Mungbean Production Manual

Production & Plant Protection Package of Technologies
Compiled and edited by

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Introduction

Mungbean (*Vigna radiata* (L.) Wilczek) is one of the most important food legumes in Asia, where 90% of global production currently takes place. It is grown mainly for its edible seeds, which are cooked, fermented, roasted, sprouted or milled. In Pakistan, mungbean seeds, like other pulses, are split in a mill, separated from the husk, and then cooked as "dal". Mungbean is also used in making soups, curries, noodles, bread, and sweets; the seeds roasted with spices are also very popular. Mungbean is easily digestible, easy to cook, free from flatulence and high in protein (22–24%) and iron. Apart from nourishing the people its cultivation improves soil health by adding nitrogen through symbiosis. The leftover leaves, stalks and husks of the mungbean plants are used as fodder, and the whole plant can be ploughed under as green manure for soil improvement.

Mungbean is one of the important kharif pulses of Pakistan. It is also grown during spring season mainly in southern Punjab and Sindh province. Punjab is the major mungbean growing province that alone accounts for 88% area and 85% of the total mungbean production. Cultivation is concentrated in the districts of Layyah, Bhakkar, Mianwali and Rawalpindi. It is mainly grown in Kharif season (July–October). Although it is grown in different crop rotations, about 75% cultivation follows mungbean - wheat crop rotation. With the development of short duration and uniform maturing varieties, mungbean can be fitted in various cropping systems. Research activities on mungbean have been mainly focused on the development of high yielding varieties with wider adaptability, resistant to diseases like mungbean yellow mosaic virus (MYMV) and *Cercospora* leaf spot (CLS), early maturity and insensitivity to photo period.
Climate

Mungbean grows in a wide range of climatic conditions. A warm humid climate with temperature ranging from 25°C to 35°C, with 400-550 mm rainfall, well distributed during the growing period of 60 - 90 days is well suited for the crop. However, it can also be grown on slightly saline soils and nutrient deficient soils under irrigated conditions. So, the farmers can use their marginal lands for additional profit.

Soil

Mungbean is grown on a wide range of soil including red laterite soil, black cotton soil and sandy soil. A well-drained loamy to sandy loam soil is best for its cultivation. The crop does not grow well on highly saline and alkaline or waterlogged soil. The farmers however, should grow mungbean on slightly saline soils by adopting best management practices and using some bio-fertilizers which have the ability to support crop growth under stress environments besides improving nitrogen fixation. An example of these bio-fertilizers is Rhizogold Plus: amulti strain bio-fertilizer that has been developed from ACC-deaminase containing Rhizobacteria and Rhizobia by Soil Microbiology and Biochemistry Laboratory, Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad.
Planting Time

There are two main planting seasons for mungbean, spring and the more conventional Kharif. Planting within the preferred window is critical to maximize the yield and grain quality.

Spring planting

In spring season, mungbean can be successfully grown where the irrigation water is available. In this season there is less vegetative growth and low risk of insect attack hence the grain quality is better.

Kharif Planting

In Pakistan, almost 80% mungbean is planted in Kharif season. Kharif planting is equally successful in irrigated and rainfed areas.
Mungbean varieties and planting time recommendations for different zones of Pakistan

