सत्यमेव जयते

Field Guide
Mungbean & Urdbean

भाकृअनुप
ICAR

A strategic initiative for augmenting production of food crops
राष्ट्रीय खाद्य सुरक्षा मिशन
NATIONAL FOOD SECURITY MISSION

NCIPM

Government of India
DEPARTMENT OF AGRICULTURE AND CO-OPERATION
Krishi Bhawan, New Delhi

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Cover Photograph

Left Top	: Mungbean pod	*Right Top*	: Urdbean pod
Left Bottom	: Mungbean grains	*Right Bottom*	: Urdbean grains

Back Cover Photograph

Mungbean field infected with yellow mosaic virus

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प्रबीर कुमार बसु, आई० ए० एस०
सचिव
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सत्यमेव जयते

भारत सरकार
कृषि मंत्रालय
कृषि एवं सहकारिता विभाग
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Foreword

Pulses are known to be among the most vulnerable crops to the attacks of pests and diseases causing huge production losses. Accelerated pulses production program (A3P) launched last year focused on holistic crop care through active Promotion of crop protection technologies under the overall technical guidance of National Centre for Integrated Pest Management (NCIPM) the premier research institute of Indian Council of Agriculture Research (ICAR) on plant protection.

I am happy to note that satisfactory results were achieved for the pigeonpea and chickpea crops which are the focus pulses crops of NCIPM. Higher yields have been achieved particularly through e-pest surveillance related activities of A3P. Farmers have been enthusiastically responding to various crop advisories made available during the crop cycle of these two crops. It is necessary to broaden the scope of this exercise to include other major pulses crops that are covered under A3P.

A lot of useful information has been generated through intensive research work under MULLARP (Mung, urad, lentils, lathyrus rajmash and pea) an All India Coordinated Project of ICAR. Directorate of Plant Protection, Quarantine and Storage (DPPQ&S) is also engaged in promoting 'Integrated Pest Management' for pulses crops and had developed some protocols. The present document "Field Guide on Mungbean and Urdbean" will serve as resource material for management of pests as it attempts to update and bring all the available material from research and field experience for urad and mung crops at one place for the convenience of field and research officials alike. It is rightly called a field guide as it contains very good reference material in a graphical and an easy to read text.

I am confident that the field guide would be used by our extension machinery in all the pulses growing States. I would urge upon the States to translate the book into their local language and prepare brochures or other extension material from its contents for appropriate promotion of the recommended practices to the farmers.

I am sure with the availability of this field guide and its extensive use by the field extension machinery it would create a similar positive impact on the productivity of the urad and mung crops. I would like to complement the authors and would wish more successes under the Accelerated Pulses Production Program of National Food Security Mission.

April 4, 2011
New Delhi

(P K Basu)

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Editors

Contents

A. Introduction

Mungbean (*Vigna radiata*) and Urdbean (*Vigna mungo*) are important pulse crops in our country after chickpea and pigeonpea. Both are important short duration grain legume crops with wide adaptability, low input requirement and have the ability to improve soil fertility by fixing atmospheric nitrogen. Mungbean is grown on about 3.70 million hectares with annual production of 1.57 million tons. Similarly Urdbean is grown on about 3.24 million hectares with annual production of 1.52 million tons. Both the crops are thought to be of Indian origin as evidenced by occurrence at archaeological sites in the Indian Subcontinent.

Mungbean

Mungbean (*Vigna radiata*) is under cultivation since prehistoric time in India. It is also known as green gram and serve are a major source of dietary protein for the vast majority of people. In India these crops are cultivated in three different seasons, *viz*., *kharif, rabi* and *summer*. It is grown under rainfed condition during *kharif* and on residual moisture during *rabi* in eastern and southern part of the country. However maximum area of its cultivation is under *kharif*, where intercropping with sorghum, pearl-millet, maize, cotton, castor, pigeonpea etc., are popular. India is the largest producer of mungbean and account 54% of the world production and covers 65% of the world acreage. Short maturity duration (<60 days) make the crop ideal for catch cropping, intercropping and relay cropping. It is grown as sole relay crop in rice fallows during *rabi* season in Andhra Pradesh, Tamilnadu, Karnataka and Orissa and sole catch crop during *spring/summer* season in Uttar Pradesh, Bihar, West Bengal, Jharkhand, Punjab, Haryana and Rajasthan.

The nutritive value of mungbean lies in its high and easily digestible protein, and contain approximately 25-28% protein,1.0% oil, 3.5-4.5% fiber, 4.5-5.5% ash and 62-65% carbohydrates on dry weight basis. Amino acid analysis indicates that the concentration of sulphur containing amino acids, namely methionine and cystine are low. Methionine concentration is larger in urdbean than in mungbean, lysine values are comparatively large and that is why, the protein of mungbean is an excellent complement to rice in terms of balanced human nutrition.

Urdbean

It is also known as black gram (*Vigna mungo)*. Archaeological studies have shown that it was cultivated in the country as far back as 2200 B.C. Based on seed color and other characteristics urdbean has been grouped under two main types viz. var. *mungo* with large black seed and early maturity and var. *viridis* with small greenish seed and late maturity. The green seeded types are locally known as *katikahia* urd and

generally grown as mixed crop with sorghum, pigeonpea and cottton. It is an important pulse crop and serves as a major source of dietary protein for majority of people. It is also cultivated in three different season, viz., *kharif, rabi* and *summer*. Although the crop is grown in all the season but maximum area is occupied under *kharif* season mostly as intercrop with sorghum, pearl-millet, maize, cotton, castor, pigeonpea etc. When intercropped with tall cereals or pigeonpea it smothers weed flora appreciably (20-45%) and consequently minimize the cost incurred on weed control. Urdbean is one of the most important pulse crops of India cultivated over a wide range of agro-climatic situations. The major urdbean growing states of the country are Maharashtra, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Tamilnadu, Karnataka and Rajasthan. Being short duration and photo, thermo insensitive, urdbean is considered as excellent for crop intensification and diversification. Development of short duration, photo, thermo insensitive and disease resistant varieties has led to its cultivation as a sole or intercrop during *spring* season in North India and as a sole relay crop during *rabi* season in the rice fallows of the coastal peninsula.

The nutritive value of urdbean lies in its high and easily digestible protein and contains approximately 25-28% protein, 1.0-1.5% oil, 3.5% - 4.5% fiber, 4.5-5.5% ash and 62-65% carbohydrates on dry weight basis. There may be some variability in protein percentage due to environment and genotype effect and that may range from 19-29%. Amino acids analysis indicates that the concentrations of sulphur containing amino acid methionine and cystine are small in comparison to Methionine which is more in mungbean. High values of lysine make urdbean an excellent complement to rice in terms of balanced human nutrition.

B. Production Techniques

B.1. Selection of Land and its Preparation

The Mungbean is cultivated in different kind of soils, which include the light sandy soil of Rajasthan to heavy black loam soil of cotton (Madhya Pradesh) and red lateritic soil of (Southern India). However, best soil for its cultivation is loam soil with good drainage. The crop should not be raised on alkaline, saline or waterlogged soils. A well prepared seedbed is required for proper germination and establishment of the crop. For this give 2 – 3 ploughings followed by planking to make the seedbed free from clods and weeds. For the *summer/spring* cultivation after the harvesting of last crops, the tillage should be done after irrigation. Similarly, urdbean is also cultivated in different types of soils. However, heavy soil with high water holding capacity is better for urdbean cultivation. Loam and clay loam soil with normal pH is considered good for its cultivation. During rainy season, good drainage system in

the field is necessary for its better production. Saline and alkaline soil is not suitable for its cultivation.

Similarly for the cultivation of urdbean, 2 – 3 tillage of soil is appropriate. After the harvest of rabi crop, a deep tillage is appropriate, which increases the water holding capacity of soil. It also exposes and kills the weed and insect pests, resting in the soil.

In sandy soils where termite infestation is common, carbaryl 5% powder should be mixed in the last stage of field preparation. In the summer crops, phorate or aldicarb @ 10 kg/ha should be mixed with soil to minimize insect pest infestation.

