Pulses and International Research

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Pulses constitute the main source of vegetable proteins, particularly in the developing countries like India. The shortage of pulses and their alarmingly high prices; have put them out of reach of the poor people in India. The factors responsible for the shortage and low production are :

(i) Poorman's crop, grown on poor soils, untouched by modern technology and confined to traditional subsistance farming situation.

(ii) Cultivation of pulses as catch crops (moong), intercrops (pigeonpea) as bonus crops, rather than main crops, which leads to all the neglect and inadequate use of inputs and poor management in their cultivation.

(iii) Lack of a breakthrough in pulse production technology which could make them highly competitive and remunerative.

(iv) Seriousness of diseases and pests.

(v) Losses in storage and unsatisfactory post-harvest technology.

(vi) Shift in the cultivation of pulses to the marginal lands.

(vii) Green revolution or wheat revolution which has pushed the pulses like gram (chickpea) out of cultivation in the wheat growing areas of north India.

(viii) Dependance of pulses on rainfed farming and dryfarming technology.

(ix) Slight decline in area.

(x) Absence of possible areas of surplus production of pulses outside the country for import, if required.

The complimentary role of pulses in human nutrition is well known but unfortunately they have received least attention by the agricultural scientists and are grown with traditional technology and under poor conditions of management. In fact, they have suffered from neglect on all accounts. World average yields of the main pulses are of the order of 0·5 ton per hectare compared with 2.8, 2.5 and 1.7 tons per hectare of maize, rice, and wheat respectively and so far no high yielding varieties of pulses, responsive to fertilizers are available.

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Recognizing the neglect from which the pulses have suffered in the past and the widening gap of protein in the nutriton of human beings, particularly, in the developing countries, international agricultural research organisations have started paying attension to some of these crops. Out of the International Agricultural Research Centres (IARC), ICRISAT has taken up research on pigeonpeas and chickpea, ICARDA on lentils and broad beans, IITA on cow peas, CIAT on dry beans and AVRDC on moong beans. The pulse improvement programs of tne international Agricultural Research Centres (IARC) are established primarily to serve the national breeding programs through (i) assembling, classifying, maintaining and distributing germplasm, (ii) developing and supplying breeding populations with sufficient diversity for use in different environments, (iii) coordinating international trials to facilitate multilocation testing, (iv) conducting workshops for breeders and providing training, (v) maintaining close liaison with national programs through personal visits and distributing newsletters, reports and other information, and (vi) strengthening cooperative programs by providing staff and support.

It is necessary to develop cultivars with high yield potential, disease resistance and superior nutritional characteristics.

The position of germplasm resources in various IARC and the production statistics of important pulses are given in Table I.

TABLE I

Common Name	Scientific Name	International Centre	Approx. production (met. tons)		Approx. No. of accessions	
			World	Tropics	1976	1986 (est.)
PHASEOLEAE						
Dry beans	Phaseolus species	CIAT	11.7	5.5	13000	28000
Cowpeas	Vigna unguiculata	IITA	2.0	1.7	9000	20000
Pigeonpeas	Cajanus cajan	ICRISAT	2.3	2.3	7000	16000
Mung beans	Vigna radiata var. aureus	AVRDC	1.5	1.3	3000	9000
VICIEAE						
Chickpeas	Cicer arietinum	ICRISAT	6.7	5.7	10600	20000
Broad beans	Vicia faba	ICARDA	5.2	0.5	1000	4000
Lentils	Lens culinaris	ICARDA	1.1	0.5	2500	6000
Dry peas	Pisum sativum	...	11.0	1.2	...	...

Source : National Standards and Methods of Evaluation for Food Legume Breeders, IDRC TS 7e,
Hulse, J. H., Rachie, K. O., and Bilingsley. L. W.

Status of Research

Out of the above mentioned 8 pulses, chickpea and pigeonpea are the most important pulse crops of the semi-arid tropics, particularly, of India. Nearly 91 per cent of the pigeonpea and 75 per cent of the chickpeas are produced in this country. The yields of both these crops are very low. The research on these crops has been started in ICRISAT from 1973. The Indian program of coordinated research on pulses is also giving these crops due importance.

Pigeonpeas

ICRISAT has collected about 7000 lines of germplasm most of which came from the Indian sources. Wild relatives including *Atylosia* spp. and other members of the tribe Phaseoleae subtribe *Cajanus cajan* are included in the collection. We have isolated from the germplasm genetic male sterility and numerous lines resistant to sterility mosaic disease. A few hybrids have also been made, which seem to offer considerable promise. The yield increases over the parents in the order of about 40 per cent. Planting of pigeonpeas as a Rabi crop in South Indian situation seems to be very promising. Even the long duration varieties when planted in Rabi season at Hyderabad matured in 4.5 months and gave 1700 kg. yield.

