under artificial (24.1%) than under natural (16.7 per cent) condition. This phenomenon brought out the fact that pollens were not wind borne. Further this was confirmed by the presence of pollen grains in clumps of five or more. The intensive bee activity noticed during blooming led to the presumption that honey bees were the primary agent for cross pollination in niger.

The percentage of germination of seeds was significantly more under open pollination (98%) than those produced

TABLE III. Effects of inbreeding on pollen and seed sterility

Variety	Pollen sterility			Seed sterility		
	Open	Self	Sib	Open	Self	Sib
G.a. 1	0.40	35.61	5.68	47.4	68.6	71.7
G.a. 5	1.10	—	1.47	62.3	—	60.4
G.a. 10	8.86	14.41	2.52	61.5	67.9	61.9
G.a. 12	1.70	36.41	2.08	41.9	74.5	61.1
G.a. 23	1.02	17.60	3.05	60.4	99.2	72.5
G.a. 25	11.74	33.33	5.99	69.7	79.9	73.2
G.a. 29	2.55	34.02	—	58.5	82.7	—
G.a. 36	2.11	36.10	3.83	57.3	82.3	56.4
C.a. 39	3.80	33.78	—	52.3	79.4	—
Mean	3.69	30.15	3.51	56.81	80.93	65.31

'F' Tet	Pollen sterility	Seed sterility
Open x self	**	*
Open x sib	N.S.	N.S.
Self x sib	**	

* Significant @ 5% level

** Significant @ 1% level

NS Non-significant

under sib (73.9%) and self (51.1%) pollination (Table II). Survival of the seedlings was affected in self pollinated lines primarily due to chlorophyll deficiency resulting in subsequent mortality.

The data on pollen and seed sterility are presented in Table III. The pollen and seed sterility was high as 30 per cent and 80 per cent respectively in self pollinated lines. However the difference between open and sib pollinations was not appreciable.

The morphological attributes and yield as influenced by self and sib polli-

nation are presented in Table IV. There was significant reduction in plant height, number of branches, number of capitula and number of disc florets under self pollinated progenies while diameter of the capitulum and ray florets was least affected. The mean yield reduction was as high as 60 per cent under self pollinated lines and it was by 25.8 per cent in sib pollination over the open pollinated lines. Differential behaviour of the varieties was also noticed in respect of yield. Yield depression was as high as 91.4 per cent in Ga.1 and

TABLE IV. Effect of inbreeding - Percentage over open pollinated progeny of morphological attributes and yield

Variety	Height		No. of branches		No. of capitula		Capitulum diameter		Ray florets		Disc. florets		Yield (g)	
	Self	Sib	Self	Sib	Self	Sib	Self	Sib	Self	Sib	Self	Sib	Self	Sib
G.a. 1	100.8	104.6	84.4	78.1	37.4	56.4	76.9	84.6	103.7	100.0	81.0	98.0	8.6	18.5
G.a. 5	—	108.9	—	100.0	—	118.3	—	108.3	—	98.8	—	100.8	—	107.8
G.a. 10	68.3	93.8	57.6	97.0	45.6	97.6	91.7	100.0	126.5	96.4	80.8	104.2	32.1	44.0
G.a. 12	82.6	81.8	71.9	93.8	73.1	91.6	91.7	91.7	86.1	100.0	87.3	97.3	49.2	92.5
G.a. 23	75.8	112.9	105.6	97.2	99.4	37.1	66.7	100.0	91.9	94.2	63.0	99.1	14.1	54.9
G.a. 25	96.9	103.1	90.0	97.5	67.9	85.0	90.9	100.0	100.0	104.9	85.7	116.0	76.2	77.4
G a. 29	63.0	—	60.0	—	43.1	—	81.8	—	90.2	—	80.2	—	13.2	—
G a. 36	81.1	92.1	91.4	114.4	95.2	115.7	72.7	90.9	93.8	100.0	59.9	100.3	24.9	125.3
G.a. 39	90.8	—	96.4	—	89.9	—	100.0	—	106.2	—	93.7	—	100.0	—
Mean	82.4	99.6	82.2	96.4	68.9	93.1	84.1	96.5	99.8	99.2	79.0	102.3	38.8	74.2

F Test)

* Significant at the rate of 5% level

NS Non-significant

Ga.39 has however, recorded equal yield to that of open pollinated lines. It was observed that inbreeding depression in niger was brought out mainly by reduction in major yield attributes like number of branches and number of capitula.

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