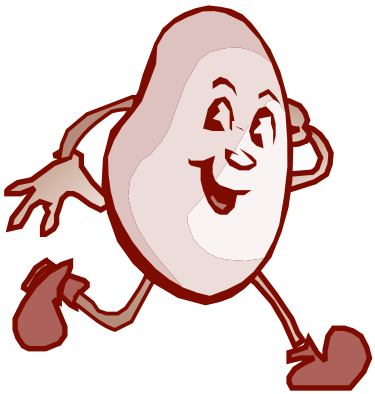
DEPARTMENT: AGRICULTURE

Dry bean production



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Dry beans is at present regarded as one of the most important field crops in South Africa on account of its high protein content and dietary benefits.

Of all the annual leguminous food crops that are harvested for dry seeds, the ordinary bean is by far the most important. Dry beans (*Phaseolus* spp.) originated in Central and South America. Within the genus *Phaseolus* there are three species which are agronomically important in South Africa.

- ***Phaseolus vulgaris***

  Many different types and colours, the most important of which are: small white, red speckled or sugar beans, carioca and green beans

- ***Phaseolus acutifolius***

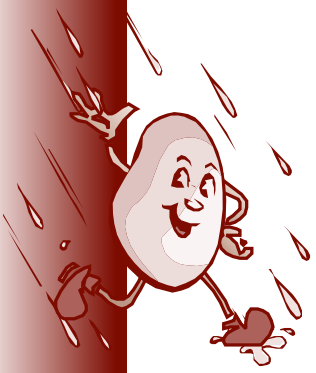
  Tepary beans

- ***Phaseolus coccineus***

  Large white kidney beans

Within each species there are many seed types which differ in size, shape and colour. Within each type there are different cultivars and the seeds of these cultivars differ very little from one another. However, considerable differences may occur in adaptability, growth habit, disease resistance and many other characteristics. In this publication, only *P. vulgaris* is discussed, except where mentioned otherwise.

CLIMATIC REQUIREMENTS



The dry bean is an annual crop which thrives in a warm climate. It grows optimally at temperatures of 18 to 24 °C. The maximum temperature during flowering should not exceed 30 °C for *P. vulgaris* and 26 °C for *P. coccineus*. High temperatures during the flowering stage lead to abscission of flowers and a low pod set, resulting in yield loss. Day temperatures below 20 °C will delay maturity and cause empty mature pods to develop. Cultivated under rainfed conditions the crop requires a minimum of 400 to 500 mm of rain during the growing season, but an annual total of 600 to 650 mm is considered ideal.

SOIL REQUIREMENTS

Beans have to be planted in warm soils (minimum temperatures preferably above 13 °C) after all danger of frost has passed.

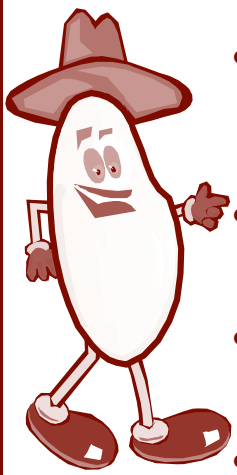
They grow well in soils with a depth of at least 90 cm, that have no deficiencies, and are well drained. Sandy loam, sandy clay loam or clay loam with a clay content of between 15 and 35 % is suitable. With sandy soils, problems of low fertility or nematode damage may occur.

Beans prefer an optimum soil pH (H_2O) of 5,8 to 6,5, and are very sensitive to acidic (pH (H_2O) < 5,2) soils (acid saturation above 10 %). They will also not grow well in soils that are compacted, too alkaline or poorly drained.

CULTIVAR CHOICE

The National Dry Bean Cultivar Trials are conducted by the ARC-GCI annually and the information is published by the DPO in *SA Dry Beans*. Dry beans are classified into types according to:

Colour and seed size



- Small white beans (15–25 g/100 seeds), used mainly for canning purposes; 10 to 20 % of local production
- Red speckled or speckled sugar beans (red speckles on a beige background) (40–55 g/100 seeds); 65 to 75 % of local production
- Large white kidney beans (80–100 g/100 seeds); 5 to 10 % of local production
- Carioca beans (khaki stripes on a beige background) 20 to 25 g/100 seeds); 3 to 5 % of local production
- Alubia beans (large white) (45–55 g/100 seeds); 1 to 5 % of local production

