Table 1 *Mean, coefficients of variation, heritability (broad sense) and genetic advance for different morphological traits in pearl millet*

Character	Progeny	Mean	Coefficient of variation Genotypic	Phenotypic	Herita-bility (%)	Genetic advance
Days to 50% flowering	S_1	61.01	2.89	7.37	15.41	3.84
	H.S.	59.04	2.97	7.51	15.67	4.10
	F.S.	57.88	3.32	7.55	17.65	11.99
Plant height	S_1	123.19	7.96	15.04	28.03	7.04
	H.S.	124.04	6.49	12.75	25.96	5.49
	F.S.	125.11	7.98	15.57	26.29	6.74
Number of tillers/plot	S_1	39.44	17.60	28.68	37.67	56.42
	H.S.	43.75	7.77	20.40	14.51	14.94
	F.S.	40.36	–	–	–	–
Ear length	S_1	22.10	6.86	16.66	16.96	26.33
	H.S.	21.81	5.99	13.37	20.13	25.42
	F.S.	21.87	6.13	13.56	20.47	26.14
Number of ears/ plot	S_1	32.14	17.63	39.23	20.21	50.81
	H.S.	37.32	8.58	27.67	9.62	14.68
	F.S.	34.02	–	–	–	–
Dry fodder weight	S_1	515.23	15.25	30.51	24.97	3.05
	H.S.	535.83	10.99	28.37	15.02	1.64
	F.S.*	523.69	–	–	–	–
Ear weight	S_1*	197.04	–	–	–	–
	H.S.	225.80	6.30	28.83	4.77	1.25
	F.S.	210.78	7.49	36.73	4.16	1.49

*The variation within progeny was found non-significant; therefore coefficients of variation, heritability and genetic advance were not estimated.

unravelling the hidden variability than either open pollination (half sib) or close mating (full sib). Ear weight per plot, the main character, has shown low variability in all the three types of progenies. During maturity adverse conditions such as high temperature and winds were observed which might have affected the grain filling. Alternatively, low variability may also be due to lack of variability in the basic material. However, high coefficients of variation observed for main yield traits namely tillers per plot and plant, ear length etc rule out the possibility of lack of variability. The heritability (broad sense) estimates were generally higher in S_1 progenies than the other two types of progenies for plant height, tillers per plot, ears per plot and dry fodder weight. Similarly the expected genetic advance was also higher in S_1 progenies for these traits. Thus S_1 progeny method appears to be superior to either half sib or full sib methods in exposing the hidden variability. Available evidence also supports this conclusion[1,2].

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SYNTHESIS OF *BRASSICA CARINATA* A. BR.

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Two major factors limiting the productivity of Indian mustard (*Brassica juncea*) are its susceptibility to biotic and abiotic stress conditions and the limited variability for these traits available within this species. On the other hand, the amphidiploid species *Brassica carinata* (Ethiopian mustard) has

high yield potential, resistance to *Alternaria* blight and white rust, tolerance to aphids and can withstand moisture stress conditions. Despite these useful attributes direct introduction of *B. carinata* has not been successful in India mainly because of its late flowering and maturity and the limited variability available in the natural species[1]. Artificial synthesis of *B. carinata* ($2n = 34$, BB CC) from its progenitor diploid species *B. nigra* ($2n = 16$, BB) and *B. oleracea* ($2n = 18$, CC) is one approach to generate the variability for suitable reconstruction of the plant type useful for commercial cultivation in India[2].

To synthesize *B. carinata*, four varieties of *B. oleracea* viz. var. *botrytis* (cauliflower), var. *capitata* (cabbage), var. *alboglabra* (kale) and var. *italica* (broccoli) were crossed reciprocally with one strain of *B. nigra*. In all, four interspecific hybrids were obtained[3]. Two hybrids, NA-1 and NA-2, were obtained from the cross *B. nigra* x *B. o.* var. *alboglabra*. NA-1 was obtained directly from hand pollination and NA-2 was obtained after culturing the pollinated ovaries. One hybrid, BN, was obtained from the cross *B. o.* var. *italica* x *B. nigra* and the other, NB, from its reciprocal cross. NA-1, NA-2 and NB were true hybrids with 17 chromosomes. BN was a triploid with 26 chromosomes[3]. Forty amphidiploids were obtained from NA-1, 4 from NA-2, 20 from BN and one from NB by chromosome doubling.

The synthesized hybrid BN is the first instance of synthesis of *B. carinata* using *B. oleracea* as the female parent. In all the previous studies on its synthesis[4–6], *B. nigra* was the female parent. Restriction patterns of chloroplast DNA have shown that in natural *B. carinata* also, *B. nigra* is the female parent[7]. Thus, artificial synthesis of BN has provided a means to exploit the variability at the cytoplasmic level also.

Figure 1. A plant of synthesized *B. carinata* with large number of pod-bearing branches.