Lines resistant to water logging, salinity, tronchlorosis, sterility mosaic and wilt have been identified and are being used extensively in breeding program.

Screening for pod borer resistance has been started and some intergeneric crosses with *Atylosia* are found resistant to this pest.

The breeding work on early maturity lines had advanced the lines to F_7 generation and some of the promising lines out of this program have already been given to the co-operators for evaluation and use in their program. The work on medium duration varieties is intensified at Hyderabad, long duration ones at Gwalior and short duration and early maturing ones at Hissar.

Possible vegetable type pigeonpeas are also available. Intensive breeding work on the lines suited for vegetable purposes is being done.

Cropping systems involving pigeonpea as an intercrop are being studied and in fact, intercropping is being used as a selection pressure for identifying the lines which are more compatible with this system. It hardly needs to be emphasised that most of pigeonpea in India is grown in intercropping situation and rarely as a pure crop.

Vigorous studies on nitrogen fixation by pigeonpea are also being made.

Wilt survey done in collaboration with Indian scientists in pigeonpea growing states in India shows that on an average 22.6, 5.3, 1.4, and 1.1 per cent was the occurrence of the disease in Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka respectively. The sterility mosaic was 12.8 per cent in Tamil Nadu and 9.8 per cent in Karnataka.

Chickpea

About 11000 accessions are available in ICRISAT Germplasm Bank. It also includes the wild species. Further collection program is in progress.

Screening of the germplasm for resistance to Fusarium, wilt, chickpea stunt and other diseases is in progress.

Crossing work for developing genotypes with high yield potential is proceeding very vigorously. Material emerging from this program in F5, F6 generation has been distributed to co-operators for testing on an international scale. In the Indian test some of the early maturing varieties have shown 40 to 136 per cent increase in yield of best bulk over the local check while in late maturing ones the increase ranges between 26 to 330 per cent.

Crosses between tall Russian varieties and dwarf varieties and Kabuli × Desi varieties have also been attempted to produce better varieties. Very intensive work on nitrogen fixation, disease resistance and fertiliser responsiveness has been taken up.

Screening of the material for protein and essential aminoacids has been in progress for the last few years. An effort is being made to identify genotypes with higher content of of sulphur containing amino acids.

It is observed that poor standard of crops is responsible for poor yields of chickpea on farmers' fields. The agronomic practices for improving the standard are being studied.

Research Work on Pulses in other International Centres

As mentioned in earlier part, IITA is working on cowpeas, CIAT on dry beans, AVRDC on moong beans and ICARDA on lentils. A number of promising varieties of cowpeas, moong beans and dry beans were developed by these Institutes and have already entered the international testing program. So far as research on lentils is concerned, it is in too early a stage.

Human Nutrition and Pulses

Pulses are the most important source of protein, particularly for the vegetarians, majority of whom live in the developing countries. They are rich in lysine and thus can compensate for its deficiency in cereals. They are deficient in sulphur bearing aminoacids. It is also observed that the protein as well as amino acid content and amino acid profile

changes considerably with the soil and climatic factors under which the crop is grown. There are also significant varietal differences in their protein and amino acid profile, but the environmental factors produce much more marked effect.

ICRISAT scientists have observed that the range of protein in chickpea is 14.3 to 30.9 and in pigeonpea 16.3 to 24.9.

There are also significant differences in the cooking quality of the various varieties. The environment also affect these characteristics.

Place of Pulses in the Inter-Cropping System

Pulses are the most important components of the intercropping systems. In fact for dry land farmer they provide an excellent mechanism for successful exploitation of environments. Pigeonpea + Sorghum, Pigeonpea + maize, Pigeonpea + Groundnut are very common inter-crops. Moong bean also fits in admirably well in cropping systems in arid and semi-arid regions. Even in the humid tropics of the South-east Asia moong bean is the most important pulse crop. All the international institutes have very significant researches on intercropping systems based on the use of pulses. There is significant evidence available in ICRISAT indicating the beneficial effect of the intercropping system based on pigeonpea. It improves not only the economics, but the efficiency for utilisation of environmental factors such as land, water, light, etc.

Conclusions

It is realised that there is acute shortage of pulses in the developing countries, but a breakthrough in production will result from the scientific research on these crops which have been neglected in the past. It calls for sustaining co-operative efferts of scientists working in the national, regional and international research institutes. Foundations for such a co-operative program with international links have been laid in the last decade.