Growth habit

- type 1: determinate or bush type
- type 2: indeterminate compact upright
- type 3: indeterminate runner type (short runners)

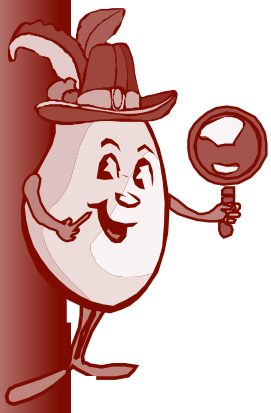
Growing season

Temperatures, especially during the night, determine the length of the growing season of a cultivar:

- short (85–94 days)
- medium (95–104 days)
- long (105–115 days).

A cultivar can have any combination of these characteristics. Further information on cultivars can be obtained from the ARC-GCI. Seed is produced by Dry Bean Seed (Pty Ltd) tel. (012) 325 1850 and PANNAR tel. (033) 413 1131.

SEED QUALITY



For successful production, it is important that high-quality (certified) seed with a high germination percentage (80 % or higher) be used. This production cost factor is slight when compared to probable yield losses due to disease or poor stand. Low-quality seed can cause a poor and an uneven stand, resulting in uneven maturity, harvesting problems and yield losses. Using disease-free seed will reduce the incidence of seed-borne diseases such as **bean common mosaic virus (BCMV)**, bacterial diseases **(common blight, halo blight** and **bacterial brown spot)** and the fungal disease, **anthrac-**

nose. Other benefits of disease-free seed are that it is:

- labelled to indicate germination percentage
- guaranteed true to type and ensures homogeneity
- guaranteed free of weed seeds and foreign matter.

SOIL PREPARATION

Seedbed preparation for the planting of dry beans follows the same pattern as that for any row crop planted in the spring. The seedbed must be deep, level and firm because this ensures better surface contact between the seed and the soil, increasing the absorption of moisture. A level seedbed also facilitates planting to a uniform depth.

FERTILISATION

It is recommended that beans be planted on soils which have been previously well fertilised. General fertility is more advantageous than direct fertilisation, because beans are sensitive to high concentrations of mineral salts.

Macronutrients

The total withdrawal figure per 1 ton of dry bean seed produced is about 36 kg N, 8 kg P and 18 kg K.

Nitrogen (N)

Inoculation of dry bean seed is regarded as ineffective. Consequently, dry beans should be considered as incapable of satisfying all of their nitrogen requirements through N-fixation. The application of all the nitrogen at planting time is recommended, particularly where undecomposed material has been ploughed in before planting.

Deficiency symptoms

Lower leaves become light green and then yellow and eventually die. Young leaves may be lighter green than normal.

Guidelines for nitrogen application

Yield potential (t/ha)	1,5	2,0	2,5
N fertilisation (kg/ha)	15,0	30,0	45,0

Phosphorus (P)

Under commercial production the yield responses to phosphorus fertilisation are not dramatic in dry beans and P is not normally a yield-restrictive factor. Under subsistence production, where small quantities of fertiliser are applied P can be a yield-limiting factor. Where the P content of the soil is lower than 20 ppm (Bray 1) it is recommended that superphosphate be broadcasted and

ploughed into the soil to a depth of 15 to 20 cm before planting.

Phosphorus fertiliser must still be band-placed at the time of planting. In low pH soils, phosphorus can be utilised efficiently by bandplacing 3,5 cm to the side and 5 cm below the seed.

Deficiency symptoms

Young leaves are small and dark green, older leaves senesce prematurely. Plants have short internodes and reduced branching.

Guidelines for phosphorus fertilisation

Soil analysis		P application for potential (t/ha)		
Ambic	Bray 1	1,5	2,0	2,5
P (mg/kg)		P fertilisation (kg/ha)		
10	13	16	22	28
15	20	12	16	20
20	27	10	13	16
25	34	9	12	15
>45	>55	5	5	5

Potassium (K)

When dry beans are grown on soils with a high clay content, potassium is not normally a limiting factor. Deficiencies are most likely to occur on sandy soils with an analysis of less than 50 ppm K. The optimum leaf content is 2 % potassium.

Deficiency symptoms

Bright yellow chlorosis of older leaves, appearing from the margins and then extending rapidly to the centre of leaflets.

