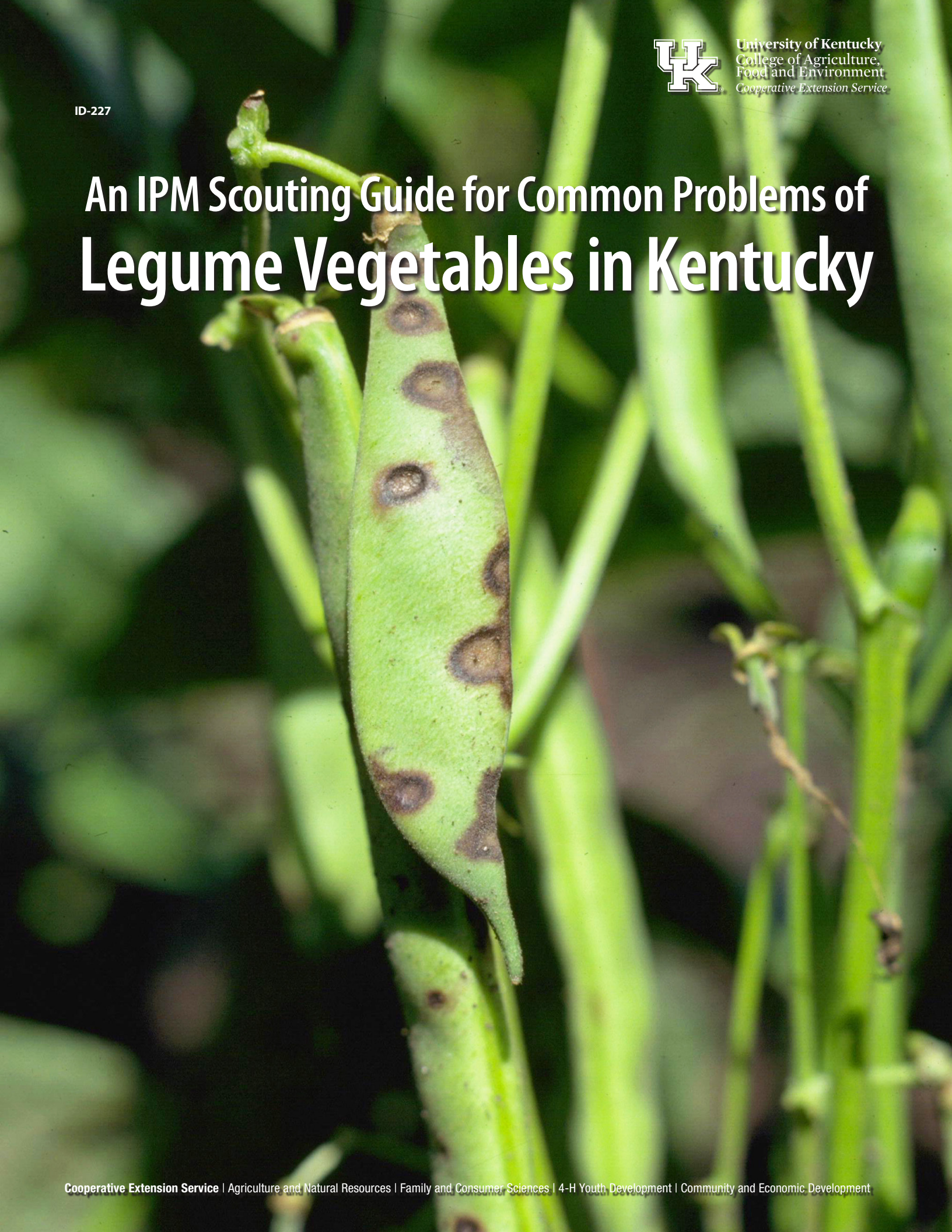
University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

ID-227

An IPM Scouting Guide for Common Problems of Legume Vegetables in Kentucky



An IPM Scouting Guide for Common Problems of Legume Vegetables in Kentucky

This manual is the result of efforts of the University of Kentucky Vegetable IPM team. Funding for this publication is from the University of Kentucky Pest Management Program.

