



Mung bean



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Mung bean

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GENERAL

Classification

Scientific name: *Vigna radiate*

Family: Fabaceae

Common names: Mung bean (English), dithlodi (Sepedi), Mungboontjie (Afrikaans)

Origin and distribution

The mung bean has been grown in India since ancient times. It is still widely grown in Southeast Asia, Africa, South America and Australia. It was apparently grown in the United States as early as 1835 as the chickasaw pea. Virtually all the domestic production of mung bean is in Oklahoma. Fifteen to twenty million pounds of mung bean are consumed annually in the United States and nearly 75% of this is imported.

Production levels

South Africa

The main production areas in South Africa are Limpopo and Mpumalanga, where it is produced mainly for consumption. Mung beans are not produced on a commercial scale. Several attempts at research into mung bean production have been made in South Africa, but with no success. This is largely because of late and erratic pod maturing, which makes it difficult to determine the harvesting period. It is also low yielding and susceptible to disease. Therefore, most of the information contained in this manual has been obtained from internationally published papers.

Internationally

The mung bean is best known in the USA, where it is used for the production of bean sprouts. The mung bean is one of the mandated crops of the Asian Vegetable Research and Development Centre (AVRDC), Shantua Tainan, Taiwan. Mung beans are also cultivated in Australia, from the Northern Territory to southern New South Wales (NSW), with the bulk of production in central and southern Queensland and northern NSW. Most of the crop is exported, with the main destinations being Taiwan, the Philippines, the USA and the UK. Mungbean beans are mainly featured in cuisine in Southeast Asia including China, Thailand, Japan, Korea, Vietnam and India (Oplinger, *et al*, 1997).

Major production areas

Major production areas in South Africa are Limpopo and Mpumalanga.

Cultivars

Not much effort is being made in the breeding of new varieties of mung bean; however, there are a few varieties available, such as Berken and Texsprout. Berken is green in colour and is the variety preferred by farmers (Myers, 2000).

The AVRDC in Tanzania has also developed several superior lines for production in the tropics and subtropics. These lines mature early (55–65 days after sowing), are high yielding, uniform and disease resistant. Thailand, the Philippines and Indonesia have released early maturing cultivars such as Chainat 60, BPI Mg7 and Merpati, respectively, using AVRDC mung bean lines (AVRDC, 1990).

AVRDC-improved mung beans have been named and released directly, or used as parents in breeding programmes in various countries. Examples of such varieties are NURI (Indonesia), SML-668 and Pusa Vishal (India).

Description of the plant

Mature plant

Mung bean is an annual crop, cultivated mostly in rotation with cereals. It is an erect plant which is highly branched and is about 60 to 76 cm tall (Oplinger, *et al*, 1990). Mung bean looks more like a garden bean than like a soya bean plant.

Roots: Mung bean roots are deep rooted just like the roots of black eye.

Stems: Both upright and vine types of growth habit occur in mung bean, with plants varying from 0,5 m to 1,3 m in length.

Leaves: The leaves are trifoliate like other legumes.

Flowers and fruit: The pale yellow flowers are borne in clusters of 12–15 near the top of the plant. Self-pollination occurs, so insects and winds are not required. Flowers will eventually develop into small, thin cylindrical pods and, often, cylindrical seeds covered with a white rough layer. Pod colour varies from black and brown to pale grey when mature. Pods are 7,5 cm to 10 cm long, each having 10 to 15 seeds. There are several pods clustered at a leaf axil, with typically 30 to 40 pods per plant. The pods turn darker in colour as they mature. The seeds are free from glycosides. The



seed colour exhibits a wide range of variations at maturity from yellow, greenish-yellow, light-green and shiny green to dark-green, dull green, black, brown, and green mottled with black. The weight per 100 seeds is 3–7 g.

Essential parts

The seeds are the essential part of the plant.