Guidelines for potassium fertilisation

Soil analysis		K fertilisation for potential (t/ha)		
Ambic 1	NH_4OAc	1,5	2,0	2,5
K (mg/kg)		K fertilisation (kg/ha)		
40	40	22	27	32
60	59	19	24	29
80	78	17	21	26
100	98	15	19	24
>100	>98	0	0	0

Micronutrients

Molybdenum (Mo)

If the soil has a pH (H_2O) of less than 6, a seed treatment of 100 g sodium molybdate per 50 kg seed and/or a foliar spray of 100 g sodium molybdate per hectare should be given. If the pH (H_2O) is below 5,3 and there are no Rhizobia in the soil, no results will be achieved by applying molybdenum.

Deficiency symptoms are similar to those of nitrogen because it is important for N metabolism.

Zinc (Zn)

The critical level of zinc in bean tissue is 15 to 20 ppm. Levels higher than 120 ppm can decrease yields. The availability of zinc is highest in slightly acid soils (pH 6,0–6,8) and lowest at pH(H_2O) above 7,4.

Deficiency symptoms

Pale, yellow leaves, especially between veins and near the tips. The plants become deformed and dwarfed and may die. Pod formation is hampered and the plants are slow to mature.

Manganese (Mn)

Deficiencies only occur on soils with a high pH value. Symptoms include small leaves with a mosaic yellowing in the interveinal areas while the veins remain prominently green. Deficiencies can be corrected by applying manganese sulphate ($MnSO_4$) at 15 to 20 kg/ha.

Boron (B)

Boron toxicity is a more frequent problem than deficiency and symptoms include chlorosis and dwarfing. With time, the chlorosis increases and resembles burn, with the leaf margins curling in. Beans should not follow a sunflower crop which has received boron fertiliser.

Iron (Fe)

Deficiency occurs on calcareous or saline soils where pH (H_2O) values are above 7,4. Symptoms are characterised by bright yellow leaves and green veins. Deficiencies can be rectified by a 1 % $FeSO_4$ solution or chelate applied as a foliar spray.

SOIL ACIDITY (pH)

The optimum soil pH levels for dry beans are:

- pH (H_2O): 5,8–6,5
- pH (KCl): 4,8–5,5.

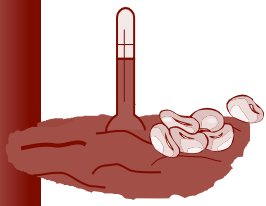
The percentage of acid saturation has to be lower than 10 % for the cultivation of dry beans. The soluble aluminium content has to be less than 25 to 30 %.

The pH can be raised (acid saturation reduced) by applications of agricultural lime. These applications to acid (low pH) soils can make certain micronutrients, such as molybdenum, more available to the plant. The availability of phosphorus is influenced by the pH. It is readily available at a pH (H_2O) of 6 to 7.

Calcium and magnesium deficiencies can be alleviated with agricultural lime. High pH soils are often associated with an excess of sodium salts which reduce nutrient uptake. Beans will tolerate a

sodium saturation percentage of up to 8 or 10 and an electrical conductivity of up to 1 mmho/cm.

PLANTING DATE



The most suitable planting date is determined by the following factors:

- Correct soil temperature
- Probability of heavy rain which may lead to soil crusting and restrict seedling emergence
- Possibility of high temperatures later in the season which may cause blossom drop
- Length of the growing season (high temperatures during flowering, rain during harvest and frost damage should be avoided)
- Crop rotation programmes (position of the bean crop in the total crop setup, i.e. planted after another crop, such as maize).

Planting dates are mainly restricted by the possible occurrence of frost (planting too late), and rain at harvesting, resulting in poor quality (planting too early). Planting dates in South Africa range from November to mid-January in areas where frost occurs. In frost-free areas, March and April are the best months for planting beans. The large white kidney bean (*P. coccineus*) is an exception and is planted from mid-November to mid-December and is not adapted to winter production.

SPACING, PLANT POPULATION AND PLANTING DEPTH

The between-row spacing for all types of beans under commercial production is 900 mm because dry beans are usually cultivated in rotation with maize. For early maturing cultivars, especially those with a determinate growth habit, a row spacing of 750 mm is recommended if mechanisation is practical (see table).