<table>
<thead>
<tr>
<th>Area/zone</th>
<th>Season</th>
<th>Planting time</th>
<th>Recommended varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Punjab</td>
<td>Spring</td>
<td>End March to Mid April</td>
<td>NIAB Mung-2011, AZRI Mung-2006</td>
</tr>
<tr>
<td></td>
<td>Kharif</td>
<td>End June to Mid July</td>
<td></td>
</tr>
<tr>
<td>Central Punjab</td>
<td>Spring</td>
<td>March</td>
<td>NIAB Mung-2016, NIAB Mung-2011, AZRI Mung-2006</td>
</tr>
<tr>
<td></td>
<td>Kharif</td>
<td>Mid May to Mid June</td>
<td></td>
</tr>
<tr>
<td>Southern Punjab</td>
<td>Spring</td>
<td>End February to Mid March</td>
<td>NIAB Mung-2016, NIAB Mung-2011, AZRI Mung-2006</td>
</tr>
<tr>
<td></td>
<td>Kharif</td>
<td>Mid May to Mid June</td>
<td></td>
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<tr>
<td>Northern KPK</td>
<td>Spring</td>
<td>Mid March To Mid April</td>
<td>Ramazan 2005, Swat-1</td>
</tr>
<tr>
<td></td>
<td>Kharif</td>
<td>July</td>
<td></td>
</tr>
<tr>
<td>Southern KP</td>
<td>Spring</td>
<td>March</td>
<td>Karak Mung-1, Dera Mung-2008, Inqalab Mung, Sona Mung</td>
</tr>
<tr>
<td></td>
<td>Kharif</td>
<td>Mid May to Mid June</td>
<td></td>
</tr>
<tr>
<td>Sindh</td>
<td>Spring</td>
<td>Mid February to Mid March</td>
<td>AEM-96, NIAB Mung-2011</td>
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<tr>
<td></td>
<td>Kharif</td>
<td>Mid June to Mid July</td>
<td></td>
</tr>
<tr>
<td>Balochistan</td>
<td>Kharif</td>
<td>July</td>
<td>NIAB Mung-2016, NIAB Mung-2011, AZRI Mung-2006</td>
</tr>
</tbody>
</table>
Soil and Seedbed Preparation

Mungbean requires well drained loamy soil with proper drainage and ample aeration in the field so that activities of the nitrogen fixing bacteria are not hampered at any stage of plant growth. In irrigated areas flush irrigation should be applied and then at optimum moisture level seed bed should be prepared by 2-3 time ploughing followed by planking. However in rainfed area for moisture conservation mould bold ploughing should be done before rain and then seed bed should be prepared by 2-3 times ploughing followed by planking at optimum moisture level. In case of salt affected soil, sowing on ridges gives good results.

Fertilizer Requirements

The application of 1-2 tons/acre of well decomposed Farm Yard Manure (FYM) provides the desired quality to the soil. The FYM must be mixed with soil three month before sowing for good results and to avoid plant damage due to high soil temperature. A fertilizer mixture of N.P.K at the rate of 9, 23 and 12 kg/acre, respectively, should be broadcasted and incorporated into the soil at the time of seed bed preparation. Top dressing of an additional dose of N at 15 kg/ha can be done at flowering stage where the farmers do not use any type of Rhizobium inoculum and if nitrogen is deficient. In simple words, farmers can use 1 bag of DAP or two bags of nitrophas fertilizer before sowing. Rhizobium inoculation is highly recommended in fields where mungbean is going to be cultivated for the first time.
Seed Rate and Seed Treatment

Only the seed of latest disease resistant and high yielding cultivars should be used. Healthy, undamaged seeds that are free from insect pests and fungi should be used. The optimum seed rate is the key factor for obtaining proper plant stand and higher crop yields. For better production, the plant population should be maintained at least 150000 plants per acre. For this purpose seed of recommended varieties should be used at the rate of 12 kg/acre. In case of ridge sowing the seed rate should be 8kg/acre.

Before sowing, the seed should be treated with fungicide (Redomil) @ 2g/kg seed against seed borne diseases.

Rhizobium inoculation is highly recommended in fields where mungbean is going to be cultivated for the first time. The farmers however, are being advised to use multi-strain bio-fertilizers with more than one plant growth promoting characters in all types of soils. This will not only increase productivity and profitability of farmers but also enhance soil fertility.
Sowing Methods

At the time of sowing, field should have good soil moisture to obtain the proper plant stand. Under low moisture, germination is affected adversely because of prevailing high temperature and low relative humidity. Mungbean sowing should be in lines using drill and by keeping row to row distance of 30 cm and plant to plant distance of 10 cm. Wheat drill can also be used successfully by simple adjustment. Broad casting is usually done in rainfed areas.