Climatic requirements

Temperature

Mung bean is a warm season crop requiring 90–120 days of frost-free conditions from planting to maturity (depending on the variety). The optimum temperature range for growth is between 27 °C and 30 °C. This means that the crop is usually grown during summer. Seed can be planted when the minimum temperature is above 15 °C. Mung beans are responsive to daylight length. Short days result in early flowering, while long days result in late flowering. However, mung bean varieties differ in their photoperiod response. Mung bean is considered to be heat and drought tolerant.

Rainfall

Adequate rainfall is required from flowering to late pod fill for purposes of ensuring good yield. Late plantings which result in flowering during the high temperature-low moisture periods will reduce yield. High humidity and excess rainfall late in the season can result in disease problems and harvesting losses due to delayed maturity.

Soil requirements

Mung beans do best on fertile, sandy loam soils with good internal drainage and a pH in the range of 6,3 and 7,2. Mung beans require slightly acid soil for best growth. If they are grown in rotation, lime to attain pH of the most acid sensitive crop. Root growth can be restricted on heavy clays. Mung beans do not tolerate saline soils and can show severe iron chlorosis symptoms and certain micronutrient deficiencies on more alkaline soils.

CULTIVATION PRACTICES

Propagation

Mung beans are propagated from seed. A seeding rate that will ensure a plant population of 200 000 to 350 000 plants/ha under dry-land conditions and 400 000 plants/ha under irrigation, is recommended.

Soil preparation

Mung beans do best on fertile, sandy loam soils with good internal drainage and a pH in the range of 6,3 and 7,2. Mung beans require slightly acid soil for best growth. If they are grown in rotation, lime to attain pH of the most acid sensitive crop. Root growth can be restricted on heavy clays. Mung beans do not tolerate saline soils and can show severe iron chlorosis symptoms and certain micronutrient deficiencies on more alkaline soils.

Field layout and design

Sow seeds directly at least two weeks after the end of the frost. Seeds planted earlier may rot. In full sun, set seeds 5 cm to 10 cm apart and 2,5 cm deep in beds that are slightly elevated for drainage. Eventually, the seedlings should be thinned to 15 cm apart. The rows should be 75 cm to 1,2 m apart. The seeds rarely germinate better than 50% to 60%. We recommend a seeding rate that will achieve a plant population of 200 000 to 350 000 plants/ha on dry land and 400 000 plants/ha under irrigation.

The crop can be sown at different row spacings of 18 cm to 100 cm depending on yield expectations, planting equipment, stubble management and rotated crops.

Planting

Seeds should be planted 4 cm deep in a well-prepared seedbed with good moisture content. If the surface layers are dry this depth can be increased to 7,5 cm if the soil type is one which does not crust easily. The seedlings of mung bean can have a hard time breaking through a thick crust and stands will be reduced.

Mung bean should be planted between late November and early December like the other legumes (field bean and cowpea) which are grown as the major crop on the field. Late planting dates will result in bloom and pod fill during the hottest, driest period of the summer. Planting equipment for soya bean, field bean and cowpea can be used to plant mung bean but careful adjustments must be made to deliver and distribute the very small seed properly and thus ensure little or no damage to the seed.

Fertilisation

Nitrogen fertiliser is usually not applied as mung bean fixes its own nitrogen, but it is advisable to use *Rhizobium inoculums* on the seed, particularly when the crop is to be grown on a piece of land that has not been sown to mung beans for several years. This inoculant can be applied to the seed just before planting or applied in the furrow in peat or granular form. Care must be taken to distribute this inoculant uniformly in the field.



Be sure to use bacteria that are specific for mung bean or closely related species.

Mung bean has phosphorus, potassium, calcium, magnesium and sulfur requirements similar to other legumes which must be met by fertiliser additions if the soil is deficient in these elements. Phosphate fertiliser is usually required at 5 to 10 kg/ha on dry-land crops and 10 to 20 kg/ha on irrigated

crops. Higher rates may be required if the crop is grown after a long fallow period or on severely P deficient soils. Mung beans are sensitive to zinc deficiency, which can be corrected by a soil application of zinc sulphate monohydrate pre-sowing or a foliar spray of zinc sulphate heptahydrate.