B.2. Cropping System

During *kharif*, mungbean and urdbean are generally grown with maize, sorghum, pearlmillet, pigeonpea and cotton as intercrop. In U.P., Bihar, Maharashtra, Gujarat and Tamilnadu, urdbean or mungbean is grown in 1:1 ratio with pigeonpea. During *spring*, mungbean or urdbean is grown in 2:1 ratio with sugarcane in U.P and northern Bihar as a tradition. In Bihar, Punjab and Haryana, mungbean/urdbean is grown with sunflower in the ratio of 2:6 during *spring*.

Suitable intercropping system

- Maize-wheat-**mungbean**
- Pigeonpea + **mungbean**-wheat-**mungbean**
- Paddy-wheat-**urdbean/mungbean**/cotton-**mungbean**
- Maize-rapseed-**mung/urdbean**
- Urdbean-wheat-**mungbean**
- Pigeonpea-wheat-**mungbean**
- Urdbean-mustard-**mungbean/urdbean**
- Potato-wheat- **urdbean**
- Paddy-wheat-jute+**mungbean**, and
- Paddy-potato-jute+**mungbean**

The development of short duration and yellow mosaic virus (YMV) resistant varieties in northern India has led to the cultivation of mungbean and urdbean during March to June and resulted in durable cropping system with more economic gains. In the rainfed areas, short duration

mungbean and urdbean varieties are sown after the onset of monsoon. Mungbean-mustard, urdbean-mustard, mungbean-mungbean-linseed and mungbean (green manure)-wheat are beneficial cropping systems.

B.3. Selection of Cultivar/Variety

The selection of variety of mungbean and urdbean depends on the prevalent cropping system, time of sowing, and distribution pattern of rain in the area. For the *summer* crop the varieties which mature in 60-70 days are appropriate, but for *spring*, the variety maturing in 80-90 days can be selected. In rainy season the varieties which are resistant to yellow mosaic virus should be used as the infestation of this virus is more pronounced during this season. Use of early variety in summer ensures empty field for the next crop, moreover, it also prevents the damage caused by the early summer monsoon.

In Southern India, after paddy crop, the medium duration varieties should be preferred than the early maturing varieties. These cultivars should be of 80-85 days and should grow profusely in the beginning for 25 – 45 days. The recommended varieties of mungbean and urdbean for different states and seasons have been given annexures II and III.

B.4. Seed Treatment and Seed Rate

Take 50 g of molasses and mix it with half litre of water and 250 g of Rhizobium *(prefer local strain) and mix 10 kg of seed thoroughly. The treated seed should be dried in shade for 2-3 hours before sowing.*

For the Prevention of soil and seed borne diseases and better yield, seeds should be treated with antifungal bio-agents, *Rhizobium* and Phoshorus Solubilising Bacteria. Seed should be treated with 5–10 g *Trichoderma* (1×10^8 cfu/g) or 2.5 g thiram or 2 g carbendazim/kg of seed for the prevention of soil borne diseases. After seed treatment, the seed should be mixed with *Rhizobium* culture. One packet of *Rhizobium* culture (250g) is sufficient for the seed required for one acre. *Rhizobium* treatment increases the nodule formation, 10-15% increase in yield, and also minimizes the use of nitrogenous fertilizers for the subsequent crop. The *Rhizobium* culture is more significant for the *summer* crop as the number of natural microbes decreases during this season.

Generally, the seed rate of 10 – 15 kg/ha of mungbean and urdbean is used for the *kharif* season. However for the *spring* season crop, 20 – 30 kg/ha seed rate is appropriate. During *kharif* season, the distance between two lines should be 30 – 35 cm and for *summer/spring*, a distance of 20 – 25 cm should be maintained. Seed should be sown in lines using seed drill at a depth of around 4-5cm.

B.5. Sowing Time

Mungbean should be sown during the last week of June to mid of July and urdbean during the first week of July in the *kharif* season. When there is delay of rain, urdbean can be successfully sown upto the last week of July, however, sowing after July results in low yields. For the *summer* or *spring* crop, mungbean should be sown after the harvest of last crop (potato, sugarcane, mustard and cotton, etc). The first fortnight of March is most suitable for *spring/summer* cultivation. Sowing should be avoided after March in Punjab, Haryana and Rajasthan because of hot air affecting flowering leading to low yields. Similarly, late sown urdbean takes more than 75 days to mature coinciding with rains leading to foliar diseases. In U.P and the nearby areas, the sowing of urdbean is very popular and successful after the wheat.

B.6. Fertilizers and Irrigation

For mungbean, 10 kg nitrogen, 45 kg phosphorus and 20 kg of sulphur should be applied at sowing time. Similarly for the urdbean 15 kg of nitrogen, 40 kg of phosphorus and 20 kg sulphur/ha should be applied at the time of sowing. Use of gypsum @ 200 kg/ha would ensures availability of calcium and sulphur at economical rates. It is advisable to use fertilizers on the basis of soil test and recommendations, normally 100 kg DAP/ha is enough for one hectare.

Generally the *kharif* crop requires one life saving irrigation, which may be applied during the early pod formation stage. For the *summer/spring* urdbean/mungbean, 3 – 4 irrigations are required. Apply first irrigation after 20-25 days of sowing and repeat after 10-15 days as per need. One irrigation before flowering and another at pod-filing stage would ensure healthy seeds. Water logging in the field should be avoided at all cost.

C. Plant Protection

Mungbean

The major biotic constraints for slow growth rate of mungbean production and productivity are as under:

- Insect pests during *kharif/spring* seasons cause major loss to mungbean. During the vegetative stage, defoliators like hairy caterpillars, semilooper and til caterpillar are common. Activity of thrips starts at the bud stage and pose serious problems when the crop attains peak flowering resulting in heavy flower drop.
- Mungbean yellow mosaic in *kharif* and *spring* in northern and powdery mildew during *winter* season in southern part of the country cause considerable losses to mungbean.

- Vulnerability to stored grain pests result in considerable post harvest losses. Mungbean is the most preferred host of bruchids and resistance against the insect is yet to be ascertained in available mungbean germplasm.

Urdbean

The major constraints of urdbean production are described as under:

- Mungbean yellow mosaic and leaf crinkle virus during *kharif*, mungbean yellow mosaic virus during *spring* in northern India and powdery mildew in southern coastal parts of the country during *winter* season cause considerable losses to urdbean.
- Infestation by insect pests during crop season results in considerable yield loss in urdbean. During the vegetative stage, defoliators e.g., hairy caterpillars and semilooper are common pests. Activity of thrips starts at the bud stage and pose serious problems when the crop attains peak flowering leading to heavy flower drop.
- Incidence of stored grain pest in storage results in considerable losses.

C.1. Diseases

Both mungbean and urdbean are infested by similar fungal pathogens and viruses. Some of these diseases are causing severe losses in yield in the epidemic conditions. Majority of diseases are common across the agro ecological zones and are being described below:

C.1.1. Yellow Mosaic Disease

This disease is caused by the mungbean yellow mosaic virus (MYMV) belonging to Gemini group of viruses, which is transmitted by the whitefly (*Bemisia tabaci*). This viral disease is found on several alternate and collateral host which act as primary sources of inoculums. The tender leaves show yellow mosaic spots, which increase with time leading to complete yellowing. Yellowing leads to less flowering and pod development. Early infection often leads to death of plants.

Management

- Opt for resistant varieties as per recommendation of local agricultural authorities [Mungbean: Narendra Mung1, Pant Mung 3, PDM 139 (Samrat), PDM-11 (Spring Season), ML 131, ML 267, ML 337, Pusa 105, MUM 2; Urdbean: Narendra Urd1, IPU 94-1 (Uttara), PS 1, Pant U 19, Pant U 30, UG 218, WBU 108, KU 92-1 (*Spring* season), KU 300 (*Spring* Season)]
- Diseased plants should be rogued out to prevent further spread of the disease.
- In order to prevent whitefly (*Bemisia* spp.) infestation spray with triazophos 40 EC @ 2.0 ml/l or malathion 50 EC @ 2.0 ml/l or oxydemeton methyl 25 EC @ 2.0 ml/l at 10-15 days intervals if required.

C.1.2. Leaf Crinkle

This disease is caused by urdbean leaf crinkle virus (ULCV) belonging to Tospovirus. The virus is transmitted by aphids, whitefly and leaf hoppers and through sap. Disease symptoms include crinkling, curling, and puckering of leaves often coupled with stunting and malformation of floral organs. Enlargement in size followed by crinkle surface of laminae are the characteristics symptoms on affected trifoliate leaves. Pollen production, fertility and subsequent pod formation is severely reduced with affect on seed weight and size of seeds in infected plants leading to decrease in yield.

