Table 1. Mean performance of pigeonpea hybrids, male parents, and checks grown at Hissar, Haryana, India in the 1981 rainy season.

Lines/hybrids	Days to 50% flower	Days to mature	100-seed weight (g)	Plant stand/m^2	Grain yield (kg/ha)	Percent of UPAS 120	Percent of male parent	Efficiency (kg/ha/day)
ICPL-4	70	117	6.5	12.7	1809	81		15.5
MS-Prabhat x ICPL-4	68	119	7.3	11.8	2287	103	126	19.2
ICPL-81	75	120	7.4	10.0	1896	85		15.8
MS-Prabhat x ICPL-81	80	128	7.6	10.4	2905	131	153	22.7
ICPL-87	80	140	11.1	7.9	2194	99		15.7
MS-T.21 x ICPL-87	95	140	7.9	11.6	3549	160	162	25.4
ICPL-161	88	141	9.2	10.2	2611	117		18.5
MS-Prabhat x ICPL-161	70	135	7.8	11.8	3900	175	149	28.9
T.21 (check)	95	145	7.0	12.5	2928	132		20.2
UPAS 120 (check)	80	123	7.3	12.3	2225	100		18.1
CD (5%)	0.34	3.2	0.6	7.9	296			
CV (%)	0.3	1.7	5.3	11.3	7.8			

seed yield per day of growth, were all more efficient than their male parents and generally ranked above the checks. The highest yielding hybrid, MS-Prabhat x ICP-161, was also the only one that matured significantly earlier than its male parent. It also showed the greatest efficiency.

All hybrids had good seed size, though two of them were significantly smaller seeded than their male parent.

The amount of hybrid vigor exhibited in this trial strongly suggests that early-maturing pigeonpea hybrids with high yield and good seed size can be successfully developed which can fit into the pigeonpea-wheat cropping system of northern India. More hybrids are being developed for testing using the same male-sterile lines and several more of our advanced breeding lines.

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Genetic Basis of Male Sterility in Pigeonpea

A new source of genetic male sterility characterized by brown, arrow-shaped anthers was identified at the University of Queensland. It was first identified in the line B15B which was derived as a selection from the cultivar Royes. To obtain preliminary information on the genetic basis of this male-sterile character, fertile plants from B15B and F_5 progenies of the cross (B15B x QPL-1) were grown.

Two or three fertile plants from each of 10 families were sampled at random. In addition, male-sterile plants identified in B15B were crossed with genetically related plants (fertile segregants within the progeny) and the cultivars Royes, 3D8103, and QPL-1.

Proportions of fertile and sterile plants within the progeny were used for genetic interpretations.

The F_1 plants of crosses between male-sterile plants and Royes, 3D8103, and QPL-1 were male fertile, while progeny of the cross to genetically related plants segregated seven male-sterile to nine male-fertile, which is a good fit to a 1:1 ratio ($P = 0.50-0.70$). From this evidence it is hypothesized that the genetically related

fertile plants were heterozygous, and the unrelated fertile plants were homozygous for the male-fertility gene, and that this male sterility was conditioned by a single recessive gene.

Segregation for sterility was observed in 25 progenies, and all plants were fertile in four progenies (Table 1). An among-progeny ratio of 2 segregating:1 nonsegregating as expected for a monogenic model, did not fit the present data, probably because of the small sample size (2-3 plants) within each family. A good fit to a 3 fertile:1 sterile ratio was indicated by the chi-square test in all but two of the segregating progenies. The reasons for the significant chi-square in progenies 12 and 499 are not clear. The test of heterogeneity (Table 1) indicated that these progenies could be pooled and the total obtained over all the segregating progenies agreed to the expected ratio of 3:1, confirming monogenic recessive control of this male-sterile source character.

Table 1. Segregation for male sterility in various single-plant progenies.

Progeny number	Number of plants			χ^2 Probability
	Total	Male sterile		
		Observed	Expected	
1	27	8	6.75	0.50-0.70
2	32	12	8.00	0.10-0.20
3	26	6	6.50	0.80-0.90
4	27	10	6.75	0.10-0.20
5	41	12	10.25	0.50-0.70
7	18	5	4.50	0.70-0.80
8	20	6	5.00	0.50-0.70
9	34	8	8.50	0.80-0.90
10	27	8	6.75	0.50-0.70
11	21	0		
12	30	13	7.50	0.02-0.05
13	20	0		
14	14	4	3.50	0.70-0.80
15	28	7	7.00	1.00
16	25	6	6.25	0.90-0.95
17	27	8	6.75	0.50-0.70
19	19	6	4.75	0.50-0.70
20	10	2	2.50	0.70-0.80
21	35	0		
22	26	6	6.50	0.80-0.90
23	30	9	7.50	0.50-0.70
24	22	5	5.50	0.80-0.90
25	23	3	5.75	0.10-0.20
26	31	7	7.75	0.80-0.90

Table 1 contd....

Progeny number	Number of plants			χ^2 Probability
	Total	Male sterile		
		Observed	Expected	
28	41	10	10.25	0.90-0.95
29	22	5	5.50	0.80-0.90
30	34	8	8.50	0.80-0.90
499	29	12	7.25	0.02-0.05
502	26	0		
Total	663	186	165.75	0.05-0.10
Heterogeneity (24 d.f.)				0.80-0.90

The allelic relationship between this source and the translucent-anther type male sterility was studied by crossing the B15B type male-sterile plants with a single-cross hybrid involving translucent-anther male sterility (MS-3A x QPL-1). All F_1 plants in this three-way cross were male fertile, suggesting that these two male-sterile conditions were determined by nonallelic genes. Due to unfavorable growing conditions, the F_1 plants did not produce enough seeds to grow large F_2 progenies to fit a digenic Mendelian ratio. However, in some progenies both translucent and B15B type male-sterile segregants were observed which suggested independent genetic control.