It is always advisable to conduct soil tests and follow the recommended applications, while considering the anticipated yield. If soil pH is below 6.3, lime should be added to raise pH to the desired level. For best results, lime should be applied one year prior to growing mung beans and thoroughly incorporated.

Irrigation

Mung beans are frequently grown under irrigation. Because of their short growth duration they need less water than many other crops. Since mung beans are sensitive to water-logging, laser-leveled fields with a relatively steep position are preferred. Water should be applied quickly and drained away through the relatively steep gradient. The most critical time for irrigation is during flowering and early pod fill. It is essential to manage irrigation carefully to provide sufficient water to fill pods but not so much that maturity is delayed.

Weed control

Mung beans are not as competitive with weeds as soya beans are. Furthermore, only a few herbicides have been registered. Weed control in mung bean is essential, since competition between the mung bean and the weed is reduced, thus ensuring higher yields. The presence of weed seed in a seed lot will result in the seed being downgraded to a lower quality. Grain sorghum and thorn apple seed are extremely difficult to remove from a mung bean seed lot, and their occurrence is not tolerated in premium grade seed.

Black nightshade, hairy nightshade, yellow nutsedge and summer annual grasses are the major weeds that can create harvest and quality problems in mung bean, and therefore it is important to pay special attention to them. Advice on suitable herbicides can be obtained from local traders and/or chemical companies. Hand weeding at about 40 days after planting is beneficial.

Mechanical: To promote good cultivation practices, inter-tillage by hand should be performed once or twice. Rotary hoeing should be performed as needed to remove weeds until flower initiation. Late emerging weeds

will have a smaller effect on yield than would early emerging weeds. Avoid cultivation of damp plants, since this can result in the spreading of bacterial and fungal diseases. It is recommended that first time growers of mung bean use wider row spacing so that mechanical weed control can be performed when weeds become a problem.

Pest control

Insect pest control is also important if one wants to achieve high seed quality. The sweet sticky secretion by mung bean attracts a host of insects. The main insect pests of mung bean will be briefly discussed.

Plant/leaf bugs (*Lygus*) have piercing and sucking mouthparts that physically damage the plants by puncturing the tissue, followed by the sucking up of the plant sap.

It appears to be the most damaging insect as far as seed yield and quality are concerned. Damage occurs from the budding to the podding stage. Affected buds will turn white and fail to develop. The flowers may senesce before pod formation, or the pods can senesce before they have matured. Most of the economical damage usually occurs at the podding stage. *Lygus* damage the seed by piercing the seed and then sucking out the sap. Damaged seeds collapse, shrink, darken, and lose their viability.

The adults and oldest nymphs do the most damage. Hot dry weather promotes *Lygus* growth. Therefore, control of *Lygus* during and after flowering is crucial. Adequate rainfall and optimum growing conditions from budding to the end of flowering may cause the crop to outgrow *Lygus* damage.

Bean fly (*Ophiomyia phaseoli*, *Ophiomyia centrocematis*, *Melanagromyza sojae*) is the most prevalent insect pest for mung bean. It causes significant damage during the seedling stage. The adult flies are tiny and therefore not easily recognised. Bean fly maggots feed on the inside of the plant stem and their damage cannot be seen from the outside. Mung beans have to be protected against bean flies. Monocrotophos, omethoate or dimethoate are recommended by the AVRDC. These are to be sprayed at 3, 7, 14, 21, 28 and 35 days after plant emergence. The first three sprays are of extreme importance and must not be delayed.