Contents

4 .. **Diseases**

14 .. **Insects**

21 .. **Weeds**

27 .. **Abiotic Disorders**

Cover photo: Bean anthracnose on pods.
Howard F. Schwartz, Colorado State University, Bugwood.org.

Long before the term "sustainable" became a household word, farmers were implementing sustainable practices in the form of Integrated Pest Management (IPM) strategies. IPM uses a combination of biological, cultural, physical, and chemical methods to reduce and/or manage pest populations. These strategies are used to minimize environmental risks, economic costs, and health hazards. Pests are "managed" (but rarely eliminated entirely) to reduce their negative impact on the crop.

Scouting and monitoring diseases, insects, weeds, and abiotic disorders in order to identify potential problems before they result in serious losses is essential to the IPM approach. Proper identification is essential to determining the proper course of action. The pictures included in this guide represent some common pests or problems that growers may encounter during bean and pea production in Kentucky. This manual is not all-inclusive, and growers may encounter a problem that is not included here. Please contact your county Extension service for assistance.

For more complete information on legume vegetable production and pest management in Kentucky, consult the following publications, available at county Extension offices or online:

Vegetable Production Guide for Commercial Growers (ID-36): http://www.ca.uky.edu/agc/pubs/id/id36/id36.htm

Home Vegetable Gardening in Kentucky (ID-128): http://www2.ca.uky.edu/agc/pubs/id/id128/id128.pdf

In addition, the following is an excellent guide to bean diseases. It can be purchased from the American Phytopathological Society via the link below:

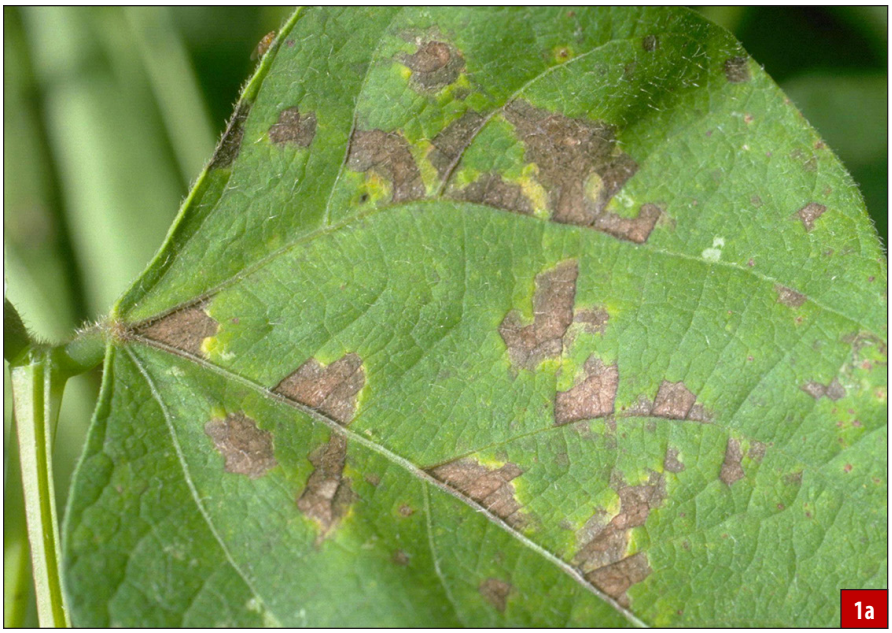
Compendium of Bean Diseases, Second Edition. Edited by Howard F. Schwartz, James R. Steadman, Robert Hall, and Robert L. Forster. 2005. APS Press. 120 pp.: http://www.apsnet.org/apsstore/shopapspress/Pages/43275.aspx

Sponsored by Kentucky IPM

UK Vegetable IPM Team
Nicole Ward Gauthier, Extension Plant Pathologist
Ric Bessin, Extension Entomologist
Shubin Saha and Shawn Wright, Extension Horticulturists
Cheryl Kaiser, Editor

Acknowledgements
The authors gratefully acknowledge the following reviewer: Julie Beale (University of Kentucky)

Diseases



Angular leaf spot on foliage (a) and on pods (b).