Spacing and plant population

Type	Spacing within rows (mm)	Spacing between rows (mm)	Plant population seeds/ha
Early maturing, determinate	75	750	177 000
Medium and late maturing	75	900	150 000
Large white kidney	100–150	900	115 000

Planting depth is determined by the soil texture and its moisture content. Generally the seeds are placed 2,5 to 5,0 cm below the soil surface.

IRRIGATION

Irrigation offers the potential for increasing yields and enabling production in otherwise unsuitable soils. Sprinkler

irrigation is the most frequent means of irrigation for dry beans. The system used is determined by the size and shape of the lands, as well as available labour and capital. In areas where water is unrestricted (not merely supplementary irrigation), the soil should be wet to field capacity to the depth of the 1 m root zone before planting. As soon as the soil is sufficiently dry, the seedbed should be prepared and planted and thereafter the field should not be irrigated until the seedlings have emerged.

Irrigation scheduling is essential for optimum yield per unit of water. The critical, moisture-sensitive growth stages are flowering and early pod set which occur at 40 to 50 % and 50 to 60 % of the growing season. It is important that irrigation cycles be correctly scheduled, because excess moisture can create conditions conducive to root rot and *Sclerotinia*. Moisture stress can also aggravate some root rots such as *Fusarium oxysporum*. Irrigation should cease when a quarter of the bean pods have turned yellow. For the correct irrigation scheduling, expert advice must be obtained.

HARVESTING

Dry beans have a moisture content of about 50 % at physiological maturity.

The beans, however, are only ready for harvesting when the moisture content drops to 16 %, the ideal being 15 %. Seeds may split during threshing when the moisture content is less than 12 % and such seeds are rejected by canners and seed companies. It is difficult to clean without further seed split or broken seed coats. Dry beans should be harvested when all the pods have turned yellow, but before they have become so dry that the pods begin to shatter.

Dry beans can be harvested as follows:

- Handpulling and threshing by driving a tractor over them on a threshing floor. Smaller volumes can be threshed by hand by beating with a stick covered in a hessian sack. The wind can be used to separate the seed from the chaff
- Partially mechanised systems, where the plants are pulled up by hand, placed in windrows and threshed with a harvester or stacked, whereafter they are threshed with a stationary threshing machine
- Fully automated system with mechanical pulling. The beans are raked into windrows and threshed by means of an automated combine.

Tips

- **Pulling of beans should start when the moisture content of the pods is temporarily high (to prevent shattering), i.e. early in the morning before the dew has evaporated.**
- **Mechanised harvesting must be done when there is no danger of crop damage by rain.**
- **To prevent cracking and splitting beans should be threshed at slow cylinder speeds with a machine equipped with an axial flow threshing mechanism.**

WEED CONTROL

Effective weed control is a prerequisite for high dry-bean yields. Dry beans, being low-growing plants, struggle to compete with or overshadow weeds. Early control is extremely important, because the root system of the plant develops at this stage and some weeds secrete chemical inhibitors which limit plant growth. At a later stage weeds hamper the harvesting and threshing processes, adversely affecting the quality of the crop.

Mechanical weed control

Mechanical weed control should begin during seedbed preparation (remove all weeds) and be repeated with a tiller between the rows when necessary up to the flowering stage. Care should be taken that implements do not damage the crop

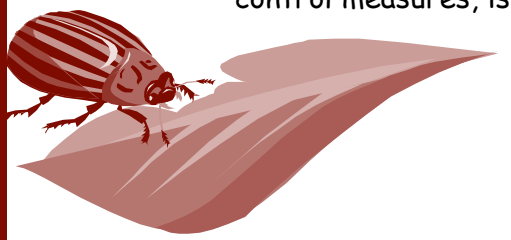
by using row spacings which permit easy access and taking care that roots are not damaged. Cultivation between the rows is also advantageous because it loosens the soil and improves aeration and water penetration. Weeds in the row have to be handpulled.

Chemical weed control

Chemical weed control can be implemented before planting or before and/or after emergence. A sufficient number of herbicides have been registered to control all weeds throughout the entire growing period of dry beans. Information in this regard is obtainable from the different agrochemical companies.

DISEASES AND PESTS

Diseases and pests may have been partially responsible for the unstable production that has been experienced in the past. Incidence and severity vary between seasons because of environmental and management practices. Integrated disease and pest management, using all suitable control measures, is recommended.