Management

- Seeds from diseased crops should not be used.
- Treat the seeds with imidacloprid 70 WS@ 5ml/kg
- Rogue out the infected plants to avoid contact between healthy and diseased plants during intercultural operations.
- Opt for resistant varieties as per recommendation of local agricultural authorities (Mungbean: D-3-9, K 12, ML 26, RI 59, T44 RII ; Urdbean**:** HUP 27, 102, 164, 315).
- Give one foliar spray of insecticide (dimethoate 30 EC @ 1.7ml/ha) on 30 days after sowing

C.1.3. *Cercospora* Leaf Spot

Cercospora leaf spot (CLS) is caused by several species dominated by *Cercospora canesens* and may cause severe losses of yield under humid weather conditions. Leaf spots with brown to greyish centre and reddish brown border are its characteristic symptoms. The petioles, stems and pods also get affected by the pathogen. During favourable condition the spots increase in size and at the time of flowering and pod formation lead to defoliation. Five species of *Cercospora* infect mungbean and urdbean with slight variation in their symptoms. The fungus survives on the infected seeds and crop debris.

Management

- Field sanitation, crop rotation, destruction of infected crop debris and avoiding the collateral hosts in the vicinity of the crop would greatly help in reducing the incidence of the disease.
- Opt for resistant varieties as per recommendation of local agricultural authorities (Mungbean: LM 113, LM 168, LM 170, JM 171; Urdbean:- Naveen, Jawahar Urd-3, Gujarat Urd-1 and Barkha)
- Treat the seeds with thiram or captan @ 2.5g/kg of seed.
- On appearance of the symptoms spray with carbendazim 50 WP @1.0 g/l or mancozeb 45 WP @ 2.0 g/l. Subsequent spray should be done after 10 to 15 days, if required. Spraying with copper oxychloride @ 3 to 4 g /liter water has also been found effective in management of the disease.

C. 1.4. Powdery Mildew

Powdery mildew is a major problem for urdbean and mungbean cultivation and causes severe yield loss. This disease is caused *Erysiphae polygonii,* which produces conidiophores carrying chains of white conidia. The disease appears on all the part of plants above soil surface. Disease initiates as faint dark spots, which develop into small

white powdery spots, coalesceing to form white powdery coating on leaves, stems and pods. At the advance stages, the color of the powdery mass turns dirty white. The disease induces forced maturity of the infected plant causing heavy yield losses and its intensity increases in stress condition. The pathogen overwinters and survives on the host tissue in the form of cleistothecia.

Unlike most fungal plant pathogens, the powdery mildews do not require the surface of the host plant to be wet for infection, favored by high humidity. It is favored by cooler conditions and is widespread in the late planted crop.

Management

- Adopt clean cultivation by destroying diseased plant refuge.
- Delayed sowing of mungbean and urdbean with wider spacings considerably reduce the disease severity.
- Opt for resistant varieties as per recommendation of local agricultural authorities (Mungbean: LM 223, LM 24, P115, ML 131, MI 322, ML 337, ML 395 SS1, JRUM 1, TARM 1 and AVRDC 1381 ; Urdbean: COBG10, LBG 648, 17, Prabha, IPU 02-43, AKU 15 and UG 301).
- Spray with NSKE @ 50 g/l or neem oil 3000 ppm @ 20 ml/l twice at 10 days interval from initial disease appearance. Spray with eucalyptus leaf extract 10% at initiation of the disease and 10 days later also if necessary.
- Spray with water soluble sulphur 80 wp @ 4 kg/l or carbendazin 50 WP @ 1 g/l (0.05%), benlate (0.05%) and topsin-M (0.15%).
- Rotate chemicals with different modes of action.

C. 1.5. Anthracnose

The disease occurs on several legume crops including mungbean and urdbean. The fungus *Colletotrichum* spp. is the causal organism of the anthracnose affecting aerial plant parts, however, the leaves and pods are more vulnerable. The characteristic symptoms of this disease are circular brown sunken spots with dark centers and bright red orange margins on leaves and pods. In severe infection,

affected part withers off. Infection just after germination causes seedling blight. Five species of *Colletotrichum* are known to attack mungbean and urdbean. The pathogen survives from one crop season to the next on infected seeds and crop residue. Intermittent rains at frequent intervals favor the epidemic development of the disease. The optimum temperature and relative humidity for disease development is 17-24°C and 100%, respectively.

Management

- Hot water seed treatment at 58°C for 15 minutes has been found effective in checking the seed-borne infection and increasing proportion of seed germination.
- Seed treatment with thiram 80% WP @ 2 g/l or captan 75 WP @ 2.5 g/l helps in eliminating the seed borne infection.
- Spray the crop with 0.2% zineb 80% WP @ 2 g/l or ziram 80% WP @ 2 g/l with first appearance of symptoms on the crop and repeat after 15 days (if necessary).

C.1.6. *Macrophomina* Blight

It is caused by the fungus *Macrophomina phaseolina* causing root rot, collar rot, seedling blight, stem rot, leaf blight, pod and seed infection. In pre-emergence stage, the fungus causes seed rot and mortality of germinating seedlings. In post-emergence stage, seedling blight disease appears due to soil or seed-borne infection. Decay of secondary roots and shredding of the cortex region of the tap root are prominent symptoms. The fungus attacks the stem at ground level, forming localized dark brown patches which coalesce and encircle the stem. Black dot like sclerotia are formed on the surface and below the epidermis on the outer tissue of the stem and root. The disease develops rapidly and causes severe infestation under high temperature and water stress conditions. The pathogen is most favoured at a temperature of 30°C and 15% moisture.

Management

- Basal application of zinc sulphate @ 25kg/ha or neem cake @ 150 kg/ha or soil application *P. fluorescens* (1×10^{10} cfu/g) or *T. viride* (1×10^{8} cfu/g) @ 2.5 kg/ha + 50 kg of well decomposed FYM at the time of sowing helps in prevention of the disease.
- The diseased plants should be uprooted and destroyed so that the sclerotia do not form or survive.
- Seeds treated with *Trichoderma* (1×10^{8} cfu/g) 5 – 10 g/kg of seed or captan 75 WP @ 2.5 g/l and thiram 80% WP @ 2 g/l before sowing provides significant protection.

- Spray with carbendazim 50 WP @ 1.0 g/l at an interval of 15 days with the appearance of the symptoms.

C.2. Insect Pests

Numerous insect pests attack the mungbean and urdbean crops. The loss in the production caused by them may reach up to 70% depending upon the severity of attack. Both the crops have common insect pests. Some common insect pests of mungbean and urdbean and their management are as follow:

C.2.1. Whitefly

Whitefly (*Bemisia tabaci*) nymphs and adults suck sap from leaves. The infested plants become very weak showing downward cupping of the leaves giving a sickly look and the plant may die due to severe attack of the pest. The insect secretes honey dew on which growth of sooty mould takes place resulting in blackening of leaves, drastically reducing photosynthetic rate and drying of leaves leading to total failure of the crop. Whitefly is a vector of number of viral diseases especially mungbean yellow mosaic virus (MYMV).

Management

- Grow maize, sorghum or pearl millet as a barrier crop to minimize the incidence of whiteflies.
- Grow cotton as a trap crop one month earlier between the mungbean rows with a single spray of dimethoate 30EC @ 1.70 ml/l at 15 days after germination of mungbean for the control whiteflies and MYMV.
- Opt for resistant varieties (Mungbean: ML 1256, ML 1260 and ML 1191; Urdbean: UL 310, 338, 389, UL 407, 557, 539, 597, UG 254, 302, 402, 600 and 633)
- Spray *Paecilomyces fairnosus* (1 x 10^8 cfu/g) for the control of adult whitefly.
- Seed treatment with dimethoate 30 EC @ 5ml/kg + foliar spray of trizophos 40 EC @ 1.0 ml/l is effective in control of whitefly in urdbean.

- Seed treatment with imidacloprid 17.8 SL @ 3ml/kg of seed and 2 sprays of imidacloprid 17.8 SL @ 0.2ml/l at 15 days intervals are effective in reducing the incidence of whitefly and MYMV disease and is a common practice.
- Spray acephate 75 SP @ 1.0 g/l and neem oil 3000 ppm @ 20 ml/l for reducing the whitefly population and MYMV incidence in mungbean.

