abnormality and designated it as *Bracteomania*. This sort of abnormality was also observed in a few pigeonpea plants of the above variety at the Pulses Research Sub-station, Junagadh, Gujarat State.

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Visual Selection for Yield in Pigeonpeas

We have found no reports of studies to determine the effectiveness of visual selection for yield in pigeonpeas. The obvious advantage to our breeding program of visually selecting high-yielding progeny, rather than harvesting, threshing and weighing all plots in order to identify high-yielding progeny, prompted us to determine in a preliminary study how accurately visual selections can be made.

At ICRISAT Center we planted in 3 replications 24 diverse breeding lines of known high, medium, and low yield potential. They were all medium-maturing (150-180 days). Plots consisted of eight rows 5 m long, spaced 75 cm apart. Each replication was planted on 8 July 1980 in a different area of the Center. Visual selection was made at maturity after the end plant of each row had been removed. Volunteers were asked to select visually (a) the top four, (b) the next four, and (c) the bottom four yielding plots within each replication. Group *a* provided a selection pressure of 17%, and *a+b*, 33%. The selectors consisted of four groups-professional pigeonpea breeders from four countries, pigeonpea scientists who were not breeders, pigeonpea technicians, and laborers working for the Pulses Program.

An analysis of variance indicated that there was no significant difference in actual yield among entries because of the high coefficient of variation. In addition, the mean yield of the three replications differed greatly (Table 4). Therefore, for analyzing the selection test, each replication has been treated separately.

The actual mean yield of the four top-, the eight top-, and four bottom-yielding plots in each replication was compared with the actual mean yield of the plots chosen by the observers. When averaged across three replications these indicated that the yield deviation at the lower selection pressure (top eight) was lower than that at the higher pressure (top four), and that the mean yield deviation from the low-yielding plots was greater than that from the high-yielding plots (bottom line of Table 5).

It is not surprising that the yield deviation from the mean yield was least for the Technical Assistants as they are in direct contact with similar material (Table 5). However, it was surprising that the non-breeder group was somewhat better than the breeders. A statistical analysis is being made on these data to determine the reliability of the differences observed.

It was interesting to note that some plots were much more frequently chosen than others, even though their yield was as much as 20% lower. This suggests that good visual characterization of the plots would have provided information about what was perceived by the selectors to confer yield.

Table 4. Mean and range of plot yields of pigeonpeas in three yield classes in three replications at ICRISAT Center in December 1980 (data in kg/ha).

Replication	Top 4 plots		Top 8 plots		Bottom 4 plots		Overall
	Mean	Range	Mean	Range	Mean	Range	mean
1	718	619- 933	622	457- 933	80	24-143	381
2	1291	1143-1419	1173	933-1419	397	310-476	800
3	1097	1010-1224	999	757-1224	442	314-524	734
Mean	1035		931		306		638

Table 5. Yield deviation of visual selections from actual mean yield across three replications made by four groups of selectors at three selection intensities at ICRISAT Center in December 1980 (data in kg/ha).

Group of selectors	*n*	Top 4 selected		Top 8 selected		Bottom 4 selected	
		Mean	Range	Mean	Range	Mean	Range
Breeders	13	84	8-145	68	20-120	70	38-119
Nonbreeders	9	76	35-162	53	28-107	70	38-121
Technical Assistants	6	41	11- 57	31	5- 82	73	38-126
Laborers	7	96	52-156	84	50-113	77	40-127
Mean		70	8-162	60	5-120	75	38-127

In general, with the relatively small number of plots involved in this test, it appears that some observers can select, quite precisely, the highest yielding plots. For example, one volunteer chose 11 of the possible 12 highest yielding plots at the 17% selection pressure and deviated only 8 kg/ha from the mean of 1035 kg/ha. It should be noted that the yield level of this test was quite low and that similar tests at different yield levels are required before any general conclusions can be drawn about the reliability of visually selecting for yield in pigeonpeas. This study is continuing to determine the accuracy of visual selection for yield in pigeonpea under a range of environmental conditions.

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Improving Protein Quality in Pigeonpea Through the Use of Wild Relatives

Protein quality of a legume is basically determined by its protein content and amino acid composition. At ICRISAT we have a program designed to increase protein levels and raise levels of limiting amino acids in pigeonpeas. The sulphur amino acids, methionine and cystine followed by tryptophan, are the limiting essential amino acids of pigeonpea.

As a first step to improving the protein quality of pigeonpea we have analyzed several thousand pigeonpea germplasm accessions and a few *Atylosia* species for their grain protein content. Some of the *Atylosia* species, which are putative progenitors of pigeonpea, were found to contain higher protein content than cultivated pigeonpea.

With this material a systematic attempt is being made to assess the usefulness of *Atylosia* species for upgrading protein quality of cultivated pigeonpeas. For this purpose crosses have been made between different *Atylosia* species and standard pigeonpea cultivars. The seed protein content of the pigeonpea cultivars, *Atylosia* spp and their hybrids and derivatives, has been determined using a Technicon auto analyzer (Table 6). The protein content in the F_1s of all the six intergeneric crosses was close to the high parent, indicating that high-protein content is a dominant character. The F_2 distribution for protein content in crosses involving the pigeonpea cultivars ICP-6997 and Pant A-2 with *Atylosia albicans* indicated that protein inheritance is quantitative.

The amino acid composition of pigeonpea cultivars, *Atylosia* spp, and their derivatives has also been analyzed with the help of a Beckman Model 120C amino acid analyzer. No difference in the amino acid profiles among the *Atylosia* species and pigeonpea were observed. Fortunately, the F_6 results repor-