

Present Status and Future Perspectives of *Glycine* and *Vigna* in India

Pandiyan M., N. Senthil, N. Ramamoorthi and S. K. Ganesh

Tamil Nadu Agricultural University

Vamban- 622 303

Pudukkottai, Tamil Nadu, INDIA.

Scenario in India

India is the second most populous country. Indians are self sufficient in major food crops thanks to green revolution in wheat and rice. Pulses are the second most important group of crops after cereals. Globally more than two dozen pulse crops are grown. Area under pulses in the world is 73.2 million ha with a production of 61.72 million tons and average productivity is 843 kg/ha. In India, the area under pulses is 23.81 million ha with a production of 15.11 million tons and average productivity is 635 kg/ha. India is the largest producer with 33% of the global area and 25% of the world's production. Pulses are relatively more important in the Indian diet than that in Asia and the world as a whole. Soybean is known as "Golden Bean" because it contains 40% good quality protein and 20% oil rich in polyunsaturated fatty acids along with minerals (Ca, P, Mg, Fe and K) and vitamins specially the B-complex and tocopherols. Additionally, it provides phyto-chemicals in high amounts, which help to protect the human body against cancer, particularly hormonal based cancers.

I) *Vigna* species

Vigna species play a vital role in sustainable pulses production in Indian Agriculture. *Vigna* species account for 31 per cent of the pulse production. Cultivated *Vigna* species are the major sources of dietary protein in the diet of vegetarians. Because of their short time to maturity, *Vigna* species show great promise for intensification in irrigated and rainfed areas. Besides being a rich sources of protein, they maintain soil fertility through biological nitrogen fixation.

During the green revolution, per capita availability of pulses was 69 g/person / day in 1961 by 2005 it was reduced to 36 g/person /day. In India, ICMR recommend the per capita availability of pulses to be 50 g/person/day at present. To alleviate protein-energy malnutrition, a minimum of 50 g pulses/capita/day should be made available in

addition to other sources of protein such as cereals, milk, meat, eggs etc. To make up this shortfall in supply besides, of course, further demand for the increasing population, at least 20 million tons of pulses are required by 2015 which is expected to touch 25 million tons by 2015 and 30 million tons by 2020. This can be realized only by adopting increasingly more productive technologies along with favourable developmental policies. ***There is an urgent need for a technology mission for boosting the production of pulses and legumes. This is a neglected area and should now be a priority.***

India is implementing three major schemes for pulses improvement viz., chickpea, pigeon pea and MULLaRP. MULLaRP - ICAR scheme comprises of six crops namely mungbean, urd bean, lentil, lathyrus, rajmash and peas. The mungbean and urdbean are the most important pulse crops of India cultivated over a wide range of agro climatic zones. These crops are grown in all the seasons as pure crop, intercrop, bund crop and relay crop.

The major mungbean growing states of the country are Maharashtra, Andhra Pradesh, Rajasthan, Orissa, Bihar and Tamil Nadu. A phenomenal increase in area, production and productivity of mungbean has occurred since 1964-65. This area has increased from 1.9 million ha in 1964-65 to 4.16 million ha in 2007-08. The production has increased from 0.60 million tons to 1.32 million tones during the same period. The increased area was due to development of relatively photo and thermo insensitive varieties which allowed a great flexibility in their planting dates. Later, short duration varieties were developed which could fit well in a wide range of intensive cropping systems. The increase in area and production has been observed in the states of Gujarat, Maharashtra, Rajasthan and Karnataka due to availability of short duration and yellow mosaic virus resistant varieties.

Urd bean is grown in Maharashtra, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Tamil

Nadu, Rajasthan and Karnataka. The total area under the crop has increased progressively from 1.98 million ha in 1964-65 to 3.20 million ha in 2007-2008. Similarly, the production has increased from 0.64 million tones to 1.39 million tones. The increase in area and production has been observed in the states of Andhra Pradesh, Karnataka, Maharashtra, Rajasthan, Uttar Pradesh and Tamil Nadu. In northern states, the upward trend in area and production resulted due to adoption of high yielding short duration varieties with resistant to yellow mosaic virus. There is tremendous potential for expansion of mungbean and urd bean.

Among pulses, mungbean area under cultivation is 4.16 million ha with a production of 1.32 million tons and the average productivity is 379 kg/ha. Urd bean area under cultivation is 3.20 million ha with a production of 1.39 million tons and average productivity is 444 kg/ha which is 30 per cent area covered by these two crops in pulses.

