

PULSES

The pulse crops in general give lower yields than the cereals. Pulses are rich in protein and it takes more energy weight for weight to synthesise protein than carbohydrates. When you compare the energy requirement of various metabolic pathways. one gram of glucose can give rise to 0.8g of carbohydrate but on an average only about 0.5 g protein and even less of oil.

Further maintenance of nitrogen fixation in roots require prolonged use of photosynthate and thus may reduce the energy available for storage in seeds. Other reasons for low yield are

1. Raised in submarginal lands.
2. Indeterminate growth habit.
3. Irregular flowering
4. Photosensitivity.

The protein from pulses are incomplete. Legumes are good source of lysine, tryptophan and threonine but are low in sulphur containing amino acids *methionine*, *cystine* and *cysteine* which are adequate in cereals. So a mixture of cereals and pulses are recommended for food. Many grain legumes contain toxic inhibitors which are removed while cooking.

RED GRAM

**Arhar, Tur
Pigeon pea**

Cajanus cajan (2n = 22)

Place of origin : Africa / Asia

Wild Species : *Cajanus kerstingii*

Related crossable genera : Rhynchosia

Putative parent :

The view is that cultivated *cajanus* arose from *Atylosia*. *Atylosia lineata* may be the progenitor of *cajanus*. In Western ghats *A.lineata* and *A.sericea* are known to local people as 'barn tur' (wild tur) so also in West Bengal and orissa *A.scaraboides* and *A.cajanifolia* are known as wild tur. The genus *Atylosia* has now been included in *Cajanus*.

Two botanically distinct varieties were described. *Cajanus cajan* var. *bicolor* (*Arhar*) perennial, late maturing, large bushy plant bearing purple streaked yellow flower. The pods are dark purple mostly cultivated in North India. *Cajanus cajan* var. *flavus* (Tur) short duration early maturing. Color of standard petal yellow. Pods green, glabrous cultivated in South India.

But the above classification is no longer valid because there are number of intermediate forms and it is hard to differentiate the varieties because of often cross pollination nature of the crop.

Breeding objectives :

1. Evolution of long duration high yielding variety suitable for rainfed to replace the local land races :

SA1 - Released during 1940

Co6 - result of mutation breeding

2. To evolve short duration (105 days) varieties suitable for irrigated / mixed crop with ground nut.

ICPL 87 - ICRISAT

Vamban 1 - 110 days.

3. Breeding for bold grain type with desirable seed coat color

HY 3C long duration variety with dull white seed coat and bold grains.

4. Breeding for vegetable type

Hosur area - Green pods with bold seeds are used as substitute for green peas. Perennial types like Attapadi local are used. BSRI is a perennial red gram whose green pods are used as vegetable.

5. Breeding for resistance to pests.

Heliothis is the major pest, Terminal cluster types are highly susceptible. All our varieties are highly susceptible.

6. Breeding for disease resistance :

Sterility mosaic, root rot, blight are important diseases. Wild species *Cajanus scaraboides*, *C.lineata* are having resistance.

7. Breeding for high protein content and quality

Mean protein content 23%. The wild species have 27% to 29%

Red seed coat contains more polyphenol (Tannin) than white seed coat. So preference is towards white seed coat. Red grain contains lesser amount of sulphur containing amino acid. When we increase protein content there will be lesser amount of these amino acids. So care is to be taken to increase them.

8. Breeding high yielding perennial redgram suitable for bund cropping

BSR 1, Attapadi selections

Breeding methods :

1. Introduction :

E.g. Prabhat short duration variety from IARI, ICPL 87 from ICRISAT.

2. Pure line selection

Earlier breeding work was based on the assumption that Redgram is a self pollinated crop. However it was later found to be often cross pollinated crop. SAI is a pure line selection from Tirupathur local.

3. Hybridization and selection :

Inter varietal : VBN 1 (Prabath x NY 34) (T.12 x 102)

Inter generic : *C.cajanus* x *Cajanus lineata*

C.cajanus x *C.scaraboides* are being attempted

4. Mass selection :

5. Population improvement :

Using male sterile line and recurrent selection methods.

Two populations are used, one is seed parent and the other is pollen parent. The seed parent must have one or two easily identifiable recessive character and the pollen parent more dominant genes. The seed and pollen parents are sown in alternate rows so as to maximize natural cross pollination.

The F₁'s and selfed ones are identified in, So generation. The identified F₁s are space planted in the next generation S₁. In S₂ generation they are yield tested in 3 environments and best ones are either recycled or taken to conventional breeding programme.

6. Mutation breeding

Co2 - Chemical mutagenesis EMS.

Co5 - Mutant of Co 1 gamma rays.

Co6 - Mutant of SA 1 gamma rays.