Causal organism, symptoms, ideal conditions, prevention and treatment of important dry-bean diseases

Disease	Causal organism	Symptoms	Ideal conditions	Prevention/treatment
Angular leaf spot	*Phaeoisariopsis griseola*	Dark grey to brown angular lesions on leaves. Small spore-carrying organs resembling beard stubble on underside of lesions. Severe infection leads to leaf yellowing and defoliation. Large, round, flat, reddish lesions on pods and elongated dark brown lesions on stems	Moderate to hot, prolonged periods of high humidity	Plant resistant cultivars; especially small seeded; work bean debris into the soil after harvesting
Anthrac-nose	*Colletotrichum lindemuthianum*	Brick-red to purplish darkening of veins on lower leaf surface. Brown lesions, becoming sunken with a reddish-brown border, on pods. Dark lesions (various sizes) on seeds	Cool and humid	Plant disease-free seed; work bean debris into the soil after harvesting; restrict movement in field; apply suitable fungicides; crop rotation with nonhosts (beans every 3-4 years)
Ascochyta	*Phoma exigua*	Dark brown to black concentric lesions on leaves and pods. Can cause ragged leaves and defoliation	Cool to moder-ate and humid	Work bean debris into the soil after harvesting; apply suitable fungicides

Causal organism, symptoms, ideal conditions, prevention and treatment of important dry-bean diseases (*continued*)

Disease	Causal organism	Symptoms	Ideal conditions	Prevention/treatment
Bacterial brown spot	*Pseudomonas syringae* pv. *syringae*	Leaf symptoms are small, irregular brown spots which are sometimes surrounded by a light-green zone. Older leaves have a tattered appearance. Pod symptoms are small, dark-brown sunken lesions. Infection of pods at an early stage, inhibits growth at the point of infection, which results in malformation and twisting of pods. Beans without visible symptoms can harbour substantial populations of the pathogen	Moderate temperatures, humid	Plant disease-free work bean debris into the soil after harvesting: apply copper-based bactericides as a preventive measure; control weeds and volunteer beans
BCM(N)V	Bean common mosaic (necrotic) virus	Both diseases cause dark-green vein banding, downward curl of the leaves and leaf malformation. Leaves have an arched, puckered and blistered appearance and look thinner. BCMNV causes systemic necrosis (black root) in plants containing the I-gene	Presence of infected sources, aphids and susceptible cultivar	Plant resistant cultivars/ disease-free seed; plant early to avoid large aphid populations; control aphids with suitable pesticide

Causal organism, symptoms, ideal conditions, prevention and treatment of important dry-bean diseases (*continued*)

Disease	Causal organism	Symptoms	Ideal conditions	Prevention/treatment
Charcoal root rot (Ashy stem blight)	*Macrophomina phaseolina*	Small, sunken black lesions on stems at soil level, spreading upward to blacken lower stems. Foliage may yellow, wilt and die off. Minute black dots (pycnidia) barely visible on blackened stems. More conspicuous on mature plants	Hot and dry	Seed treatment with suitable fungicides (only effective at an early stage); flooding or very wet conditions for a few weeks before planting; good irrigation; work in bean debris after harvesting. Crop rotation has limited value because maize, sorghum and small-grain crops are also hosts
Common blight	*Xanthomonas axonopodis* pv. *phaseoli*	Leaf symptoms appear as large, brown necrotic lesions surrounded by a narrow, bright yellow margin. Pod symptoms are circular, slightly sunken, dark reddish-brown lesions. Seeds directly connected with pod lesions may be discoloured	Hot and humid	Plant disease-free seed; work bean debris into the soil after harvesting; apply copper-based bactericides as a preventive measure; control weeds and volunteer beans
*Fusarium root rot (dry root) rot)	*Fusarium solani* f. sp *phaseoli*	Elongated reddish discoloration of the taproot, (root may rot completely), Plants may become stunted, show premature defoliation and evenually die. Secondary roots near the soil surface. Infection most severe when the root system is under stress	Stress conditions, especially drought. Pathogen occurs in most soils and may be spread in soil dust (wind) or on seeds)	Crop rotation with maize or other grain crop; deep ploughing; avoid stress, poor nutrition and damage to stems (by for example bean fly, hoeing, machinery); use tillage which minimises soil compaction

Causal organism, symptoms, ideal conditions, prevention and treatment of important dry-bean diseases (*continued*)