In recent years, their expansion in new niches such as in rice fallows of Tamil Nadu, Andhra Pradesh and Orissa has been remarkable.

Soybean

Soybean is the foremost oilseed pulse crop of the world. The seeds are rich in both oil (16-21%) and protein (36-42). The advent of commercial exploitation of soybean in India is nearly four decades old. In this short spell of time, the crop has shown unparallel growth in area and production. Till 1998-99, the crop has shown an average simple growth rate of 14-15 percent per annum. After 1998-99, although the area remained close to 6 million hectares till 2003-04, the production and productivity showed fluctuations on account of drought except during 2003 and 2004 of normal rain spells. The growth in area and production further picked up from 2004-05 onwards. During 2006-07, it is estimated that the crop was planted in 8.18 million ha with the production of 8 million tons. India is the second largest importer of edible oil in the world. The supplementation of soybean oil has helped greatly in curtailing the expenditure on import. Moreover, the crop plays an important role in national economy by way of earning foreign money to the tune of approximately 33,000 million rupees (about 733 million US\$). During 206-07, it has touched all time high figuring export value of 44,000 million rupees (about 977 million US\$).

Strategies for Increasing *Vigna* Production and

Research

The following are the reasons for the low productivity level of *Vigna* species:

- » Lack of high yielding varieties adapted to diverse growing conditions
- » Large area under rainfed cultivation (88%)
- » Biotic and abiotic stresses (up to 30% losses)
- » Poor plant stand
- » Poor response to high input conditions and better management
- » Moisture stress at terminal growth stage
- » Inadequate seed replacement rate
- » Emerging deficiencies of secondary and micro-nutrients
- » Low risk bearing capacity
- » Resource poor farmers
- » Farmers' reluctance and lack of knowledge about improved mungbean and urd bean varieties and seed storage methods
- » Susceptibility of *Vigna* crops to pest and diseases (pod borers, wilt, mosaic, yellow mosaic virus)
- » Inadequate technology transfer efforts

To make India pulse sufficient, the productivity level of pulses has to increase substantially from the present level. This requires a proactive strategy from researchers, planners, policy makers, extension workers, market forces and farmers aiming not only at boosting the per unit productivity of land but also reduction in the production costs.

The following approaches require immediate attention, which can have substantial bearing on the pulse production without further constraining natural resources.

- » Genetic options
- » Management options
- » Developmental efforts

Genetic options

Improved plant type

Physiologically more efficient plant types are essential for breaking the yield barrier in pulses for higher productivity. Systematic and concerted research efforts over the years have resulted in significant improvement in cultivated *Vigna* species such as wider adaptability, yield stability, increased yield, early maturity, tolerance to biotic and abiotic stresses and market specific characteristics like seed size and colour. The All India Coordinated Pulses Improvement Project (AICPIP) has played a key role in organizing and guiding strategic and adaptive research

through a national network. Focused programmes on breeding and refinement of production and protection technologies have resulted in a profound effect on crop productivity. Nationally about 450 varieties of various pulse crops have so far been released, out of which 333 are released after 1960. Among them, 250 released varieties were mungbean and urd bean. Tamil Nadu Agricultural University, one of the leading Universities in carrying out pulses research, has so far released about 90 improved pulse varieties and developed agro techniques to suit all the agro-climatic zones of Tamil Nadu. These varieties are not only high yielding suitable for different agro climatic zones but also tolerant to biotic and abiotic stresses thus providing the much-needed stability in the production.

One of the most important research achievements in *Vigna* species has been substantial reduction in time to maturity of improved varieties. This has increased the per day productivity of pulses comparable to any rainfed crops besides making them suitable for introduction in new niches and diversification of the existing cropping systems. Expansion of urd bean in rice fallows of coastal regions was possible due to development of short duration varieties like ADT 3. Development of early varieties of urd bean / mungbean with synchronous maturity and resistance to yellow mosaic virus coupled with terminal stress tolerance has helped their introduction to newer areas.

Systematic research on inter/mixed cropping with emphasis on genotypic compatibility and spatial arrangement has led to the identification of efficient intercrops such as pigeon pea with soybean, groundnut, urd bean, mungbean and sorghum, urd bean / mungbean with sugarcane. These intercrops, in a particular row ratio significantly increase total productivity and land use efficiency besides leaving considerable organic matter and nitrogen for the succeeding crops.