1. Angular leaf spot (*Phaeoisariopsis griseola*) begins on leaves as gray to dark brown irregular spots that become angular; centers become necrotic and yellow halos may appear. Black spores (conidia) develop on lower leaf surfaces during wet or humid weather. Leaf spots may coalesce, leading to leaf drop. Stem and petiole lesions appear elongated and may include yellow surrounding tissue. Pod lesions develop into large reddish-brown circular spots of concentric rings and distinct borders.
Management—Use resistant cultivars, employ sanitation and remove infected plant material, plow remaining debris to encourage decomposition, rotate with nonhost crops for at least 2 years, apply fungicides at first sign of infection.

2. Anthracnose (*Colletotrichum lindemuthiana*) causes red to purple lesions along veins, especially on undersides of leaves and along petioles. Early infections appear as dark brown to black sunken lesions on cotyledons and stems; stunting or death may occur if severe. Infected pods develop raised reddish-brown to black circular spots with grayish-black interiors. During wet conditions, lesions exude masses pink spores. Severe infections result in shriveled pods; seeds also may become infected. Spots on seeds are sunken and brown to black.

Anthracnose on pods (a) and on leaf petiole (b).

Management—Use clean seed, plant resistant cultivars, employ sanitation and remove infected plant material, avoid water runoff, plow remaining debris to encourage decomposition, rotate beans with nonhost crops for at least 2 years. Apply fungicides at first sign of infection; fungicides are not effective once disease becomes established.

Ascochyta leaf spot.

3. Ascochyta leaf spot (*Ascochyta pisi, A. lentis, A. fabae,* and *A. rabiei*) begins as small circular dark-brown spots on tops and bottoms of leaves. Spots turn light gray as they elongate and develop and become irregular and zonate; in moist conditions, spore structures (pycnidia) form in concentric circles in centers of spots. As disease progresses, spots coalesce to cover most leaf surfaces; centers may fall out. Tissue surrounding spots becomes necrotic. Stem lesions are darker than leaf lesions, covered with scattered pycnidia, and may cause stems to split and lodge (fall over). Pod lesions are sunken with pale centers and dark margins, and covered in concentric rings of pycnidia; seeds may become infected.
Management—Plant resistant cultivars, use clean seed, rotate crops every 3 or more years, use fungicides at first signs of disease, harvest as early as possible.

4. Ashy stem blight (*Macrophomina phaseolina*) usually begins as sunken black lesions with concentric rings on seedling stems near the soil line. Infection spreads upward, new cankers develop, and lesions may coalesce. Advanced disease causes girdling, and thereby wilting, leaf drop, or death of upper plant parts. Black fruiting bodies (sclerotia and pycnidia) develop as ashy gray cankers age. Similar ashy gray lesions may develop on pods and seeds if disease persists.
Management—Begin with clean seed, use resistant cultivars, follow a 4-year crop rotation with nonhosts, plow soon after harvest to encourage decomposition, use fungicide seed treatments.

Ashy stem blight (a), and close up of symptoms and signs (b).

Bacterial brown spot in planting (a),on foliage (b), and on a pod (c).