Bruchid beetle (*Callobruchus maculatus*) is a serious post-harvest pest and is commonly termed pulse beetle or cowpea weevil. This pest attacks mung bean both in the field and in storage, with the greater losses occurring in stored grains. The nutritional quality of the grains deteriorates as a result of bruchid infestation, rendering them unmarketable.

Proper sanitation of the storage area, complete drying of the seed and the application of non-toxic chemicals such as vegetable oils can assist in the controlling of this pest. For large-scale storage, fumigation with phosphine or other suitable fumigants can be adopted. Always follow the instructions as set out on the label whenever using any pesticides.

Stink bug (*Nezara viridula*) can, at times, also attack mung bean. If unusually high populations of this pest (three to four insects/meter row) are observed uniformly over the entire field and when pods are still green, spray with fenvalerate or deltamethrin at weekly intervals until the threat has been eliminated.

Other pests of importance: Aphids, cucumber beetles, mosquitoes and several species of worm are also attracted to mung bean. However, they appear to cause minimal damage. It should be noted that if unusually high aphid populations are observed (over 20 insects per plant), insecticides such as dimethoate can be sprayed once a week until the aphids are eradicated. Seed corn maggot and wireworms could also attack seed in the early stages of germination, thus reducing the germination rate and, subsequently, stand density. Occasionally, grasshoppers or caterpillar infestation can occur and may cause defoliation.

Chemical control involving the use of one or two sprays is usually necessary, but care should be taken when choosing the insecticides and they should be applied at the right time in order to achieve maximum control.

Disease control

Mung bean, just like any other legume crop, is susceptible to diseases caused by fungi, bacteria and viruses. Various leaf and stem pathogens, such as powdery mildew and bacterial blight, are frequently seen, especially in growing crops, but do not cause much damage.

Mung bean Yellow Mosaic Virus (MYMV) is the most serious disease of mung bean on the Indian subcontinent. Planting of MYMV-tolerant/resistant mung bean varieties is the best control measure.

Powdery mildew occurs under cool temperatures (18 °C to 20 °C) and is favoured by cloudy weather. In the early stages of infection, light yellowish, irregular spots appear on the leaves, which rapidly turn brown. A powdery mass grows over the spots covering the entire leaf surface. It is usually seen in the late stage of the plant's life cycle, and is therefore of minor significance in crops that have been sown at the optimum time, but can cause significant damage (up to 40% yield loss) to crops sown late in summer.

Planting of resistant cultivars, if available, is recommended to control powdery mildew. When powdery mildew susceptible cultivars are used, ethirimol must be sprayed at a rate of 200 ml a.i./ha, starting three weeks after emergence.

Cercospora leaf spot (*Cercospora canescens*) commonly attacks mung bean in the tropics. Infection is characterised by the appearance of leaf spots that are circular and/or irregular in shape with greyish-white centres and reddish-brown to dark brown margins. It can cause yield losses of up to 58%.

Removing the crop debris and weed hosts at the time of planting, and planting disease-resistant cultivars can aid in the avoidance and/or control of the disease. When susceptible cultivars are planted, spray with fungicides such as chlorothalonil at 2 kg a.i./ha at two-week intervals (Lal, G., *et al*, 1990).

Sclerotium blight (*Sclerotiniarolfsii*) attacks mung bean stems. Symptoms include wilting, decay of the basal part of the stem and the appearance of white cottony mycelia on the stem as well as in the soil. It is rather difficult to control the disease. However, one can avoid it by deep ploughing. Some resistant varieties have also been identified.

Leaf blight (*Thanatephorus cucumeris*) is favoured under warm and humid conditions. Webs of fungal hyphae cover leaves in both healthy and necrotic areas. Symptoms include rapid necrosis and drying of the leaves. It is difficult to control the disease, but the use of fungicides can slow disease development.

Scab (*Spaceloma glycine*) is mostly favoured by warm, wet weather. Round to elliptical lesions occur on the leaves, petioles and stems. The lesions are greyish-white at the centre, while the margins are reddish-brown. To control the disease, we recommend the use of fungicides. The disease is most problematic in Indonesia (AVRDC, 1990).