Exploitation of hybrid vigour

Some pulse research centers have initiated research work for conversion of CMS lines in urd bean and mungbean for exploiting hybrid vigour.

Exploitation of untapped yield genes

Wide hybridization in cultivated *Vigna* crops has been attempted for broadening the genetic base of cultivated germplasm, creation of genetic variability for efficient plant types, introgression of genes for wider adaptability and minimizing the risk of epi-

demics. Important traits introduced from wild species into the cultivated varieties are resistance to MYMV and bruchid in *Vigna*. Inter-specific crosses between cultivated and wild species among *Vigna* have been attempted to transfer specific genes for resistance to diseases, insect pests and other edaphic stresses.

Multiple resistance

Vigna umbellata is a stable resistance source for many biotic and abiotic stresses. Establishment of wild *Vigna* garden at the National Pulses Research Centre, Vamban, assists the breeders for the introgression of desirable genes into varietal improvement programmes.

Development of nutrient responsive and nutrient use efficient genotypes

Developing genotypes in *Vigna* species for fertilizer response without compromising yield or quality has great potential. Lower input requirements, reduced production costs and less pollution could be some of the benefits expected to accrue with nutrient use efficient plants. Information about genetic aspects of plant mineral nutrition should be derived to augment research strategies for developing nutrient use efficient genotypes in *Vigna* species.

Management options

Integrated nutrient management

Vigna have shown varying degrees of response to fertilizers in different agro-climatic situations. The present yield level can be boosted up when the balanced application of primary (NPK), secondary (Ca, Mg) and micro nutrients (Fe, Zn, Molebdenum) fertilizers is done in time.

Enhancing biological nitrogen fixation

Biofertilizers have an important role to play in improving the nutrient supply and their availability in integrated nutrient management in *Vigna* species. About 10-15% increase in yield is possible through inoculation of seed with efficient *Rhizobium* culture. Besides *Rhizobium*, several other free-living microorganisms are reported to facilitate nutrient uptake. Phosphate solubilizing bacteria helps increase the availability of phosphorus, which needs to be capitalized. Vascular Arbuscular Mycorrhizae (VAM)-an obligatory fungus has been reported to increase availability of plant nutrients and water, both being the most precarious in rainfed agriculture.

IPM module against pod borer complex

IPM modules for management of this dreaded pest have been developed and field-tested. Use of sex pheromone trap at 3-5 traps/ha for monitoring the pest is recommended. The economic threshold level (ETL) is 1-2 larvae per metre row length. The integrated pest management strategy comprises timely sowing to exploit host avoidance phenomenon.

Drought management

Over 80% of *Vigna* are grown in rainfed areas where drought of different intensities and duration are often experienced causing substantial loss in productivity. Under these conditions, water harvesting and its recycling, choice of suitable crops and varieties, planting techniques, seed bed preparation, plant population management, balanced nutrition, *in situ* moisture conservation and use of mulches and water absorbing polymers help in combating drought. Water harvesting which implies diversion of runoff to an appropriate site through land treatment and storing in surface reservoirs for subsequent use as protective/life saving irrigation has proved a boon in many dry areas. Small farm ponds with 1-10 catchment areas have been found quite beneficial which need to be promoted.

Mechanization

Nearly 15 million tons of pulses are being produced annually in India at present. Most of the pulses are being threshed manually or using animals or running tractor over the heap of dry crops of pulses. **Nearly 10% to 15% of the grains of pulses go waste** with the crop residue as the pods of the pulses don't break completely in the traditional threshing. The loss of grains is estimated more than 1.0 million ton per year, which amounts to nearly 1000 crore rupees (about 220 million US\$). The traditional threshing methods are labour intensive, and cost for threshing is more than 2000 rupees (45 US\$) /- per ton of grains. Hence, modern mechanized implements / tools like pulse thresher cum grader would be advocated.

DEVELOPMENTAL OPTIONS

An aggressive approach towards transferring the technologies generated at research stations coupled with developmental policies to ensure timely availability of critical inputs is warranted for bridging the yield gaps. Four options are readily available for bringing additional area under pulses:

❖ Inclusion of short duration varieties of pulses as

catch crop in irrigated areas

- ❖ Introduction in new niches
- ❖ Substitution of existing low yielding crop in the prevailing systems and
- ❖ Pulses as intercrop with wide space planted crops and relay crop.