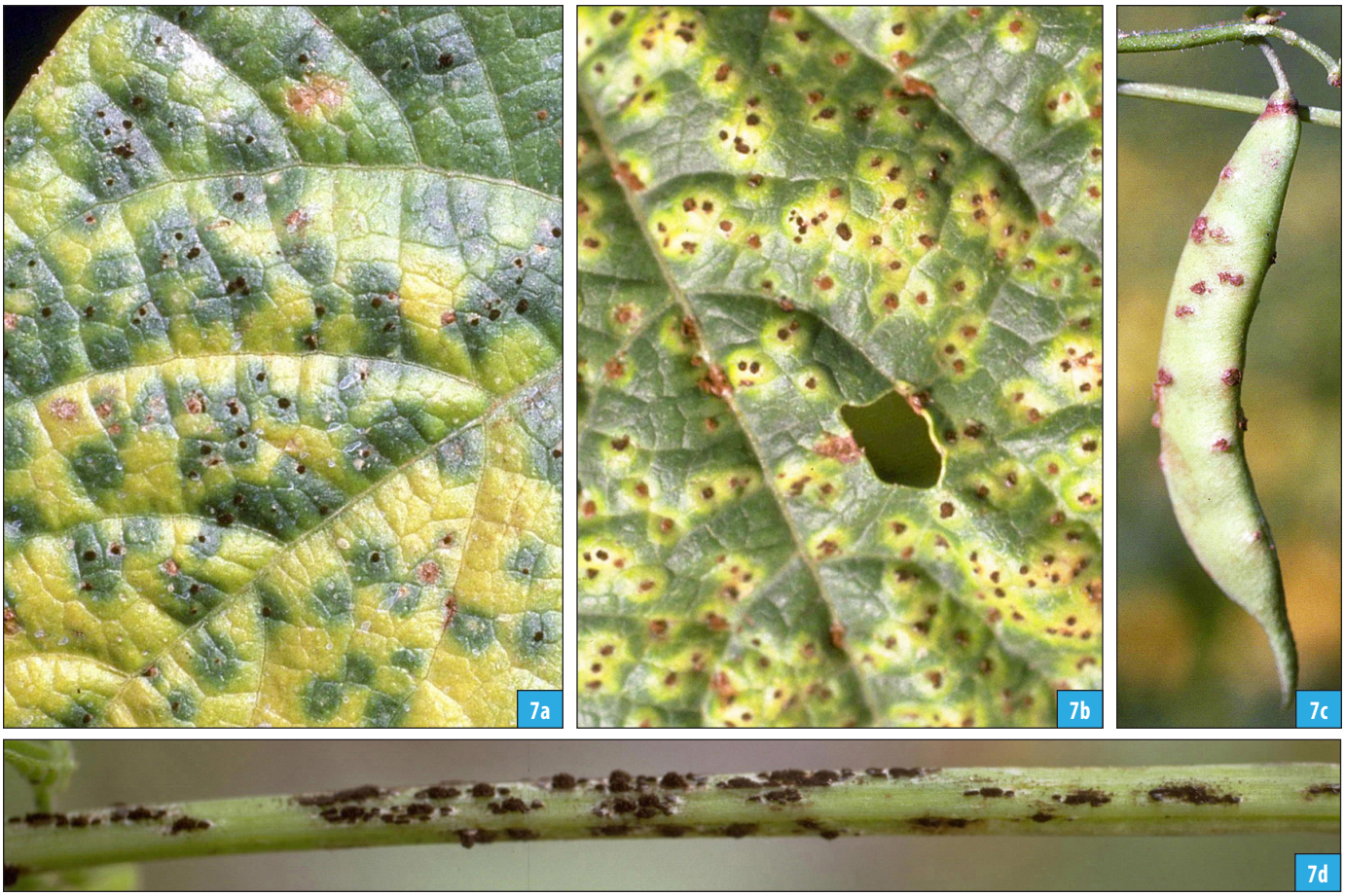
5. Bacterial brown spot (*Pseudomonas syringae* pv *syringae*) is identified by numerous small brown circular lesions. Spots may have yellow halos and necrotic centers that fall out, leaving a ragged appearance. Infected pods have water-soaked circular lesions with necrotic centers; pod distortion is common.

Management—Begin with clean seed, use resistant cultivars, avoid spread via overhead irrigation, apply copper sprays to help reduce secondary spread, manage weeds that may serve as hosts.

6. Bean common mosaic virus (BCMV, BCMNV) causes mosaic patterns of dark and light green regions. Leaf distortion may include puckering, leaf rolling, and stunting. Mild symptoms may be difficult to identify. Virus is spread through infected seed, with secondary transmission by aphids.

Management—Begin with certified or virus-free seed, plant resistant cultivars. Aphid management has proven ineffective.