Disease	Causal organism	Symptoms	Ideal conditions	Prevention/treatment
Fusarium yellows (F. wilt)	*Fusarium oxysporum* f. sp. *phaseoli*	Visible in field as groups of yellowing plants. Leaves become yellow and die off. Internal discoloration of lower stem (vascular tissue). Younger plants stunted, may wilt and die	Hot and dry, stress conditions	Crop rotation with grain crops (maize, wheat, etc); deep ploughing; avoid stress and damage to stems (by for example bean fly, hoeing, machinery)
Halo blight	*Pseudomonas savastanoi* pv *phaseolicola*	Leaf symptoms initially appear as small, water-soaked lesions on the underside. Lesions turn reddish brown and become necrotic with age. The most characteristic symptom is a light-green zone (halo) surrounding the necrotic spot. Pod symptoms are greasy, water-soaked spots of various sizes. Lesion margins may turn brown as they mature. Lesions normally stay green on dry pods. Plants with infected vascular systems (systemic infection) appear stunted, generally showing a lime-green colour and a reddish discoloration at the nodes	Cool and humid	Plant disease-free seed; work bean debris into the soil after harvesting; apply copper-based bactericides as a preventive measure; control weeds and volunteer beans

Causal organism, symptoms, ideal conditions, prevention and treatment of important dry-bean diseases (*continued*)

Disease	Causal organism	Symptoms	Ideal conditions	Prevention/treatment
Powdery mildew	*Erysiphe polygoni*	Originally faint blackened superficial starlike blotches, becoming white, coalescing to cover aerial parts in a dry powdery film. Plants may dry out and become defoliated	Hot and moderately humid	Resistant cultivars, suitable fungicides
*Pythium	*Pythium* spp	Poor emergence, wilting and dying off of young seedlings. Water-soaked, then grey to brown lesions near soil surface, spreading to stems and roots and leading to soft rot. Areas in rows with dead plants bordered by stunted plants. In severe cases, large areas may be affected	Cool and wet conditions	Seed treatment with suitable fungicides; good drainage; crop rotation
*Rhizoctonia root rot	*Rhizoctonia solani*	Reddish-brown lesions on lower stems, becoming sunken and spreading to cause wilting and dying off of plant. Often more severe at seedling stage but may cause stunting and uneven maturation in older plants	Moderate to high soil moisture and temperatures	Seed treatment with suitable fungicides; good drainage; deep ploughing; shallow planting; crop rotation

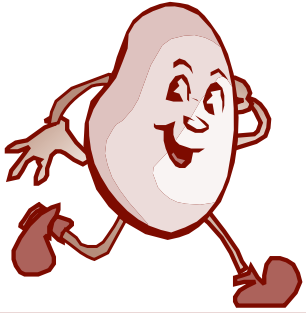
Causal organism, symptoms, ideal conditions, prevention and treatment of important dry-bean diseases (*continued*)

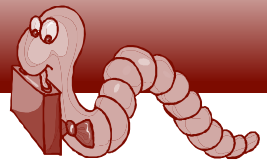
Disease	Causal organism	Symptoms	Ideal conditions	Prevention/treatment
Rust	*Uromyces appendiculatus*	Small, white spots develop on leaves, (sometimes only on underside), lesions enlarge and burst open to form raised, rust-coloured pustules releasing a reddish-brown dust (spores) when rubbed. Spores may become black at end of season. Pustules sometimes surrounded by yellow halo or necrotic (dead) tissue. Leaves may yellow and die off. Pustules on pods elongated.	Moderate temperatures, alternate wet and dry periods, windy	Resistant cultivars; suitable fungicides; work in plant debris after harvesting; remove volunteer beans
Scab	*Elsinoë phaseoli*	New leaves and shoots curl upwards. On older leaves, grey to light-brown circular scab-like lesions, usually concentrated near the veins. Similar lesions, darkening with age, on the pods	Hot and humid	Plant disease-free seed; plant resistant cultivars; apply suitable fungicides
Sclerotinia (white mould)	*Sclerotinia sclerotiorum*	Early symptoms small, water-soaked spots on leaves and stem, followed by white masses of mycelium. Sclerotia form on this mass and turn black after 7–10 days. Dried out infected tissue have a characteristic bleached appearance	Humid, dense leaf canopy	Crop rotation with maize; use disease-free seed; schedule irrigation cycles so that plants do not remain wet for long periods; avoid over-irrigation; apply suitable fungicides