Policy Issues

Lack of assured market is one factor for the poor performance of pulses. Due to serious problem of stored grain pests and lack of storage facilities, farmers are compelled to sell their produce to middlemen at low price. The minimum support price announced by the Government does not benefit farmers in absence of procurement mechanism. Moreover, all pulse crops are not covered under the minimum support price. Therefore, procurement policy for pulses needs to be strengthened immediately coupled with distribution of pulses through a public distribution system

- ❖ Minimum support price
- ❖ Market Intervention
- ❖ Reasonable buffer stocks
- ❖ Pulse under public distribution system
- ❖ Credit facilities
- ❖ Crop Insurance
- ❖ Export

Post-harvest Technology and Value Addition

Besides losses during harvest, transportation and threshing, pulses also encounter insect pest damage during storage, which is estimated to be around 7.5 %. A mass awareness programme to educate farmers on scientific storage along with distribution of seed storage bins can check the post-harvest losses and increase the shelf life of pulses. To generate employment opportunities and to augment income of the farmers, the value-addition and agro-processing activities have to be strengthened by distribution of efficient Dhal mills and information on final products and by-products of pulses. This would help protect the resource poor farmers from the hands of middlemen and market forces, which tilt towards the consumers at the time of harvest.

Ways to obtain higher yield among *Vigna* species

- Quality seeds of recommended varieties should be chosen and cultivated
- Seed treatment packages should be invariably

followed

- The seed sowing should be done at appropriate time as early sowing escapes the attack of many insect pests and diseases
- The lab to land and land to lab techniques is most important for adopting the current technology of crop production and for solutions to problems encountered.
- The plant protection measures should be taken if needed
- Harvesting should be done at appropriate times to avoid shattering of pods.

II) Soybean

Soybean has emerged as an important oilseed legume crop in India with an average total production of about 7.5-8.0 million tones on an area of over 8.0 million ha. During the year 2007-08, the production of soybean is expected to be over 9.0 million tons on area of about 8.8 million ha, an all time high. This has been possible due to concerted research efforts in different areas of soybean production technology. Ninety three varieties have been bred under AICRP for soybean with different traits namely high yielding, resistant/ tolerance to insect-pest and diseases, early maturity, drought tolerance, food grade characters etc. The research efforts on processing and utilization of soybean have paved the way for its popularization in the country. The major cultivating states are Madhya Pradesh and Maharashtra.

Research and development

(A) Infrastructure

To ease the availability of edible oil and pulses, the government has been consistently making efforts to gear up research and development programmes through TMO (1986) and TMOPM (1991) and 2004 onward through ISOPOM programmes. The R&D set up in the case of soybean was always ahead of its time in India. The ICAR started the All India Coordinated Research Project on Soybean (AICRPS) in 1967 when hardly any area of significance was under the crop. Eventually, ICAR established the National Research Centre for Soybean (NRC for Soybean) at Indore in Central India in 1987 when soybean covered only about 1.5 million hectares, nearly one-fifth of the present coverage by the crop. At present, it has surpassed groundnut rapeseed/mustard in cultivable area and production, the two most important edible oilseeds among nine oilseeds grown in the country.

Crop Improvement

- NRC for Soybean is National Active Germplasm Site and maintaining 3752 accessions of soybean, which included wild and weedy relatives and varieties released in India. The accessions are evaluated for agronomic traits, diseases and insect-pests resistance and other useful characters.
- Ninety-three varieties have been developed so far for different zones of the country and about 30 of them are in the seed chain.
- Several varieties like JS 335, JS 80-21, NRC2, NRC 37, Punjab 1, Kalitur have been developed with high seed longevity. Eight bold seeded sections retaining good seed longevity under ambient storage have been developed.
- Varieties like MACS 58, NRC 37, Type 49, Durga, Punjab 1 are suitable for mechanical harvesting having high insertion of the lowest pod was identified. The trait of high insertion of the lowest pod was strongly and positively associated with plant height.
- Timely release of rust tolerant varieties viz. PS 1024, PS 1029, Indira Soya 9, MAUS 61, MAUS61-2 etc. under the AICRPS were useful in the management of rust. At the NRC for soybean, strains viz. NRC 49, 50 and NRC 51 have been developed that are moderately resistant to rust. Several rust resistant donors (containing genes rpp 1 to rpp 4) are available but have failed to show resistance in hot spots for rust. NRC 55 field resistance to beetle and NRC 57 field resistant to semi-looper were developed.
- PI 542044 was identified as line devoid of Kunitz inhibitor and can be utilized in the breeding programme.
- Varieties like Hardee and Punjab 1 and Shilajeet have been found to have low level of trypsin inhibitor while KHS b2, Punjab 1 and Shilajeet have been found to have low level of lipoxigenases.
- Activity of lipoxigenases, the isozymes responsible for off-flavored was determined in 51 released varieties.
- The production of breeder seed has been raised to over 16000 quintals in 2006 from 585 quintals 1982.