Ridge sowing is commonly used in spring sowing sugarcane/cotton intercropping system and in saline soils. Ridge to ridge distance should be 30-45 cm and plant to plant distance should be made 10 cm. Thinning is recommended 7-10 days after germination. In sugarcane intercropping system, it can be sown on beds with row to row distance of 30 cm and plant to plant, distance of 10 cm. Seed rate of 6 kg/acre is recommended for bed sowing. In field with salinity problems, or if sowing is done in rainy season, farmers are recommended to grow mungbean on ridges to reduce the problem of crusting and poor seed germination and seedling emergence.
Irrigation

Irrigation depends upon weather, soil and field conditions. Usually the first irrigation is required after 30-35 days after sowing; second and third irrigation must be applied at flowering and pod formation stage respectively, if rainfall does not occur.

Weed Management

Weeds cause 30-40% losses in the grain yield. Weed control at proper time and with appropriate method is very essential to get higher yields. Post-emergence herbicides are available which can control the weeds very effectively.
Herbicides for weed control in mungbean

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Example trade name</th>
<th>Weeds type</th>
<th>Rate/acre</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactofen</td>
<td>Halt, Conquest</td>
<td>Broad leaf weeds</td>
<td>300mL/acre</td>
<td>Post-emergent (3-4 weeks after emergence of crop)</td>
</tr>
<tr>
<td>Haloxyfop-R-Methyl</td>
<td>Corner, Pulsar, Percept</td>
<td>Narrow leaf weeds</td>
<td>400mL/acre</td>
<td>Post-emergent (3-4 weeks after emergence of crop)</td>
</tr>
</tbody>
</table>

Spray recommended doses of herbicides by mixing in 80-100L water for one acre.
Diseases and their management

The important diseases affecting this crop and control measures are described below.

**Mungbean Yellow Mosaic Disease (MYMD)**

This disease is caused by begomoviruses, starting as small yellow specks along the veinlets and spreading over the lamina; the pods become thin and curl upward. The disease is transmitted by whitefly (*Bemisia tabaci*). Mungbean plants infected with this disease generally show yellowing or chlorosis of leaves followed by necrosis, shortening of internodes and stunting of plants with deformed, small, immature and shriveled seeds. It can be controlled through the use of resistant varieties and control of white fly by proper insecticide and eradication of weeds manually (hoeing). Spray the crop with Imidachloprid, acetamaprid or other latest chemicals to control whitefly after proper interval.

**Cercospora leaf spot**

*Cercospora* leaf spot is caused by *Cercospora* spp. and symptoms are circular to irregularly shaped leaf spots with grayish white centers and reddish brown to dark brown margins.

Control: (1) Spray triazole fungicide (Hexaconazole or Difenconazole @ 0.1% with Dithane Z-78 or Dithane M-45 @ 3.2 g/L of water. (2) Remove the plant debris from the field. (3) Remove all the infected plants and burn them. (4) Do not sow the seeds of affected plants.

**Powdery Mildew**

Powdery mildew is caused by the fungi *Erysiphe* spp. or *Podosphaera* spp. It occurs under cool temperature (20-26°C) and is favored by cloudy weather. A white-grey powdery mildew appears first in circular patches, but later spreads over the surface of the leaves, stems and pods.
Control: (1) Spray different botanical extracts such as Spray of Neem Seed kernel Extract (NSKE) at 50g/L or Neem oil at 20mL/L twice at 10 days interval from initial disease appearance or Eucalyptus leaf extract 10% at initiation of the disease and 10 days later. (2) Spray Carbendazim @ 1 g/L or wettable sulphur @ 2.5 g/L of water rotating with botanical extracts to reduce the risk of developing fungicide resistant problems and (3) Nativo 25% ww 65 g/100L water and (4) Grow disease resistance cultivars if available.

Bacterial Leaf Spot

Bacterial leaf spot is caused by *Pseudomonas syringae*. Infected leaf has ovate-shaped spots of dead tissues surrounded with yellow-green to lemon-yellow margins. As the spots enlarge, they may join together often having torn out dead tissues, developing a shot-hole appearance. An infected pod has initially tiny water-soaked spots that later enlarge and join together, become sticky, and develop tiny crusty area on its center during rainy days. Later, the infected area turns brown and dies causing the pod to twist or bend. To manage this disease rotate crops, use disease-free seeds or use resistant cultivars, remove and properly dispose off infected plants and burn infected plant tissues when possible.
Urdbean Leaf crinkle virus

This disease is caused by urdbean crinkle virus. Major symptoms of the disease include puckering of leaves; turn downward, primary leaves are thick & brittle, severely dwarfed/stunting plant. Pod formation severely reduced in this disease. Use of resistant variety and control of aphids and whitefly population are important as these are vectors of this virus.