Causal organism, symptoms, ideal conditions, prevention and treatment of important dry-bean diseases (*continued*)

Disease	Causal organism	Symptoms	Ideal conditions	Prevention/treatment
*Sclerotium root rot (southern blight)	*Sclerotium rolfsii*	Grey water-soaked lesions, becoming brown, near the soil surface, spreading to the taproot and leading to wilting and death of the plant. Lower leaves may also be affected. Characteristic small round light-yellow to brown sclerotia and white fungus growth visible on established lesions.	Dry weather followed by hot and humid	Good drainage; crop rotation; work in bean stubble after harvesting; deep ploughing

* Diseases of the roots and stem, known as "root rot", often occur in a complex and can include any of the following: fusarium, pythium, rhizoctonia, charcoal rot and sclerotium root rot (Southern blight), the first three being the most frequent. The latter four can also cause rotting of seed and damping off. To some extent root rot can be prevented, but not treated. Fungicides can only be applied to seed as a preventive measure against *Pythium* and *Rhizoctonia* root rot





Pests

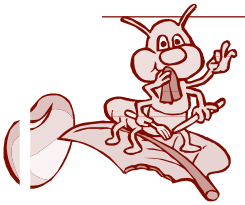
Insect	Scientific name	Damage	Treatment
Black bean aphid	*Aphis fabae*	Vectors of various viruses	Apply suitable insecticide
Groundnut aphid	*Aphis craccivora*	Vectors of various viruses	Apply suitable insecticide
Tobacco whitefly	*Bemisia tabaci*	Potential vector of bean golden mosaic virus	No insecticide currently registered
Tobacco leafhopper	*Jacobiella fascialis*	Suck sap from leaves	No treatment necessary
Bean seed maggot	*Delia platura*	Maggots attack cotyledons, mine into stems below soil level and pupate	Control with a seed dressing insecticide
Bean stem maggot	*Ophiomyia spencerella* *Ophiomyia phaseoli*	Maggots mine into stems and pupate	No insecticide currently registered
Spotted maize beetle	*Astylus atromaculatus*	Feed on pollen, destroy flowers	No insecticide currently registered
CMR beetle	*Mylabris oculata*	Destroy flowers	Apply suitable insecticide

Pests (*continued*)

Insect	Scientific name	Damage	Treatment
Black maize beetle	*Heteronycus arator*	Damage stems on or beneath soil surface	Apply suitable insecticide
Chafer beetle	*Adoretus cribrosus* *Adoretus tessulatus*	Feed on young leaves, petals and pollen	Apply suitable insecticide
Bean bug	*Clavigralla tomentosicollis*	Suck sap from leaves, stems and pods—cause wilting of developing pods	No insecticide currently registered
Tip wilter	*Anoplocnemis curvipes*	Suck sap from stems—cause wilting and dying of tips of shoots	No insecticide currently registered
Green vegetable bug	*Nezara viridula*	Suck sap from pods—cause browing of seeds inside	No insecticide currently registered
Common cutworm	*Agrotis segetum*	Damage stems on or beneath soil surface	Apply suitable insecticide
African bollwurm	*Helicoverpa armigera*	Feed into pods and damage seeds	Apply suitable insecticide
Cabbage semi-looper	*Trichoplusia orichalcea*	Feed into pods and damage seeds	Apply suitable insecticide

Pests (*continued*)

Insect	Scientific name	Damage	Treatment
American leafminer	*Liriomyza trifolii*	Larvae tunnel into leaves	Apply suitable insecticide
South American leafminer/Potato leafminer	*Liriomyza huidobrensis*	Larvae tunnel into leaves	No insecticide currently registered
Bean flower thrips	*Megalurothrips sjöstedti*	Feed in flowers, causing a roughened, silvery texture on pods	Apply suitable insecticide
Bean thrips	*Sericothrips occipitalis*	Feed in flowers, causing a roughened, silvery texture on pods	Apply suitable insecticide
Bean weevil	*Acanthoscelides obtectus*	Larvae enter seed and hollow it out by feeding	Apply suitable insecticide
Bean gall weevil	*Alcidodes erythropterus*	Larvae enter stems, pupate in the galls formed	Apply suitable insecticide



Enquiries

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  and subscribe to **SA Dry Beans**, a quarterly magazine.

  The Dry Bean Production Manual can also be ordered from the same address.