Crop production technology

- Intercropping of soybean with pigeon pea, maize and sorghum in 4:2 and 2:2 row ratios under rainfed conditions was found to be biologically efficient and remunerative when compared with sole cropping of soybean.

- The maximum crop yield and soybean equivalent yield (soybean-wheat and soybean-linseed) were recorded with minimum tillage. Soybean-wheat cropping system for irrigate and soybean - chickpea/linseed/safflower cropping systems for rained conditions was found remunerative.
- With a view to provide sustainability and minimize cost of production to be competitive, it was considered to bring in diversity in the cropping system. Inclusion of maize either in crop rotation or in intercropping showed beneficial effect on productivity. Energy utilization and economics of crop culture cropping sequences of longer duration (2 years or more) are appropriate for providing sustainable production of soybean.
- Potassium application needs inclusion in fertilization schedule of farmers. This helps in raising productivity levels through balanced fertilization and also protects crops from specific pests and water stress.
- The integrated nutrient management through balanced fertilization with specific inclusion of S and Zn in fertilization enhance/stabilize the productivity levels of soybean based cropping systems.
- Application of poultry manure (2.5 tons/ha) in combination with recommended 20kg N, 60kg P₂O₅ and 20 kg K₂O per ha led to high dry matter production and enhanced the soybean seed yield and results into improved soil health.
- Application of 5-10 t FYM/ha was found sufficient to fulfill micronutrient requirement for soybean.
- The planting of soybean on broad bed furrow system in vertisols under real farm conditions helps preventing ill effects of moisture stress and helps in yield enhancement in soybean as well as of soybean - wheat system.
- Dual inoculation of *Bradyrhizobium japonicum* and Phosphate Solubilizing Bacteria (PSB) considerably promoted growth of soybean.
- Integrated weed management schedule comprising summer ploughing, recommended herbicide such as fluchloralin, trifluralin (as-Pre-plant incorporation), alachlor, pendimethalin, metalachlor, clomazone (as pre-emergence). Imazethapyr, quizalofopethy 1 (as post-emergence herbicide), and 'dora' have been recommended. The recommended post-emergence herbicide provides an opportunity for herbicide application at later stage if needed.
- Donors such as Hardee, MACS 124 and Pusa 24 were identified as source of desirable physiological attributes viz. high photosynthesis, specific leaf weight and leaf thickness.
- Screening for drought resistance revealed that varieties Hardee, NRC 7 and JS 81-472 were high yielding but drought - susceptible.
- Varieties/lines resistant to pod-shattering, seed longevity, field weathering, water logging and high temperature have been identified. Selection criteria such as specific leaf weight for high yield. Root to shoot weight ratio for drought resistance, electrical conductivity for resistance to seed deterioration and pod wall thickness for resistance to pod shattering have been identified.
- A preliminary soybean growth and yield model has been developed in association with the Centre for Applications of System Simulations. IARI. New Delhi using INFORCROP generic mode. The beta version of the same has been released by the CASS, IARI, New Delhi.
- Soybean model under DSSAT has been calibrated and validated for simulating soybean growth and yield under Indian condition.
- MACS 330, EC 325097, and EC 34101 were identified as photo – insensitive these can be used in breeding programmes to develop varieties which can perform at varying latitudes and spread over sowing dates MACS 330 possesses long juvenile trait.
- Varieties with 33-35 days to flowering and 90-95 days to maturity are likely to give maximum yield under Central Indian weather conditions. Breeders may develop varieties with these characters.