Charcoal rot (*Macrophomina phaseolina*) is the most prevalent disease in mung bean. Charcoal rot normally has little effect on growing plants, but is a significant problem for sprouting seed.

Other cultivation practices

Mung bean has a short growing duration, which means that it requires less water than many other crops and is easily fitted into rotations. Proper rotation, tillage practices, and water management (if under irrigation) can be effective in reducing the impact of the diseases and some of the pests.

Harvesting

Harvest maturity

Mung bean matures within 75 to 90 days. Pod maturity in mung bean is not uniform because the plants flower over an extended period. This makes it difficult to decide when to harvest. Generally, harvesting should begin when one half to two thirds of the pods are mature. Harvesting too early can result in the loss of immature pods while harvesting too late can result in losses from pod shattering during the harvest operation. A desiccant is often used to kill green leaf and the few remaining green pods before harvest.

Beans can easily split or be damaged during harvesting but the farmer can minimise this by harvesting at the correct seed moisture content (14% to 16%), by avoiding harvesting during the middle of the day, and by paying careful attention to harvester settings. Also, a dry harvest period is highly desirable as most varieties are very susceptible to weather damage caused by wet and humid conditions that can result in severe reduction of seed quality.



Harvesting methods

Mung bean pods are thin and brittle when dry so shattering can be a problem during harvesting. Harvest conditions and management often determine the success or failure of the crop (Murray, 1986). Harvesting should take place when pods are mature and dry, but before they start shattering. Manual or mechanical harvesting can be applied. According to the AVRDC (1990), manual harvesting is usually practiced, but the use of mechanical harvesters is also recommended in order to save on labour costs.

When harvesting is done manually, mung bean stalks are cut with a band saw and the average manpower requirement for the task is about 32 men/day/ha. Thereafter, the harvested mung bean stalks containing the pods should be sundried for four to seven days (averaging 5,8 days). However, this practice is not 100% safe as it presents problems to farmers, since by spreading of the mung bean on the ground for sun-drying—they reabsorb moisture during the night and become soaked with condensates from the early morning moist air. The problem is even more severe during winter.

According to Murray (1986), direct combining as a method to reduce seed shattering is preferred to windrowing of mung bean. Mechanical harvesting requires the plants to defoliate and dry down beforehand. Defoliant or desiccants can be used to achieve defoliation, but registered defoliant have disappeared from the marketplace. According to the AVRDC (1990), Ethrel, at 39, 5% a.i and 500 dilutions will result in 90% defoliation without negatively affecting seed quality.

If windrow and cutting methods are going to be practised, instead of using a combine, plants should be cut when approximately half of the pods have turned black. Many green pods will still be left, but most will continue to maturity because of stem thickness and their ability to retain moisture. After they have been cut, sufficient time should be given for the seed to dry with no mechanical disturbances (Murray, 1986).

For the vine-type varieties, or when there is delayed maturity, some growers swath the plants to allow further maturity of the pods and then use a pick-up header on a small grain combine. To prevent severe shatter losses, swathing should be performed earlier in the day.

Mung beans can be directly combined using a platform head or a row crop head in weed-free, uniformly mature fields of the upright growth habit type (Oplinger, et al, 1990). It is important to adjust the cylinder speed and concave clearance for complete threshing with a minimum of seed breakage. In developing countries, mung beans are hand-picked as the pods mature. Five pickings are possibly in some high-yielding lines

POST-HARVEST HANDLING

Sorting

After combining, the seed should be cleaned rapidly to remove green pods, leaf material, debris, etc., prior to storage, since these could create drying and storage problems.

Small cracks in the seed coat that are not readily visible can occur with incorrect harvester settings or rough handling and can cause downgrading of a seed lot because of high over-soak levels.