Mosaic symptoms (a) and leaf distortion (b) due to bean common mosaic virus.



Bean rust lesions on common garden bean leaf, upper leaf surface (a). Note the 'green island' effect—on dry bean (b), pod (c), and plant stem (d).

7. Bean rust (*Uromyces appendiculatus*) produces rust-colored pustules on leaves, pods, and stems. A yellow halo may develop around pustules. High humidity and persistent moisture (rain or irrigation) increase spore production and subsequent infections. Resistant cultivars have been developed for many races of the pathogen, but variability of the rust fungus makes resistance unstable or incomplete.
Management—Utilize resistant cultivars when available, reduce overhead irrigation, eliminate weeds and volunteer beans that can serve as disease reservoirs, rotate with nonhost species, protect susceptible plants with fungicides.

Leaf curling/crinkling (a) and dieback (b) due to bean yellow mosaic virus.

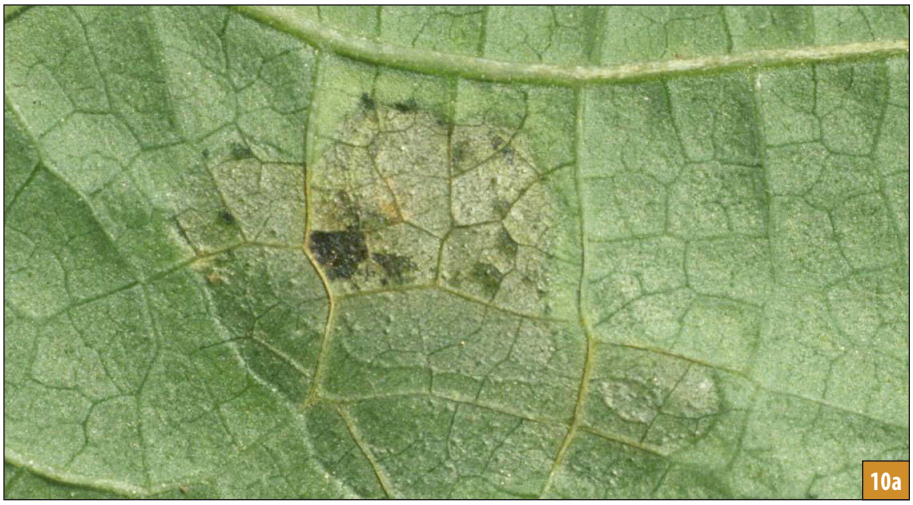
8. Bean yellow mosaic virus (BYMV) exhibits varying symptoms depending on plant age, virus strain, and environmental conditions. Leaf symptoms include mosaic patterns of green and bright yellow that intensify with plant age. Downward leaf curling, leaf "crinkling," stunting, and distortion may occur in the most severe cases. Infected plants may have short internodes that cause excessive bushiness; stunting is common.

Management—Plant resistant cultivars. Use of insecticides for management of aphid vectors is not effective.