7. Heterosis breeding

Ms T 21 x ICPL 87109	CoRH 1
Ms Co 5 x ICPL 83027	CoRH 2

Red gram Ideal plant type - long duration :

The genotype that have steady rate of growth and have a moderate harvest index.
 High seed weight
 Long pods
 Increased number of pod bearing branches.

Short duration :

Dwarf in nature with erect branches having high dry matter production
 High seed wt.
 Long pods.
 Increased no of seeds / Pod
 Less flower drop.

RED GRAM VARIETIES FOR TAMIL NADU

Varieties

Varieties	Parentage	Duration
SA 1	Pureline selection from Thirupattur local	160-180
Co 3	Mutant of Co1	90-95
Co 4	Pure line selection from gene pool	90-95
Co5	Mutant of Co 1	100-110
Co6	Mutant of SA 1	160-180
Vamban 1	(Prabath x NY 34) (T12 x 102)	95-100
APK 1	PLS from ICPL 87101	95-105
VBN2	ICPL 341 x BSR local	170-185

Hybrids

CoRH 1	Ms T 21 x ICPL 87109	110
CoRH 2	Ms Co 5 x ICPL 83027	110

Hybrid Seed Production of CoRH. 1 Pigeonpea

In the exploitation of hybrid vigour for commercial cultivation, efficient production of hybrid seed is essential for which a full knowledge of the various steps involved in hybrid seed production is necessary to achieve the twin objectives of maximizing the hybrid seed production and improvement in quality of hybrid seed.

For hybrid seed production, a ratio of 4:1 of male sterile pollen parent is adopted. Sufficient isolation distance i.e., more than 200 metres for the hybrid seed production plot is needed. There should not be any pigeonpea crop within a radius of 200 metres from the seed production plot. Since the male sterility is maintained in heterozygous state following the test cross principle, there would be fertile and sterile plants in the ratio 1:1 in the male sterile population. It is therefore imperative to remove the male fertile plants in the male sterile population before flower opening. The roguing should be done thoroughly to avoid contamination by the pollen from any left out fertile plants.

Steps involved in hybrid seed production

1. Selection of site

- (i) Fertile field with an irrigation source
- (ii) Previous crop should not be pigeonpea
- (iii) Isolation distance of 200m from any other variety of pigeonpea.

2. Fertilizer

- (i) Farm yard manure @ 20 cart loads per hectare
- (ii) 25 Kg N + 50 Kg of P as basal application

3. Sowing

- (i) The female and male parents are sown in the ratio of 4:1 with two border rows of pollinator parent.
- (ii) The pollen parent (ICPL 87109) should be sown one week after sowing the female parent (MS T.21).
- (iii) Row spacing of 45 cm.
- (iv) Plant to plant spacing should be 15 cm.
- (v) Dibble 2-3 seeds per hill for the female parent
- (vi) Seed rate (per hectare) for 4:1 ratio 40 Kg of female parent, 5 kg of male parent.
- (vii) Sowing should be done during first fortnight of June or first fortnight of December.
- (viii) The whole plot should be bordered with sunflower to increase the bee activity to effect cross pollination.

4. Irrigation

- (i) First irrigation after sowing and a life irrigation 2-3 days after sowing.
- (ii) irrigate the plot at 7-10 days interval depending upon the moisture in the field

5. Rogueing

- (a) Male sterile line or female parent :

- (i) Remove the off type plants
 - (ii) Remove the male fertile plants by examining the colour of the anthers (yellow) at the time of first flower formation, one-day before flower opening.
 - (iii) Rogueing should be completed in 7-10 days time
 - (iv) Remove the late flowering plants also.
- (b) Male fertile line or pollen parent :
- (i) Rogue out off types.
 - (ii) Remove the immature pods set in the plants from time to time to induce continuous flowering and to ensure pollen availability for a longer period.

6. Harvesting

Collect the pods from the female parent i.e., male sterile parent. This will give the hybrid seeds.

Production and maintenance of male sterile line

Genetic male sterility is utilized in hybrid seed production. In case of pigeonpea, the male sterile line will segregate in 1:1 ratio of fertile to sterile. For the maintenance of the male sterile population (to be raised under isolation), the male sterile plants have to be identified and tagged and the fertile plants have to be retained without tagging. The male sterile lines will be pollinated naturally by the pollen from the male fertile plants in the population through insect pollinators. After maturity, the seeds from the tagged male sterile plants are collected and will be used for producing male sterile lines again or for producing hybrid seeds.

The main difference between the hybrid seed production and the male sterile line maintenance is, during hybrid seed production the male fertile plants from the male sterile population are to be rogued off, while they are retained during male sterile line maintenance.