Selection of Plant Type for Resistance to Water Logging in Pigeonpea

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In India pigeonpea occupies an area of 3.2 m ha and produces 2.7 m t annually at an average yield of 829 kg/ha (1984 85). The main constraints in pulse production are pests and diseases, plus susceptibility to drought, water logging and salinity. Pigeonpea is highly susceptible to water logging, which occurs in India as a result of rain for a week or more in the monsoon season during August and September. To stabilise productivity in areas where water logging is a problem it is necessary to develop suitable genotypes. Little selection for water logging tolerance has occurred in pigeonpea.

In breeding crop varieties for stress environments, Blum (1985) emphasised development of screening techniques for tolerance to major stresses such as drought, salinity, heat and freezing. Dodds et al. (1982) emphasised physiological aspects of water logging resistance in *Vicia faba*. Singh and Shrivastava (1976) studied the various plant types of pigeonpea grown under different agroecological situations.

One hundred and twenty genotypes were screened for water logging tolerance under field conditions during kharif 1983-84. Forty-three genotypes performed relatively better. During 1984-85 kharif these 43 genotypes were tested in a replicated trial under artificial flooding, created for 24 hours at 35 and 60 days after sowing. The genotypes were classified into four groups on the basis of plant type. Survival, plant height, width and plot yield were recorded.

TABLE 1. Effect of water logging on different plant types in pigeonpea.

Plant type	No. of genotypes		Plant height (m)	Width (cm)	Seed yield (t/ha)
	Tested	Survived			
A. Tall, compact	5	2	1.6-2.0	60	0.6-3.3
B. Tall, spreading	26	14	1.6-2.1	120	1.0-3.2
C. Short, compact	2	1	1.3	40	1.2
D. Short, spreading	12	10	1.2-1.5	80	1.4-3.09

Among the 43 genotypes tested only 27 survived until harvest. Data on seed yield were analysed after log transformation as some of the plot yields were zero due to the incidence of wilt (*Fusarium udum*) at a later stage of plant growth.

All the surviving genotypes matured in 240-260 days. Highest seed yield of 3.3 t/ha was obtained by PDA(WL) 85-2, followed by 3.2 t/ha for PDA(WL) 85-6. The former is tall and compact in growth and the latter is tall and spreading. Other water logging tolerant genotypes were also evident in the short spreading group. PDA(WL) 85-8, developed from cross ICP 4213XT.17, yielded 3.0 t/ha. The promising lines selected from this study are under test at four different locations.

Blum, A. 1985. Critical Reviews in Plant Sciences, 2, 199-238.
Dodds, J.H. et al. 1982. Plant Growth Regulation, 1, 203-207.
Singh, L. and Shrivastava, M.P. 1976. Indian Journal of Genetics, 36, 293-300.

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The Promise of High Protein Pigeonpea

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Results obtained from progeny of intergeneric crosses made at ICRISAT between *Cajanus cajan* and *Atylosia* spp. indicate that it is possible to produce pigeonpea cultivars with protein as much as 40% higher than that in existing cultivars (Table 1).

TABLE 1. Percent protein of high protein lines compared to the nearest control cv C 11 at ICRISAT Centre. (Protein determined on dehulled seed).

Line	100-seed mass (g)	1981	1982	1983	Mean	% increase over control
HPL 7	10.0	29.3 (21.5)[1]	29.5 (23.4)	28.0 (23.7)	28.9 (22.9)	26.2
HPL 19	8.8	27.8 (20.8)	32.7 (22.1)	28.9 (23.8)	29.8 (22.2)	34.2
HPL 29	6.4	27.6 (20.8)	32.2 (22.3)	33.0 (23.6)	30.9 (22.2)	39.2

[1] Figures in parentheses represent percent protein of the nearest control plot.

Although the full potential of this material is yet to be exploited, preliminary yield trials suggest that it will be possible to identify high protein lines with performance and seed size similar to existing adapted cultivars (Table 2)

TABLE 2. Performance of a high protein line derived from a *Cajanus cajan* × *Atylosia albicans* cross (From high-protein yield trial 1985).

	Days to maturity	100-seed mass (g)	Grain yield (kg/ha)	Protein (%)	Protein (kg/ha)
HPL 40-5	169	9.6	2100	26.9	565
BDN 1 (control)	168	9.6	2020	23.2	465
SE	0.9	0.18	181	0.46	46.6
Mean (n = 25)	170	9.1	1809	26.3	475
CV %	0.9	3.4	17.3	3.0	17.0

These results have important implications, particularly in countries of tropical Asia such as Thailand and Indonesia which spend foreign currency to import soybean as a protein supplement for animal feed. Pigeonpea can produce a good crop in these countries where soybean is unadapted. Feeding trials show that pigeonpea can substitute for much of the soybean in pig (Visitpanich et al. 1985) and poultry (R. Elliot, pers. comm.) rations. Pigeonpea can also replace soybean in fermented human food products such as tempeh and tofu (F.S. Wallis, pers. comm.). High protein pigeonpea also can improve the human diet where pigeonpea is already grown and used, as the protein quality, measured by the proportion of sulfur bearing amino acids, is similar in *Atylosia* spp., high protein derived lines, and normal cultivars.

Research at ICRISAT has also shown that environment has a marked effect on protein percent although environmental factors influencing these differences have yet to be identified. In these experiments if the mean square for either genotypes (g) or environment (e) is high, that for their interaction is relatively low. This suggests that substantive differences among genotypes in protein percent can be consistently identified.

The protein content in the pigeonpea germplasm collection at ICRISAT over years ranged from 12.4 to 29.5%. In the *Atylosia* spp. used in crosses the protein content was 28.7% (*A. albicans*), 29.2% (*A. cajanifolia*) and 32.6% (*A. lineata*).

A high protein male sterile line has been identified at ICRISAT. This may be important if high protein hybrids are to be produced as results at ICRISAT suggest that there is a strong maternal effect on protein level.

Finally, the high protein pigeonpea lines so far identified are all of mid-duration. Crosses have been made to breed short-duration lines with a high protein level.

Visitpanich, T., Batterham, E.S. and Norton, B.W. 1985. Aust. J. Agric. Res., 36, 327-345.

Food Legumes for the Calcareous Soils of Nusa Tenggara Timur, Indonesia

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Food legumes are an important component of the cropping system in much of Timor: the most widely grown, mungbean and groundnut, are used for cash and local consumption, while pigeonpea, cowpea and ricebean are grown mainly to supplement the maize-based diet. However, the soils of Timor, which have been developed from limestone-rich marine materials, and are highly calcareous (pH 7.5-8.5), present a major constraint to food legume production.

The main problem is induced iron chlorosis, the severity of which varies, among species, in the order: groundnut > mungbean > cowpea > ricebean > soybean > pigeonpea.