C.2.2. Aphids

Aphids (*Aphis craccivora*) attack a large number of pulses and leguminous crops. The adults are black and shiny, upto 2 mm long and some are winged. Nymphs are covered with waxy coating that makes them grey and dull. Nymphs and adults are seen in large numbers on young plants, leaflets, stem and pods. Young leaves of seedlings become twisted. Excretion of honey dew attracts sooty mold. *A. craccivora* transmits cowpea banding mosaic virus and cucumber mosaic virus in cowpea and green gram.

Management

- Spray with 5% crude neem extract or 2% neem oil 3000 ppm.
- Spray with dimethoate 30 EC (1.7 ml/l), endosulphan 35 EC (2ml/l) and imidacloprid 17.8 SL @ 0.2 ml/l.
- Conserve coccinellid beetles, their grubs and Chrysoperla.

C.2.3. Bean Thrips

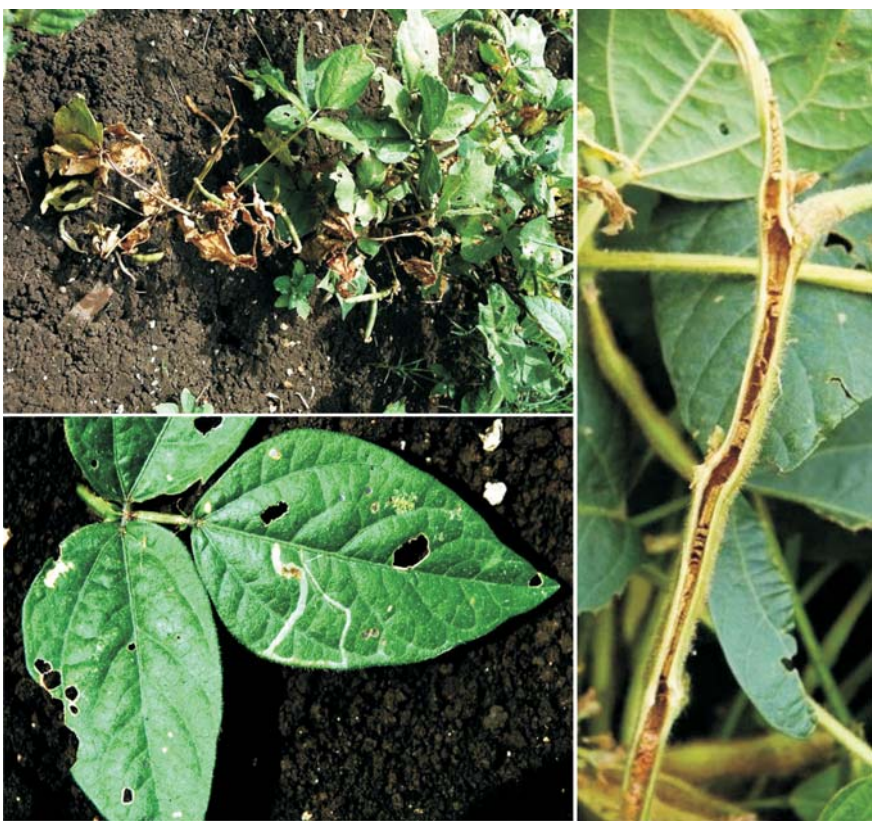
The thrips (*Megalurothrips distalis*) nymphs and adults feed on stigma inside the flower, the flower sheds before opening and there is elongation of terminal shoot. In case of severe incidence, the plants attain a bushy growth and the crop looks dark-green in colour, bearing few pods with shriveled grains.

Management

- Timely irrigation at an interval of 15 days results in low build up of thrips.
- The incidence of bean thrips can be minimized by intercropping mungbean with cotton.
- Opt for resistant varieties (Mungbean: PIMS 2, PMS 3, 12-333, Co 3, ML 5, ML 337; Urdbean: PDU 5, KB 63, PDU 88-23, PDU 2, 5, UG 567, DU4, T9, UH 80-4,UH 90-9, and UH 80-7)
- Seed treatment with thiomethoxam 70 WS 0.2% + foliar spray of thiomethoxam 25 WG 0.02% is quite effective in controlling bean thrips.
- Spray neem seed kernel extract (50 g/l) and neem oil 3000 ppm @ 20 ml/l.
- Spray of, triazophos 40 EC @ 2.0 ml/l, ethion 50 EC @ 2 ml/l and endosulphan 35 EC @ 2.0 ml/l.

C.2.4. Stem Fly

Stem fly (*Ophiomyia phaseoli*) maggots mine the leaves or bore into the leaf petiole or tender stem resulting in withering, drooping and death of plant. The



characteristic symptoms of damage include drooping of the first two leaves and yellowing of plants. The sites of plant attacked early have larvae and pupae and are swollen and start rotting. It can cause 5 – 20% and 3 – 62% damage in mungbean and urdbean, respectively.

Management

- Follow clean cultivation, crop rotation, earthing up, growing trap crop, destroying alternative hosts like *Solanum nigrum* to minimize the stem fly incidence.
- Opt for resistant varieties (Mungbean: CoGG 912 & CoGG 917; Urdbean: CoBG 671 & AC 222).
- Seed soaking either in imidacloprid 17.8 SL @ 5.0 ml/kg seed in 100 ml water for one hour or thiomethoxam 25 WG @ 5.0 g/kg seed in 100 ml water to avoid early incidence of stem fly is recommended.
- Spray either imidacloprid 17.8 SL @ 0.2ml/l or thiomethoxam 25 WG @ 0.3g/l at 15 days after sowing.

C.2.5. Galerucid Beetles

The beetles (*Madurasia obscurella*) feed on young plants during the early morning hours on leaves by making small holes and during the day time they hide in soil crevices. In the rainy season, the grubs make holes in the root nodules, enter them and make them completely hollow. It has been reported to cause 25 and 60% damage on root nodules of mungbean and urdbean, respectively. The beetle is also reported as vector of bean southern mosaic virus.

Management

- Seed treatment with monocrotophos 40 EC @ 10 ml/kg seed or disulfoton 4% is very effective against beetle damage.
- Granular systemic insecticides like phorate 10 G, disulfoton 5 G are effective to control the pest.

C.2.6. Blue Butterflies

Blue butterflies (*Lampides boeticus; Catochrysops* spp.) pest is widely distributed in India and infests cowpea, red gram, black gram and lablab. Small blue butterflies have wings which are bluish on the upper side while the underside is pale brown with narrow whitish bands. Hind wings have one or two black spots and a hair-like projection. Bluish

sculptured eggs are laid singly usually on young buds. Larvae are green, oval, flat and oniciform and pupate in soil or plant debris. Larvae chew leaves but preferably feed on buds, flowers and pods.

Management

- Spray with crude neem extract (5%) or neem oil as they work as anti-feedant and repellent.
- In case of serious infestation, carbaryl 50 WP @ 4.0 g/l or endosulfan 35 EC @ 2.0 ml/l may be sprayed.

C.2.7. Bihar Hairy Caterpillar

Bihar hairy caterpillar [*Spilarctia* (*Spliosoma*) *obliqua*] female moths lay eggs on plants in a field. The young caterpillars emerge out and start feeding on these plants in a gregarious form. They eat away all the green matter of the leaves and it can be easily recognized by perforated, dusty white coloured leaves in the field. The grown-up caterpillars feed voraciously on leaves, soft stems and branches. The insect totally denude the crop within few days resulting in total failure of the crop.

Management

- Uproot the damaged plants along with the young larvae at the gregarious phase and burry under the soil.
- Spray of endosulfan 35EC @ 2.5 ml /l or quinalphos 25EC @ 2.0 ml/l or dichlorvos 100 EC @ 1.0 ml/l or fenvalerate 20 EC @ 1.0 ml/l or dusting with fenvalerate 0.4% @ 15 kg/ha.

C.2.8. Red Hairy Caterpillar

Red hairy caterpillar (*Amsacta moorei*) prefer to eat the growing points of the plants. Grown up larvae completely devour the foliage and ultimately finish up the entire seedlings. In severe infestation, the entire field looks as if grazed by cattle. It is widely distributed in India and in severe infestation there may be a complete failure of the crop.