Anthracnose

Anthracnose is caused by Colletotrichum lindemuthianum. Symptoms of anthracnose can appear on any plant part. Initial symptoms may appear on cotyledonary leaves as small, dark brown to black lesions. On older stems, the eye-shaped lesion is about 5-7 mm. Lesions may first develop on leaf petioles and the lower surface of leaves and leaf veins as small, angular, brick-red to purple spots which become dark brown to black. Later, the lesions may also appear on veinlets on the upper surface of leaves. Pod infections appear as flesh to rust-colored lesions. Seed should be pathogen-free.

Control: (1) Infected crop residues should be buried and rotation with non-susceptible crops is often recommended. Crop rotations of 2-3 years are often recommended because the pathogen can survive in infected crop debris for more than two years. (2) Nativo 25% ww 65 g/100L water

Charcoal Rot

Charcoal rot is caused by Macrophomina phaseolina. Generally occurs after flowering during a period of heat or moisture stress, and results from infection of the roots by soil-borne microslerotia. An early sign of stem infection is the presence of brown lesions at the base of the plant or where the branches join the main stem. Infected plants usually die prematurely and the stems turn ashy-grey, often with minute black specks (microslerotia) evident within the affected area. Yield can be significantly reduced. Suitable seed dressing fungicide should be used to manage the disease.
Insect Pests

The important pests and their control measures are described here.

Tobacco caterpillar (*Spodoptera litura*)
The small larvae are black whereas grown up larvae are dark green with black triangular spots on body. Besides leaves, they also damage floral buds, flowers and pods. **Control:** (1) Collect egg masses and young larvae with leaves and destroy them. (2) Spray with neem (commercial neem formulations or neem oil or neem seed kernel extract), *Bacillus thuringiensis* formulations and/or *Spodoptera litura* nuclear polyhedrosis virus (NPV), novaluron 10 EC @ 1.5 mL/L or acephate 75 SP @ 8 g/L or Chlorpyriphos 20 EC @ 15 mL/L of water.

White fly (*Bemisia tabaci*)
The adults are tiny and very delicate and have white or smoke colored wings with which they flitter away from plants on little disturbance. Nymphs of whitefly stick to the lower surface of leaves. The leaves of infected plants show yellowish discoloration. **Control:** (1) Spray the crop with Neem oil at 20mL/L. (2) Use yellow sticky traps against whiteflies. Spray the crop with Imidachloprid 250mL/100L of water, Acetamaprid 125g/100L water, Spirotetramate 125mL/100L of water, Buprofezin 600g/100L of water, Pyriproxifen 400mL/100L of water to control whitefly after proper interval.
Bean pod borer (*Maruca testulalis*)
It is a very serious pest and cause substantial damage to the crop. They feed on buds, flowers, pods and grains. The larvae may be pale-green, yellow, brown or black in color; 3-5 cm in length. Larvae presence can be judged from dark green feces under the plant canopy.

**Control:** To control pod borer, spray the crop with following insecticides or bio-pesticides: Emmamectin benzoate @ 200mL/100L of water or Indoxacarb @ 2 mL /L of water, neem (commercial neem formulations or neem oil or neem seed kernel extract), *B. thuringiensis* formulations

Bean fly (*Ophiomyia phaseoli*)
It is the most important insect pest of mungbean. It causes significant damage during the seedling stage. The adult flies are too tiny, only 2 mm, and cannot be recognized easily. The bean fly maggots feed inside the plant stem and their damage cannot be seen from the outside.

**Control:** Spray Imidachloprid 250mL/100L of water, Acetamprid 125g/100L water and Thiamethoxam 24g/100L of water. The first three sprays are very important and must not be delayed. Effective seed-dressing insecticides have been identified. Moth bean, chickpea, lentil, and cluster bean could be used as 'dead-end trap crops'—the bean fly adults lay eggs on these crops, but the eggs fail to hatch.

Thrips (*Megalurothrips distalis*)
Thrips are very small insects found in the flowers and causes flower drop, deformation of pods and ultimately reduction in yield.