Grading

Since large quantities of mung bean produced elsewhere in the world are exported to Asia, the normal procedures for commercial mung bean marketing will be briefly set out.

The graded seed is sampled for quality evaluation by an accredited laboratory and, following classification, a sample is usually given to an exporter who arranges the sale. It has been common practice for exporters to sell on sample, but the establishment of quality seed grades has resulted in an increasing number of seed lots being sold on grading. A recent innovation has been the sale of crops in bulk for dhal production. This is an option for growers who note that at the time of harvest their crop will be classified as processing grade.



Packing

For some buyers, seed can be cleaned and bagged, while others will prefer taking the grain in bulk and cleaning it themselves. The rasing is carried out in different ways and with varying degrees of efficiency.

Storage

Mung beans with about 12% moisture can be stored in regular grain bins that have been fumigated to control bean weevils. If beans are higher in moisture, above 12%, they can be dried slightly by moving unheated air though thin layers until they are near or at the 12% value. Care should be taken to keep all possible contaminants away from the storage area as the seeds will be sprouted and eaten directly.

Transport

Following harvest, beans are trucked to a grading shed where they are cleaned, graded and bagged as soon as possible. Mung bean does not require specialised transport.

Marketing

As with all specialty crops with limited market uses, a grower should always identify markets before producing mung bean on a large scale. It is



also advisable to identify markets as early as possible rather than waiting until after the harvest. Local health food stores, restaurants and brokers may be able to purchase the produce. Production costs for mung beans are very similar to production costs for soya bean, except that post-harvest cleaning and transportation costs may differ.

Information on the costs for the production of mung bean in South Africa is not available, but just like elsewhere in the world, costs are similar to those of cowpea and soya bean. Since there are no locally available seed sources, seed cost will likely be slightly higher and its availability could be a major problem.

Although profits from mung bean are not dramatically different from those of soya bean, their drought tolerance and the fact that they are a food crop rather than a feed crop can aid in buffering some of the farmer's economic risk because of the variability in weather and commodity crop prices (Myers, 2000).

There are potential market opportunities for mung bean as production is reported to be on the decline in some Asian countries. A high rate of germination must be maintained, since buyers purchasing mung bean for bean sprouts may want to test germination rates before agreeing to a purchase.

PRODUCTION SCHEDULES

Activities	January	February	March	April	May	June	July	August	September	October	November	December
Soil sampling												
Soil preparation												
Planting												
Fertilisation												
Irrigation												
Pest control												
Disease control												
Weed control												

Activities	January	February	March	April	May	June	July	August	September	October	November	December
Pruning												
Leaf sampling												
Harvesting												
Marketing												

UTILISATION

The most important product of the mung bean plant is its seed. Mung bean is used in several food products, both as a whole seed and in processed form (Myers, 2000). Like most legumes they are relatively high in protein—about 14 g of protein per cooked cup (250 ml). The amino acid profile of mung bean is similar to that of other beans and is complementary to cereal grains. They also contain thiamin, iron, magnesium and other nutrients and are a good source of folate.

The principal domestic use of mung bean is the production of bean sprouts, which is commonly seen in Asian cooking. Mung bean can also be used for dhal when used in ethnic cooking. It is used as a staple legume in many diets around the world. Processed mung beans are used as a soup base, for bean flour which is used for making noodles, and in a wide range of traditional Asian foods.

Mung bean sprouts serve as a good alternative vegetable and source of income, especially during hot wet summers and rainy seasons when there is an acute shortage of fresh vegetables. One cup of mung bean sprouts equates to 35 calories, 22% of the daily vitamin A and 20% of the daily vitamin C requirements. To enhance shelf life, keep the sprouts refrigerated or frozen. Place the sprouts in a plastic bag with a few drops of water, seal and keep in the refrigerator. Stored in this manner, they will last for one to two days.

As mung bean is drought resistant, it is grown for forage, silage, hay and chicken feed.

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