Management

- Deep summer ploughing of the field is helpful in destroying pupae by exposure to sunlight and predatory birds.
- Deploy light traps of electric or petromax lamps placed just above a broad flat basin full of kerosenized water at night following the first shower of the monsoon and continued throughout the period of emergence for about one month.
- Destroy the gregarious larvae by uprooting the plants and burying them under ground.
- Spray 1.25 litres of quinalphos 20 EC or endosulfan 35 EC or 500ml of dichlorovos 10 EC in 500 litres of water.

C.2.9. Pod Borer

Helicoverpa (Helicoverpa armigera) being a polyphagous pest of agricultural crops also infests mungbean as well as urdbean. The immature larvae feed and forage on crops at all stages of plant development, damaging flowers and pods. *Helicoverpa* defoliation is characterised by rounded chew marks and angular holes. High population in seedling or drought-stressed crop can cause considerable damage if vegetative terminals and stems are eaten. Once crops reach flowering, larvae focus on buds, flowers and pods. Young larvae are more likely to feed on vegetative terminals, young leaves and flowers before attacking pods. Small pods may be totally consumed by *Helicoverpa*, but larvae target the seeds in large pods. Age of the crop affects the behaviour of larvae, spending more time on the upper parts.

Management

- Deep summer plaughing for exposure and destroying the pupating larvae.
- Deploy pheromone trap @ 5 /ha for monitoring of pest population.
- Spray of emamectin benzoate 5 SG @ 0.2 g/l effectively manages the larval population or profenopohos 50 EC @ 2 ml/l or rynaxypyr 20 SC @ 0.15 ml/l.
- Spray HaNPV @ 1ml/l or NSKE or crude neem 5% @ 50 g/l or neem oil 3000ppm @ 20 ml/l.

C.2.10. Tobacco Caterpillar

Newly hatched tobacco caterpillar (*Spodoptera litura*) feed gregariously on the leaf surface for about 2-3 days and leave behind the whitish membranous leaf only. Later they disperse in the whole field in solitary phase. The larvae makes irregular holes on the leaf surface and in severe infestation, they skeletonize the foliage. They are voracious feeders of the foliage and remain hidden in cracks and crevices or plant debris in the soil during day time. The maximum damage is caused to the young plants, which are often totally destroyed.

Management

- Collection and destruction of egg masses and newly hatched larvae along with skeletonized leaves can reduce infestation.
- Spray of microbial pesticides like SNPV [500 LE/ha or 500 ml ($1x10^9$ POB/ml)] or *Bacillus thuringiensis* formulations in synchrony with early larval instars is effective against the pest.
- Spray malathion 50 EC @ 2.0 ml/l or endosulfan 35 EC @ 2.05 ml/l.
- Foliar application of novaluron 10 EC @ 0.75 ml/l, chitin synthesis inhibitor against eggs of *S. litura*.
- Spray extract of custard apple as feeding deterrent against the pest.

C.2.11. Spotted Pod Borer

Earliest sign of spotted pod borer (*Maruca vitrata*) infestation is the webbing of flowers. The larva webs the leaves, inflorescence and feed inside the flowers, flower buds and pods. Eggs are laid on or in the flowers (inserted between the petals). Young larvae feed inside the flowers before moving to developing pods when mid-sized. A larva may consume 4-6 flowers before larval development is completed. Third to

fifth instar larvae are capable of boring into the pods and feeding the developing grains. Seeds in damaged pods are totally or partially eaten out by larvae. Entry holes also let in water, which stain the remaining non-eaten seeds.

Management

- Opt for resistant varieties (Mungbean: JRUM 1, JRUM 11, JRUM 33, DPI 703, LAN 14-2, UPM 83-6, UPM 83-10, Pusa 115, PDM 116 and ML 353
- Spray of profenophos 50 EC @ 2.0 ml/l +DDVP @ 0.5 ml/l found to highly effective against Maruca.
- Spray *Bacillus thuringiensis* 5 WG @ 1.0 g/l.
- Spray profenophos 50 EC @ 2 ml/l + DDVP 76 EC @ 0.5 ml/l is highly effective against m. vitrata.
- Seed treatment with imidacloprid 17.8 SL @ 3 ml/kg + foliar spray of profenophos 50 EC @ 2.0 ml/l.
- Pesticides are most effective if applied before larvae enter pods.
- Spray chlorpyriphos 20 EC @ 2.5 ml/l and lambdacyhalothrin 10 EC @ 0.5 ml/l
- Foliar spray of lambdacyhalothrin 10 EC @ 0.5 ml/l + NSKE 5% is effective against *M. vitrata*.
- Spray of spinosad 45 SC @ 0.2 ml/l is most effective in controlling this pest.

C. 2.12. Pod Bugs

Pod bug (*Claivgralla gibbosa*) adults and nymphs damage leaves, flower buds, stem and pods by sucking cell sap. Major damage is done to the green pods before

Nazara virudula sucking sap from pods

Clavigrella gibbosa sucking sap from pod

Reptortus pedistris sucking sap from pod

the maturity of the crop. The attacked pods show pale yellow patches. The grains in the pods become shrivelled and small in size resulting in considerable yield losses.

Management

- Physical shaking of the infested plants over the vessels of oil and water or oily cloth help reduce the population.
- Spray endosulfan 35 EC @ 2.0 ml/l or monochrotophos 36SL @ 1.0 ml/l water during flowering and at pod formation stage.

C.3. Storage Pest

These insects are reported to infest the crop at drying stage and in barnyards; however, they attack most of the pulses under storage conditions. If left unattended they can cause 100% losses. The adults are small brownish beetles, with characteristics emarginated eyes. Eggs are laid, stuck on the outer sides of the pods by the female beetle; laying up to 90 eggs. If the pods have dehisced, eggs are laid directly into seed. The newly emerged larvae bore onto the seeds and feed on them.

Management

- Crop should be harvested before the pods shatter.
- The grains should be sufficiently dried up to the moisture level of 10 %.
- Stores should be cleaned and the residual bruchid population should be destroyed.
- Boiled and dried gunny bags should only be used.
- Mix the plant products like neem leaves for controlling the bruchid population.
- Smearing of edible oils *viz.,* mustard oil, neem oil @ 10 ml / kg seed and activated charcoal powder @ 10g/kg seed is very effective in preventing the bruchid damage.
- Fumigate with ethelyne dibromide (EDB) ampule @ 3ml/100kg to control the bruchids, if necessary.

C.4. Weed Control

Weeds cause 30-50% losses in the grain yield of mungbean. However, the magnitude of loss varies with the intensity and type of weed flora. The critical period of crop-weed competition varies from 15-30 DAS. The crop is mainly infested with *Cyperus rotundus, Amaranthus viridis*, *Chenopodium album,Convolvulus arvensis*,

Heliotropium europium, Melilotus indica, Rumex dentatus, *Trianthema portulacastrum, Eleusine aegyptium, Digitaria sanguinalis* and *Tribulus terrestris*.

Management

Application pendimethylene 30 EC @ 3.75 ml/l or alchlor 50 EC @ 3.75 ml/l or 3L of alachlor 50 EC/800 litres water/ha should be used within 2 days after sowing. If the weedicide is not applied, weeds should be hand picked after 20-25 days after sowing (DAS). If needed, one more handpicking should be done as and when required.

C.5. Integrated Pest Management

Due to indiscriminate use of chemical pesticides in the field, serious negative impacts have been observed on the environment and food chain. Therefore, farmers need effective alternative pest management practices, that are ecofriendly and economically more reliable, such as cultural practices host plant resistance, biological control and bio-rational group of chemicals like neem which are safe to non-target beneficial organisms. In mungbean and urdbean, IPM packages based on multidisciplinary methodologies have been found practical, effective, economical and protective for both public health and environment.

Following IPM strategies have been recommended for mungbean and urdbean cultivation:

Cultural Practices

- Opt for resistant varieties
- Early sowing during summer reduces the occurrence of diseases and pests.
- Intercropping with non-host crops like sorghum and pearl millet.
- Timely irrigation in summer/spring crop reduces thrips damage as their multiplication is very rapid under drier conditions.
- Removal and destruction of MYMV infested plants.