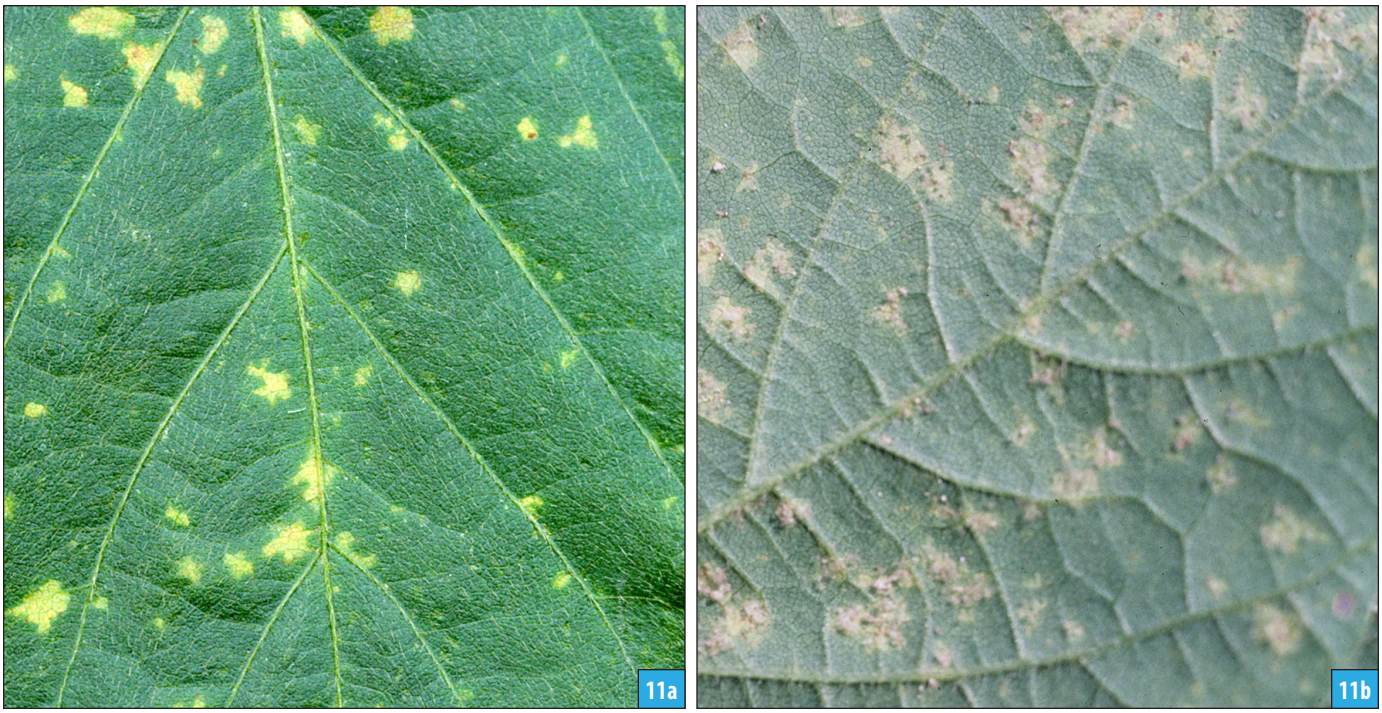
Cercospora leaf spot in planting (a) and on the underside (left) and upperside (right) of bean leaves (b).

9. Cercospora leaf spot (*Cercospora canescens*, *C. cruenta* [*Mycosphaerella cruenta*, *C. phaseoli*, *C. caracallae*]) affects mature leaves, causing circular to irregular spots that have rusty red borders and lighter centers. Necrotic centers produce raised clusters of spores (conidia); leaf centers often fall out. Leaf spots coalesce if disease is severe, and leaf-yellowing is common as disease progresses. Pods and stems can also become infected. **Management**—Begin with clean seed, plant resistant cultivars, apply copper sprays or other fungicides to help reduce spread, rotate with nonhost crops, plow debris to destroy infective propagules.

10. Common bacterial blight (*Xanthamonas campestris* pv *phaseoli*) can become a problem during rainy years. Small water-soaked spots appear along veins and leaf margins, and then leaves lose firmness and begin to droop. Yellow borders are common along blighted zones. Leaf margins may appear scorched. As disease spreads and spots coalesce, leaves remain attached to plants. Lesions on pods are circular, sunken, and reddish-brown. Seeds become infected if pod lesions are severe. **Management**—Begin with clean seed, plant resistant cultivars, use antibiotic seed treatments, rotate out of beans for 2 or more years, manage weed hosts, spray with protectant copper treatment as a preventative.



Common bacterial blight water-soaked lesion (a); lesion with a yellow border (b); blight on pods (c).



Downy mildew symptoms on upper leaf (a); pathogen growth on underside of leaf (b).