**Control:** Crop must be sprayed with Imidachloprid 250mL/100L of water and Carbosulfan 200-250 mL/100L of water at flower initiation stage.

Cowpea aphid (*Aphis craccivora*)
Aphids can attack mungbean. Unusually high aphid populations (over 20 insects/plant) its noticed.

**Control:** Spray Carbosulfan 200-250 mL/100L of water weekly until aphids are eradicated. Use neem oil, either alone or in
combination with the entomopathogenic fungi biopesticides. The ladybird beetles and green lacewings are efficient predators of aphids. Protect the population of these predators by avoiding the use of broad-spectrum pesticides. *A. craccivora* can develop resistance to pesticides.

**Pod-sucking bugs**
A range of pod-sucking insects attack mungbeans, including green vegetable bug (*Nezara viridula*), redbanded shield bug (*Piezodorus oceanicus*); large brown bean bug (*Riptortus serripes*); small brown bean bug (*Melanacanthus scutellaris*). They start breeding as soon as they move in to flowering crops and nymphs must feed on pods to complete their development. Feeding by pod-sucking bugs causes shrivelled and distorted seed, and can severely reduce yield and seed quality. Pod-sucking bugs can even damage seeds in black pods that are nearing harvest maturity.

**Control:** Spray Bifenthrin 200-250mL/100L of water and Carbosulfan 200-250mL/100L of water at flower initiation stage.

**Bruchids (*Callosobruchus chinensis*)**
This is commonly called pulse beetles or cowpea weevils. These attack mungbean both in field and storage. But the greater losses occur in storage. The nutritional quality of the grains deteriorates rendering them unmarketable.

**Control:** Clean storage area properly, dry the seeds well (9-10% moisture), and apply non-toxic chemicals such as vegetable oils. For large-scale seed storage, fumigation with phosphine or other suitable fumigants can be adopted. Treating the mungbean grains with clays, sand, kaolin, and ash has been proven effective in controlling bruchid infestation in storage. Vegetable oils (e.g., olive oil or mustard oil at the rate of 15 mL/kg seed can also be used to treat mungbean grains and seeds to protect from bruchid infestation. Storage of mungbean grains or seeds in airtight containers is an effective way to eliminate bruchid, as they are unable to survive without air. Triple-bagging mungbean grains for storage can substantially reduce bruchid infestation. Vacant store and bags must be treated with proper chemicals to destroy the eggs of the insects.
Yield Potential

If farmers follow the complete production technology they can achieve the yield potential of 1.5-2.4 t/ha under irrigated condition and 1-1.4 t/ha under rainfed conditions.

Harvesting

Manual harvesting is usually practiced, but mechanical harvesting can save labor cost and time. Harvest mungbean when 80% pods become mature before they start shattering. Mungbean has indeterminate flowering habit. This means that they do not have defined flowering period and will continue to flower while there is an adequate soil moisture. Therefore desiccation of the plants is needed before mechanical harvesting. This can be done by spraying Diquat or Paraquat (2-3L/ha) to desiccate the plants. If you are following manual harvesting then threshing must be done as soon as the pods becomes dry.
Storage

One must know that during medium-long (3-6 months) storage, mungbean continues to age and that quality deteriorates over time. Seed coat darkening is accelerated due to high moisture contents. Stored grain pests also cause severe damage to seed. It is therefore, necessary to clean storage area properly, dry the seeds well (9-10 % moisture), and apply non-toxic chemicals such as vegetable oils. For large-scale seed storage, fumigation with phosphine or other suitable fumigants can be adopted. Treating the mungbean grains with clays, sand, kaolin, and ash has been proven effective in controlling bruchid infestation in storage. Vegetable oils (e.g., olive oil or mustard oil at the rate of 15 mL/kg of seed) can also be used to treat mungbean grains and seeds to protect from bruchid infestation. Storage of mungbean grains or seeds in air-tight containers is an effective way to eliminate bruchid, as they are unable to survive without air. Triple-bagging mungbean grains for storage can substantially reduce bruchid infestation. Vacant store and bags must be treated with proper chemicals to destroy the eggs of the insects.
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