Mechanical Practices

- Removal and destruction of MYMV infested plants.
- Collection and destruction of egg masses and skeletonized leaves along with early instar larvae of hairy caterpillar and *Spodoptera litura*
- Deploying of light traps or bonfire against hairy caterpillar moth.
- Installation of Pheromone traps @ 3.5 /ha to monitor moths of *S. litura* and *Helicoverpa armigera.*

- Adopt physical monitoring of crop health on bi-weekly basis to restrict pest population.

Biological Control

- Spraying microbial biopesticides like *Spodoptera* or *Helicoverpa* NPV [500 LE/ha or 500 ml ($1x10^9$ POB/ml)] or *Bacillus thuringiensis* formulations in synchrony with early larval instars of these pests.
- Seed treatment and soil application of *Trichoderma* spp./*Pseudomonas fluorescence* enriched FYM at the time of sowing of crop.

Chemical Control

- Seed treatment with imidacloprid 17.8 SL @ 3ml/kg, dimethoate 30 EC @ 5 ml/kg seed and foliar spraying of triazophos 40 EC @ 0.4 ml/l (0.04%).
- Application of ecofriendly insecticides against galerucid beetles, defoliators and pod borers.
- Soil application of phorate 10 G @ 1 kg a.i. /ha at the time of sowing reduces the incidence of thrips and whiteflies during *summer* and it is effective against stemfly, jassids, whitefly and defoliators during *kharif* season.

Economic threshold level (ETL)

- Aphids: 20/2.5 cm shoot length
- Pod borers: 10% of affected pods
- Spotted pod borer: 3/plant
- Stem fly: 10% of affected plants
- Tobacco cut worm: 8 egg masses/100 m^2

Beneficial insect

The combined action of a number of beneficial species can be seen in the resource poor farmer's fields having some impact on lepidopteran pests. It is therefore desirable to conserve as many beneficials as possible. Natural enemies of mungbean pests include predators of eggs, larvae and pupae, parasites of eggs and larvae and caterpillar pests. Other predatory bugs and beetles that attack *Helicoverpa* eggs and larvae include spined predatory bug, glossy shield bug, damsel bug, bigeyed bug, apple dimpling bug, assassin bug, red and blue beetle, predatory ladybirds, ants, spiders and lacewings. Some of the important parasitoids of *A. craccivora* are *Thioxys indicus, Lysiphlebus fabarum* and *L. tesaceipes*. Important predators include coccinellid beetles, e.g. *Cheilomenes sexmaculata* and *Coccinella septempunctata*, neuropteran larvae, e.g. *Micromus timidus* and predatory diptera, e.g. *Aphidoletes aphidimyza* and a syrphid (*Ischiodon scutellaris*).

Natural enemies of insect pests of mung and urdbean

Coccinellid beetle predating on aphids

LBB larva predating on aphids

Chinch bug predating on caterpillar

Syrphid fly

Spider

Black drongo

Annexure-I

List of Recommended Pesticides

Sl. No.	Name of the Pest	Recommended pesticide	Dosage
Insect Pest			
1.	Whitefly (*Bemisia tabaci*)	Dimethoate 30 EC	1.7 ml/l
		Dimethoate 30 EC+ Triazophos 40 EC	Seed treatment @ 5ml/kg + 0.4 ml/l foliar spray respectively
		Imidacloprid 17.8 SL	Seed treatment @ 3 ml / kg + 2 sprays @ 0.2 ml / l at 15 days interval
		Acephate 75 SP	1.0 g / l
		NSKE 5 %	50 g / l
		Neem oil 3000 ppm	20 ml / l
2.	Aphids (*Aphis craccivora*)	NSKE 5 %	50 g / l
		Neem oil 3000 ppm	20 ml / l
		Dimethoate 30 EC	1.7 ml / l
		Endosulphan 35 EC	2 ml / l
		Imidacloprid 17.8 SL	0.2 ml / l
3.	Stem Fly (*Ophiomyia phaseoli*)	Imidacloprid 17.8 SL	Seed treatment @ 5 ml / kg
		Thiomethoxan 25 WG	Seed treatment @ 5 g / kg
		Imidacloprid 17.8 SL	0.2 ml / l after 15 DAS
		Thiomethoxan 25 WG	0.3 g / l after 15 DAS
4.	Galerucid Beetle (*Madurasia obscurella*)	Monocrotophos 40 EC	Seed treatment @ 10 ml/kg
		Disulfoton 5 G	Seed treatment @ 40 g / kg
		Phorate 10 G	10 kg /ha
		Disulfoton 5 G	2 kg/ha
5.	Blue Butterfly (*Lampides boeticus*)	NSKE 5 %	50 g / l
		Neem oil 3000 ppm	20 ml / l
		Acephate 75 SP	1 gm / l
		Endosulphan 35 EC	2 ml / l
		Carbaryl 50 WP	4 g / l
		Quinolphos 25 EC	2 ml / l
		Chlorpyriphos 20 EC	2.5 ml / l
6.	Bihar Hairy Caterpillar (*Spliosoma obliqua*)	Quinolphos 25 EC	2.5 ml / l
		Dichlorvos 100 EC	1.0 ml / l
		Fenvalerate 20 EC	1.87 ml / l
		Fenvalerate 0.4 DP	15 kg / ha
		Endosulphan 35 EC	2.5 ml / l

Sl. No.	Name of the Pest	Recommended pesticide	Dosage
7.	Red Hairy Caterpillar (*Amsacta moorei*)	Quinolphos 20 EC	2.5 ml / l
		Endosulphan 35 EC	2.5 ml / l
		Dichlorvos 10 EC	1.0 ml /l
8.	Tobacco Caterpillar (*Spodoptera litura*)	SNPV ($1x10^9$ POB/ml)	3.0 ml / l
		Malathion 50 EC	2.0 ml / l
		Endosulfan 35 EC	2.0 ml / l
		Lufenuron 5 EC	0.04 ml / l
		Novaluron 10 EC	0.75 ml / l
9.	Spotted Pod Borer (*Maruca vitrata*)	Imidacloprid 17.8 SL + Profenophos 50 EC	Seed treatment 3.0 ml / l + 2.0 ml / l foliar spray
		Bacillus thuringiensis 5 WG	1.0 g / l
		Dimethoate 30 EC	Seed treatment 5.0 ml / l
		Triazophos 40 EC	0.4 ml / l
		Chlorpyriphos 20 EC	2.5 ml / l
		Lambdacyhalothrin 10 EC	0.5 ml / l
		Lambdacyhalothrin 10 EC + NSKE 5%	0.5 ml /l + 50 ml / l
		Spinosad 45 SC	0.2 ml / l
		Profenophos 50 EC + DDVP 76 EC	2 ml +0.5 ml / l
10.	Bean Thrips (*Megalurothrips distalis*)	Thiomethoxam 70 WS + Thiomethoxam 25 WG	Seed treatment 2 ml / kg + Foliar spray 0.2 gm / l
		NSKE 5 %	50 ml / l
		Neem oil 3000 ppm	20 ml / l
		Triazophos 40 EC	2.0 ml / l
		Ethion 50 EC	3.2 ml / l
		Endosulfan 35 EC	3.75 ml / l
11.	Pod Bug (*Clavigralla gibbosa*)	Endosulfan 35 EC	1.6 ml / l
		Monocrotophos 36 SL	1.0 ml / l
		Methomyl 40 SP	1.0 g / l
		Fenitrothion 50 EC	1.6 ml / l
12.	Bruchids (*Callosobruchus* sp.)	Mustard oil or Neem oil + activated charcoal powder	Mix with storage seed @ 10 ml / kg + 10 g / kg
		Ethylene-di-bromide (EDB) ampule	Fumigate seeds @ 3 ml / 100 kg

Sl. No.	Name of the Pest	Recommended pesticide	Dosage
Diseases			
1.	Yellow Mosaic Disease	Malathion 50 EC	2.0 ml / l
		Triazophos 40 EC	2.0 ml / l
		Oxydemeton methyl 25 EC	2.0 ml / l
2.	Leaf Crinkle	Imidacloprid 70 WS	5.0 ml / kg
		Dimethoate 30 EC	1.7 ml / l
3.	Cercospora Leaf Spot	Captan 50 WP or Thiram 50 WP	Seed treatment @ 2.5 g / kg
		Carbendazim 50 WP	1.0 g / l
		Mancozeb 45 WP	2.0 gm / l
		Copper oxychloride 50 WP	3 – 4 g / l
4.	Powdery Mildew	Sulphar 80 WP	4.0 g / l
		Carbendazim 50 WP	1.0 g / l
		NSKE 5 %	50 g / l
		Neem oil 3000 ppm	20 ml / l
		Eucalyptus Leaf extract 10 %	100 ml / l
5.	Anthracnose	Thiram 75 WP or Captan 75 WP	Seed treatment @ 2 – 3 g / kg
		Zineb 80 WP or Ziram 80 WP	2.0 g / l
6.	Macrophomina Blight	*Trichoderma* (1 x 10^8 cfu / g)	Seed treatment 5 – 10 g / kg
		Neem cake	150 kg / ha
		Captan 75 WP	Seed Treatment 2.5 g / kg
		Thiram 75 WP	Seed Treatment 2.0 g / kg
		Carbendazim 50 WP	2.0 g / l

Note : Pesticide and their formulations mentioned in the text are based on recommendation of SAUs and published work irrespective of their label claim.