The limited data available from this study give a fairly good indication that (i) the new source of male sterility is conditioned by a single recessive gene, and (ii) is nonallelic to ms_1. The gene symbol ms_2 is proposed for this new source of male sterility.

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New Steriles in Early Pigeonpea

We identified three new sources of sterility at ICRISAT's Hissar station during 1981. This adds to the list of steriles already reported in the 1980 International Pigeonpea Newsletter.

1. New male-sterile source MS-41. In an F_3 progeny row from a single F_2 plant, from the cross Comp.1 ODT-2 x ICPL-86, 11 of 26 plants were found to be male sterile. Acetocarmine squashes of the anthers from the male-sterile plants showed a complete absence of pollen, whereas anthers from the fertile plants contained over 99% of normal pollen. Young androecium of this male sterile is characterized by small, whitish (translucent), nondehiscent anthers which become brown as the bud grows. Male-sterile plants set no pods when selfed but did produce pods when fertilized with pollen from fertile plants in the same progeny row and from ICPL-81 and ICPL-267. We have designated this male sterile as MS-41. The allelic relationship of MS-41 with other male-sterile sources is being studied.

2. A syngenesious male sterile. In the single-plant progeny ICPL-151-37 one plant with syngenesious-like anthers was identified late in the season. All 10 fully developed pale yellow anthers in flowers on this plant were tightly united into a tube surrounding the style with the filaments remaining free (Fig. 1). The stigma protruded above the bundle of anthers. The anthers were nondehiscent unless ruptured by a needle or forceps. During the growing season only one single-seeded pod was formed. This pod might have been the result of foreign pollen carried to the flower by an insect. No pod setting was observed on covering the inflorescences with a cloth bag even when the anthers were ruptured. However, pods were set when flowers on this plants were pollinated with pollen from ICPL-81 and ICPL-267. In acetocarmine squashes about 70 to 80% of the pollen appeared normal. This suggests that the male sterility in this plant may be because of nondehiscent anthers. This supposition is being tested along with an investigation of the stability of this character.

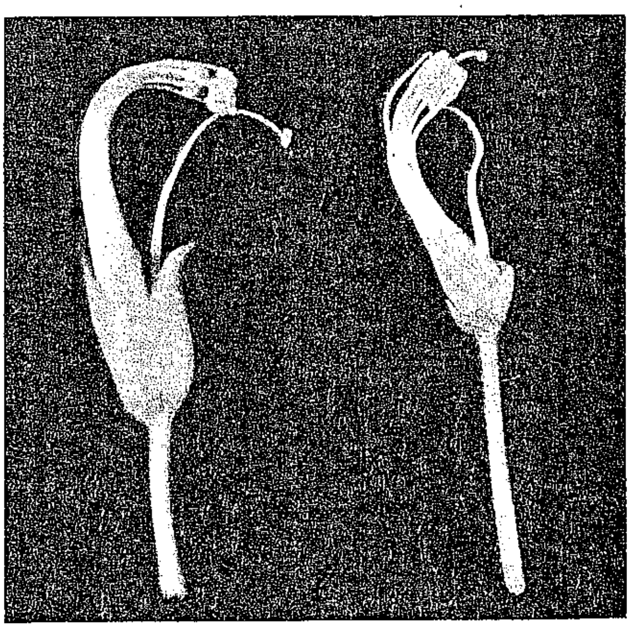

Figure 1. Comparison of normal pigeonpea anthers with the synagenesious-like male sterile of single-plant selection ICPL-151-37.

3. A complete sterile. One F_1 plant from the cross ICPL-81 x [(ICP-8504 x Prabhat) x ICPL-10-H30-HB] was found to be both male and female sterile. An acetocarmine squash of its scaly and translucent anthers showed a complete absence of pollen. No pod set was obtained either on selfing this plant or on pollinating with pollen from ICPL-81 and ICPL-267. Microscopic examination showed the ovaries to be devoid of ovules. This plant is of no practical use as it formed a dead end.

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Screening Pigeonpea Varieties for Intercropping

Pigeonpea is the major pulse crop in the Solapur region of Maharashtra, India. It is grown either as a pure crop or more frequently mixed with different crops. Our Station has recommended intercropping pigeonpea with pearl millet as an efficient cropping practice, based on our results with the pigeonpea variety No.148. This cultivar has given an LER value of 0.8 as an intercrop.

The study reported here was conducted to compare No.148 with other pigeonpea varieties under intercropping. Five pigeonpea cultivars were tested during the 1979 rainy season. The pearl millet and pigeonpea were planted in a 2:1 row proportion maintaining 150,000 pearl millet and 60,000 pigeonpea plants per ha; the sole pigeonpea was planted at 83,000 plants/ha. A randomized block design with four replications was used with a net plot size of 1.8 x 5.4 m.

When compared with other cultivars, BDN 1 produced the most branches per plant under sole cropping as well as in the intercropping system (Table 1). The variety T.21 on the