Crop protection technology

- Management schedules of root and foliar diseases (rust, Myrothecium leaf spot, bacterial pustule, yellow mosaic, etc.) have been worked out.
- Study indicated that the primary source of rust inoculum for Karnataka and Maharashtra states are situated around Krishna River.
- Strain variation in *Sclerotium rolfsii* and *Xanthomonas axnopodis* pv. *glycines* has been established.
- Varieties/lines resistant to major diseases have been identified.
- *Trichoderma viride* and *Pseudomonas fluorescens* have been found effective for the management of collar and charcoal rot. A few natural plant products like species of *Lawsonia*, *Tagetes* and *Acacia* were found promising for the management of Myrothecium leaf spot.
- Integrated Pest Management for soybean has been standardized and demonstrated in farmers' fields. The module led to yield advantage of 3.88 q/ha

over farmers' practice.

- Infestation of blue beetle and plant damage due to girdle beetle decreased with increasing levels of K.
- Suitable management practices involving different approaches were worked out. The following management approaches were found to be effective against major insect-pests of soybean; Blue beetle - Soil application of Phorate or spray of Bt - Monocrotophos; Green semi-looper - spray of Chlorpyrifos or Triazophos or Monocrotophos, Bt alone or Bt+ Monocrotophos Stem fly - spray of Ethofenprox or Monocrotophos or Trizophos or Chlorpyrifos' Girdle beetle - spray of monocrotophos or Triazophos.
- For the management of defoliators and stem borers along with foliar diseases tank-mix formulation of Bt + Monocrotophos + Carbendazim / Thiophen-ate methyl had been found effective. In rust prone areas addition of Triadimafon to the mixture of Bt+Monocrotophos, contain rust as well as defoliators and stem borers.
- To facilitate scouting and monitoring, management of spray application and assessment of likely damage, a month wise calendar of insect incidence has been prepared.
- Effective chemical insecticides have been identified and recommended.
- Microbial insecticides, based on *Bacillus thuringiensis* and *Beauveria bassiana* were found effective for the management of defoliators.
- On the basis of large-scale field screening and laboratory screening, sources for insect resistance have been identified and are being used for developing insect resistant varieties.

Farm mechanization

Machines namely rotary weeder, intercrop seed drill, conservation seed drill, FYM spreading mechanism for tractor trolley, cross mechanism for seed drills, spraying and weeding machine and seed covering device for seed drills have developed for mechanization of soybean cultivation.

Utilization rated R & D work

The research work relate to utilization of soybean started in the late 1960's at G.B. Pant University of Agriculture and Technology, Pantnagar and JNKVV, Jabalpur. The work was carried out to develop food products like soy flour, soymilk. Soy paneer, soy curd, soy candy, soy nuts, extruded snacks, fortified traditional foods, soy oil, soy sauce etc. from whole soybean as well as from defatted soy

flour to harness all the health benefits of soybean.

Future challenges

- Molecular tagging of genes responsible for resistance to key biotic and abiotic stresses needs to be done to assist breeding programmes. Further, research on functional genomics to address some of the key problems should be initiated.
- A farmer - participatory approach need to be institutionalized and practiced by national programmes for faster adoption and rapid impact at the farm level. This also helps in farmer - farmer seed distribution, which is the major factor in varieties dissemination.
- To improve the nutritional status of mungbean and urd bean consumers, it is essential to develop micro nutrient - dense varieties. The most important micronutrients, which can be improved through breeding, are iron and zinc.
- A combination of conventional and molecular breeding approaches can lead to new advances in legume productivity for agricultural development and improved livelihoods of the rural poor.
- Integrated Crop Management (ICM) technologies should focus on the entire cropping system with emphasis on year - round and multi- year management.
- There is a need to evaluate the challenging scenario of diseases and pests in a crop sequence as a whole, and detailed information on the ecology, epidemiology and life cycle pattern of key pests is essential to develop, validate and promote cost effective IPM modules for pod borer complex and effective storage systems for bruchid management.
- Development of disease prediction models needs to be initiated. The precision and accuracy of these models need to be tested and validated at multi locations for future suitability especially for the devastating disease, **YMV**.
- The potentials of local antagonists and bio- agents should be tapped and the most suitable ones should be involved as components of IPM programmes.
- The markets for pulses are thin and fragmented, new niches need to be identified and appropriately supported by improved technologies and policies.
- Although governments regularly announces minimum support prices for pulses but their procurement is not so effective as for major cereals. The government should take measures to ensure that growers get remunerative price for their product.
- Bridging the gaps in research, production, extension, development and policy in a time bound man-

ner will substantially contribute to national pulses production and sustainable rainfed agriculture.