Annexure-II

Mungbean varieties

State	Varieties	Seasons	Special features
Andhra Pradesh	LGG 407	Kharif	Resistant to MYMV
	Madhira 295	Kharif	Tolerant to PM
	Madhira Pesara 347	Kharif	Tolerant to MYMV
	Pusa 9072	Rabi	Modratly resistant to PM
	LGG 410	Rabi	Resistant to leaf spot
	LGG 460	Rabi	Resistant to MYMV
Assam	Pant moong 2	Kharif	Tolerant to MYMV
	Pant moong 4	Kharif	Resistant to MYMV
	Narendra moong 1	Kharif	Resistant to MYMV
	Pusa Bold 1(Pusha vishal)	Spring & Summer	Resistant to MYMV
	Pant moong 5	Spring & Summer	Resistant to MYMV
Bihar & Jharkhand	Pant moong 2	Kharif	Tolerant to MYMV
	Pant moong 4	Kharif	Resistant to MYMV
	Pant moong 5	Spring & Summer	Resistant to MYMV
	Narendra moong 1	Kharif	Resistant to MYMV
	Samrat (PDM139)	Spring & Summer	Resistant to MYMV
	MH2-15 (Sattya)	Kharif	Resistant to MYMV
	HUM-1(Malviya Jyoti)	Kharif	Resistant to MYMV
	IPM2-3	Kharif	Resistant to MYMV
	Pusa Bold 1 (Pusha vishal)	Spring & Summer	Resistant to MYMV
	TMB 37(TM 99-37)	Spring & Summer	Tolerant to MYMV
Delhi	Pant moong 1	Kharif	Resistant to MYMV
	Pant moong 3		Resistant to MYMV & moderately resistant to PM
	ML 267	Kharif	Tolerant to MYMV
	ML 337	Kharif	Resistant to MYMV & tolerant to CLS & PM
	MUM 2	Kharif	Resistant to MYMV
	Ganga 8 (Gangotri)	Spring & Summer	Tolerant to MYMV
	MH 02-15 (Sattya)	Kharif	Resistant to MYMV
	IPM2-3	Kharif	Resistant to MYMV
	Pant moong 5	Spring & Summer	Tolerant to MYMV
Gujarat	ML 337	Kharif	Resistant to MYMV & tolerant to CLS & PM
	Gujarat moong3	Kharif	Tolerant to MYMV
	Pusa 9531	Kharif	Resistant to MYMV
	Pant moong 2	Kharif	Resistant to MYMV

State	Varieties	Seasons	Special features
	PIMS-4 (Sabarmati)	Kharif	Tolerant to MYMV
	Meha (IPM 99-125)	Kharif, Spring & Summer	Resistant to MYMV
	Samrat (PDM 139)	Spring & Summer	Resistant to MYMV
Haryana	Pusa Bold 1(Pusha vishal)	Kharif, Spring & Summer	Resistant to MYMV
	Ganga 8 (Gangotri)	Kharif	Tolerant to MYMV
	Sattya (MH 2-15)	Kharif	Tolerant to MYMV
	IPM 2-3	Kharif	Tolerant to MYMV
	Muskan (MH 96-1)	kharif	Resistant to MYMV
	Basanti (MH 125)	Kharif	Resistant to MYMV
	Pant moong 5	Spring & Summer	Tolerant to MYMV
Himachal Pradesh & J&K	Pant moong 2	kharif	Tolerant to MYMV
	Pant moong 6 (UPM 02-17)	Kharif	Resistant to MYMV
	Sweta (KM 2241)	Kharif	Resistant to MYMV
	Pusa 672	Kharif	Tolerant to MYMV
Karnataka	ML 131	kharif	Resistant to MYMV &CLS and PM
	Malviya Jyoti (HUM 1)	Kharif	Resistant to MYMV
Madhya Pradesh & Chhattisgarh	Pant moong 3	Kharif	Resistant to MYMV & moderately resistant to PM
	ML 337	Kharif	Resistant to MYMV & tolerant to CLS & PM
	Malviya Jyoti (HUM 1)	Kharif, Spring & Summer	Resistant to MYMV
	Meha (IPM 99-125)	Kharif, Spring & Summer	Resistant to MYMV
	Pusa 9531	Spring & Summer	Resistant to MYMV
	Samrat (PDM 139)	Spring & Summer	Resistant to MYMV
Maharashtra	ML131	Kharif	Resistant to MYMV & tolerant to CLS & PM
	TARM 1	Kharif	Resistant to PM
	TARM 18	Kharif	Resistant to PM
	TARM 2	Kharif	Tolerant to PM
	PK V Moong 8802	Kharif	Resistant to PM
	HUM 1	Spring & Summer	Resistant to MYMV
	Pusa 9531	Spring & Summer	Resistant to MYMV

State	Varieties	Seasons	Special features
Orissa	ML 131	Kharif	Resistant to MYMV & tolerant to CLS & PM
	TARM1	Kharif	Resistant to PM
	Samrat (PDM 139)	Kharif & Rabi	Resistant to MYMV
	Pusa 9072	Rabi	Modratly resistant to PM
	LGG-460	Rabi	Resistant to MYMV
Punjab	ML 5	Kharif	Resistant to MYMV
	ML 267	Kharif	Tolerant to MYMV
	ML337	Kharif	Resistant to MYMV & tolerant to CLS & PM
	MUM 2	Kharif	Resistant to MYMV
	ML 613	Kharif	Resistant to MYMV & tolerant to CLS
	Ganga 8 (Gangotri)	Kharif	Tolerant to MYMV
	Sattya (MH 2-15)	Kharif	Resistant to MYMV
	IPM 2-3	Kharif	Tolerant to MYMV
	ML 818	Kharif	Tolerant to MYMV
	Pusa Bold 1Pusha vishal	Spring & Summer	Resistant to MYMV
	Pant moong 2	Spring & Summer	Tolerant to MYMV
	Pant moong 5	Spring & Summer	Tolerant to MYMV
Rajasthan	Ganga 8 (Gangotri)	Kharif	Tolerant to MYMV
	Durga (RMG 268)	Kharif, Spring & Summer	Tolerant to MYMV
	MUM 2	Kharif	Resistant to MYMV
	IPM 2-3	Kharif	Tolerant to MYMV
	Sattya (MH 2-15)	Kharif	Resistant to MYMV
	Samrat (PDM 139)	Spring & Summer	Resistant to MYMV
	Meha(IPM 99-125)	Spring & Summer	Resistant to MYMV
Uttar Pradesh & Uttaranchal	Pant moong 2	Kharif	Tolerant to MYMV
	Pant moong 3	Kharif	Resistant to MYMV & moderately resistant to PM
	Narendra moong 1	Kharif	Resistant to MYMV
	Pant moong 4	Kharif	Resistant to MYMV
	Pant moong 5	Kharif, Spring & Summer	Tolerant to MYMV
	Samrat (PDM 139)	Spring & Summer	Resistant to MYMV
	Pusa Bold 1(Pusha vishal)	Spring & Summer	Resistant to MYMV
	Meha(IPM 99-125)	Spring & Summer	Resistant to MYMV
	TMB 37(TM 99-37)	Spring & Summer	Tolerant to MYMV
	Malviya Jankalyani (HUM-16)	Spring & Summer	Resistant to MYMV