The range of variability generated in the synthesized amphidiploids with respect to some important plant characters is presented in table 1. A wide range of variation was observed for plant height, number of primary and secondary branches, length of pod-bearing axis, pod density and days to flowering for the synthesized amphidiploids. One amphidiploid had up to 151 secondary branches (figure 1). A high pod density of 1.28 pods/cm on main axis was obtained in some synthesized amphidiploids compared to a low value of 0.65 in natural *B. carinata*. Such yield contributing characters are of importance in breeding suitable types of *B. carinata*. Attempts are being made to use these synthesized amphidiploids directly as a variety after selection and stabilization, and also as a raw material in breeding *B. carinata* under Indian agroclimatic conditions.

Table 1 *Range of variability of some plant characters of natural and synthesized B. carinata*

Plant material	No. of plants studied	Plant height (cm)	Primary branches per plant	Secondary branches per plant	Length of main fruiting branch (cm)	Pods/cm of main axis	Days to flower
Natural *B. carinata*	10	202–221	16–24	58–130	26–37	0.4–0.6	140–150
Synthesized *B. carinata*							
NA-1	40	82–241	7–24	0–92	6–75	0.2–1.3	68–110
NA-2	4	86–212	9–17	29–65	23–66	0.4–1.2	103–155
BN	20	55–120	3–26	0–120	12–53	0.2–1.1	61–122
NB	1	154	18	151	62	0.5	90

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ERGOT ALKALOID PRODUCTION IN SUSPENSION CULTURES OF *IPOMOEA BATATAS* POIR.

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DIFFERENT aspects of ergot alkaloid biosynthesis in *Claviceps* species, *Aspergillus fumigatus* and other microorganisms have been carried out by earlier workers[1–3]. Some plants belonging to the family Convolvulaceae also contain ergot alkaloids[4,5]. But very little work has been done in higher plants regarding the production of ergot alkaloids *in vitro*. The present communication deals with the influence of various growth regulators on the growth and alkaloid production in suspension cultures of *Ipomoea batatas* Poir.

Tuber callus of *I. batatas* Poir. was initiated on Murashige and Skoog's (MS) medium[6] containing 2 mg/l 2,4-dichlorophenoxyacetic acid (2,4-D) and 0.4 mg/l kinetin (KN). The culture vessels were incubated at a constant temperature (26 ± 2°C) and light (500 lux) conditions. Callus cultures were later maintained on the same medium subculturing every 30 days. Cell suspensions were initiated by inoculating 300 ± 30 mg of fresh tissue into 40 ml of MS basal medium with additives as above (but without agar-agar). Culture vessels were continuously agitated on a horizontal rotary shaker at 26 ± 2°C under constant illumination (500 lux). Growth of cell suspensions was measured as an increase in fresh and dry weights. Five replicate cultures were harvested at the end of 30 days for growth measurements and alkaloid production.

Dry tissue (100 mg) was macerated with 0.4 mg of ammonium hydroxide, 0.5 ml of ethanol and 0.5 ml of diethyl ether overnight, mixed in 25 ml of chloroform and boiled for about 15 min. The extract was then passed through a specially prepared glass column. The filtrate was evaporated to dryness and spotted on thin layer chromatographic plates (Kieselgel G Type 60). The plates were run in chloroform:ethanol (9:1) solvent system and sprayed with modified Van Urk's[7] reagent. The spots were eluted, dissolved in ethanol and total ergot alkaloids were measured in a colorimeter at 580 nm using Ergocrystine as standard.

Different concentrations (0.2, 1.0, 2.0 and 5.0 mg/l) of indole-3-acetic acid (IAA), indole-3-butyric acid (IBA), naphthaleneacetic acid (NAA) and 2,4-D were tested on suspension cultures of sweet potato for their influence on growth and ergot alkaloid production. Increasing concentrations of IAA increased the growth slightly but the alkaloid production was not much influenced (table 1). While maximum growth was obtained with the incorporation of IBA and NAA in the medium, highest production of total alkaloid was noticed on 2,4-D containing medium (on μg/100 mg dry weight basis). NAA is known to enhance RNA content[8] by as much as 50% which would result in the increased synthesis of structural and functional proteins. NAA is also found to accumulate rapidly in plant tissues and is then metabolized slowly to a series of unidentified derivatives[9]. The optimum level of NAA in the system can thus be maintained resulting in the rapid growth of tissues. Though higher concentrations of 2,4-D suppressed the growth, alkaloid production was maximum at 1 mg/l level (table 1) as was also reported by Nambiar[10] in callus cultures of *Evolvulus alsinoides* L. The total alkaloid content on 1 mg/l 2,4-D medium at the end of 30 days was almost equal to that of intact tubers. *In vivo* studies showed the maximum quantity of alkaloids in tubers (17 μg/100 mg of dry tissue) compared to leaves and stems. Hence, suspension cultures derived from tuber callus of sweet potato can be used further for commercial exploitation of these ergot alkaloids.

Low concentrations of KN and 6-benzylaminopurine (BAP) promoted the growth of the tissues considerably but higher concentrations decreased both fresh and dry weight of the tissues (table 2).