State	Varieties	Seasons	Special features
Tamil Nadu	ADT 3	Kharif	Moderately resistant to PM
	CO 5	Kharif	Tolerant to MYMV & PM
	Pusa 9072	Rabi	Moderately resistant to PM
West Bengal	Narendra moong 1	Kharif	Resistant to MYMV
	Pant moong 4	Kharif	Resistant to MYMV
	Pant moong 5	Kharif,Spring & Summer	Tolerant to MYMV
	Sattya (MH 2-15)	Kharif	Resistant to MYMV
	Samrat (PDM 139)	Spring & Summer	Resistant to MYMV
	Pusa Bold 1(Pusha vishal)	Spring & Summer	Resistant to MYMV
	Meha(IPM 99-125)	Spring & Summer	Resistant to MYMV
	TMB 37(TM 99-37)	Spring & Summer	Tolerant to MYMV
	Malviya Jankalyani (HUM 16)	Spring & Summer	Resistant to MYMV

Annexure-III

Urdbean varieties

State	Varieties	Seasons	Special features
Andhra Pradesh	Pant U 30	Kharif	Resistant to MYMV
	Pant U 31	Kharif	Resistant to MYMV
	WBU 108	Kharif	Resistant to MYMV
	LBG 648 (LAN 648)	Kharif	Resistant to MYMV
	Shekhar 1 (KU 301)	Kharif	Resistant to MYMV and tolerant to PM
	LBG 685 (LAN 685)	Kharif	Resistant to wilt
	WBG 26 (Warangal 26)	Kharif, Rabi	Resistant to PM
	LBG 17	Rabi	Tolerant to PM
	LBG 402	Rabi	Tolerant to wilt and PM
	LBG 709 (LAN 709)	Rabi	Resistant to wilt and tolerant to MYMV
	LBG 611	Rabi	Tolerant to wilt
	LBG 623	Rabi	Tolerant to MYMV
	TU 94-2 (Trombay UDID)	Rabi	Resistant to MYMV and tolerant to PM
Assam	Pant U 19	Kharif	Resistant to MYMV
	Pant U 30	Kharif	Resistant to MYMV
	Sujata (WBU 109)	Kharif	Resistant to MYMV
	IPU 2-43	Kharif	Resistant to MYMV and PM
	WBU 108	Kharif	Resistant to MYMV
	IPU 94-1 (Uttara)	Kharif	Resistant to MYMV
Bihar & Jharkhand	Pant U 19	Kharif	Resistant to MYMV
	Pant U 30	Kharif	Resistant to MYMV
	Sujata (WBU 109)	Spring	Resistant to MYMV
	WBU 108	Kharif	Resistant to MYMV
	Birsa Urd 1	Kharif	Tolerant to MYMV and PM
	IPU 94-1 (Uttara)	Kharif	Resistant to MYMV
	Pant U 31	Kharif, Rabi	Resistant to MYMV
	Ajad Urd 1 (KU 91-2)	Spring	Resistant to MYMV
Gujarat	T 9	Kharif	Tolerant to MYMV
	TAU 2	Kharif	Tolerant to PM
	WBU 108	Kharif	Resistant to MYMV
	AKU 4	Kharif	Tolerant to MYMV and PM

State	Varieties	Seasons	Special features
Haryana	Pant U 19	Kharif	Resistant to MYMV
	WBU 108	Kharif	Resistant to MYMV
	Mash 338	Kharif	Tolerant to MYMV
	UG 218	Kharif	Resistant to MYMV
	Shekhar 2 (KU 300)	Kharif, Spring	Resistant to MYMV
	Pant U 31	Spring	Resistant to MYMV
Himachal Pradesh	Pant U 19	Kharif	Resistant to MYMV
	Pant U 31	Kharif	Resistant to MYMV
Karnataka	T 9	Kharif	Tolerant to MYMV
	Pant U 30	Kharif	Resistant to MYMV
	WBU 108	Kharif	Resistant to MYMV
	TU 94-2 (Trombay UDID)	Kharif	Resistant to MYMV and tolerant to PM
	WBG 26 (Warangal 26)	Kharif	Resistant to PM
	LBG 402	Rabi	Tolerant to wilt and PM
Madhya Pradesh & Chhattisgarh	Pant U 30	Kharif	Resistant to MYMV
	Jawahar Urd 2	Kharif	Tolerant to MYMV and CLS
	Jawahar Urd 3	Kharif	Tolerant to YMV and CLS
	Pant U 40	Kharif	Resistant to MYMV
	Barkha (RBU 38)	Kharif	Tolerant to CLS
	Pant U 31	Kharif, Spring	Resistant to MYMV
	Pant U 30	Spring	Resistant to MYMV
Maharashtra	Barkha (RBU 38)	Kharif	Tolerant to CLS
	Pant U 30	Kharif	Resistant to MYMV
	TAU 1	Kharif	Tolerant to PM
	AKU4 (Melghat)	Kharif	Tolerant to MYMV & PM
Orissa	KU 301 (Shekhar-1)	Kharif	Resistant to MYMV & tolerant to PM
	WBG 26 (Warangal 26)	Kharif	Resistant to PM
	WBU 108	Kharif	Resistant to MYMV
	T 9	Kharif	Tolerant to MYMV
	Sarla (B-12-4)	Kharif	Tolerant to MYMV
	Pant U 31	Kharif	Resistant to MYMV
	TU 94-2 (Trombay Udid)	Spring	Resistant to MYMV & tolerant to PM
	LBG 402	Spring	Tolerant to wilt & PM
	LBG 17 (Krishnaya)	Spring	Tolerant to PM
	Prassd (B-3-8-8)	Spring	Tolerant to MYMV
	Mash 338	Spring	Tolerant to MYMV

State	Varieties	Seasons	Special features
Punjab	IPU 94-1 (Uttara)	Kharif	Resistant to MYMV
	WBU 108	Kharif	Resistant to MYMV
	Mash 414	Kharif	Resistant to MYMV
	Mash 338	Kharif	Tolerant to MYMV
	KU 300 (Shekhar-2)	Spring	Resistant to MYMV
Rajasthan	IPU 94-1 (Uttara)	Kharif	Resistant to MYMV
	WBU 108	Kharif	Resistant to MYMV
	Pant U 31	Kharif	Resistant to MYMV
	KU 300 (Shekhar-2)	Kharif & Spring	Resistant to MYMV
	Barkha (RBU 38)	Kharif	Tolerant to CLS
Uttar Pradesh & Uttaranchal	IPU 94-1 (Uttara)	Kharif	Resistant to MYMV
	WBU 108	Kharif	Resistant to MYMV
	Pant U 30	Kharif	Resistant to MYMV
	Pant U 40	Kharif	Resistant to MYMV
	Narendra urd 1(NDU 88-8)	Kharif & Spring	Resistant to MYMV
	Pant U 19	Kharif & Spring	Resistant to MYMV
	KU 92-2(Azad Urd 1)	Spring	Resistant to MYMV
	KU 300 (Shekhar-2)	Spring	Resistant to MYMV
	(Sujata)WBU 109	Spring	Resistant to MYMV
	Pant U31	Spring	Resistant to MYMV
Tamil Nadu	ADT 3	Kharif	Tolerant to PM
	ADT 5	Kharif	Tolerant to MYMV
	Pant U 30	Kharif	Resistant to MYMV
	WBU-108		Resistant to MYMV
	KU 301 (Shekhar-1)	Kharif	Resistant to MYMV & tolerant to PM
	Vamban-3	kharif	Resistant to MYMV & tolerant to PM
	ADT 4	Kharif	Tolerant to MYMV
	VBN 4	Kharif	Tolerant to MYMV & PM
	ADT 5	Kharif	Tolerant to MYMV
	WBG 26 (Warangal 26)	Rice-fallow	Resistant to PM
	TU 94-2 (Trombay Udid)	Rice-fallow	Resistant to MYMV & tolerant to PM
West Bengal	IPU 94-1 (Uttara)	Kharif	Resistant to MYMV
	Pant U 19	Kharif	Resistant to MYMV
	WBU 108	Kharif	Resistant to MYMV
	Pant U 31	Kharif & spring	Resistant to MYMV
	KU 92-2(Azad Urd 1)	Spring	Resistant to MYMV
	(Sujata)WBU 109	Spring	Resistant to MYMV

राष्ट्रीय खाद्य सुरक्षा मिशन
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