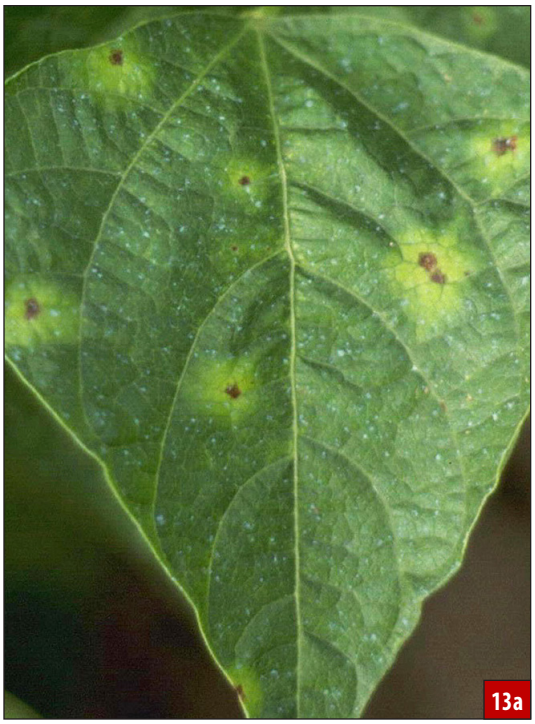
11. Downy mildew (*Phytophthora nicotianae*) is most destructive when it infects pods that touch the ground and make contact with contaminated soil. Infected pods develop white downy growth (mycelia and spores), resulting in reddish-brown discolored areas, followed by blackening and pod death. Killed pods usually remain attached. Leaf and petiole infections develop similar white downy mycelial growth, wilt, and eventually die. Blossoms may also become infected. Infection of young seedlings results in damping-off. The water mold pathogen favors excessive moisture, such as excess rain or irrigation and high humidity. **Management**—Use resistant cultivars, rotate with nonhost crops, reduce excess water, prevent pods from touching soil, apply fungicides during flowering and pod development.

Fusarium root rot.

12. Fusarium root rot (*Fusarium solani* f. sp. *phaseoli*) is a common disease of stressed plants. Infected seedlings show symptoms of red streaking on taproots and hypocotyls, with lesions expanding and becoming necrotic. Necrosis of taproots usually induces production of adventitious (lateral) roots near the soil line. Root loss results in plant stunting, leaf yellowing, and defoliation. Varying degrees of stunting often result in irregular crop distribution and varying canopy size/height.

Management—Choose resistant cultivars and reduce stresses, such as compaction, wet soil, drought, and nutrient deficiencies.

13. Halo blight (*Pseudomonas syringae* pv. *phaseolicola*) begins as small water-soaked lesions that rapidly become necrotic and develop pronounced yellow halos. Leaf chlorosis/yellowing may occur in extreme cases, especially during moderate temperatures and wet conditions; during hot weather, halos may be minimal or absent. Older lesions may ooze bacterial secretions, giving a watery or greasy appearance. Pod and stem infections appear as water-soaked spots with yellow halos.
Management—Use clean seed, plant-resistant cultivars, rotate with nonhost crops for 2 or more years, avoid overhead irrigation, manage weed hosts, apply copper protectants to reduce secondary spread.



Halo blight on leaves (a) and on pods (b).

14. Pythium rot (*Pythium* spp.) is caused by a water mold that infects seeds, young plants, or pods in wet or poorly drained conditions. Infections include damping-off, root rot, stem rot, and pod rot. Lesions on roots, stems, or hypocotyls appear water-soaked, becoming dry, sunken, and necrotic. Rapid disease development can lead to wilting and plant death, while slow disease progression results in plant stunting. Pod rot occurs when the soilborne pathogen infects pods that are touching the ground. Fluffy white fungal-like growth (resembling Sclerotinia white mold) may be visible. Pythium diseases usually occur within a complex that includes other diseases such as Rhizoctonia root/stem rot.
Management—Manage soil moisture (e.g. improve drainage), treat seeds with fungicides (effective when disease pressure is low), apply appropriate fungicides to plants in high-pressure fields or as preventatives when wet conditions persist.

Pythium stem rot (a) and pod rot (b).

Rhizoctonia root and stem rot (a); close-up of lesions (b).

15. Rhizoctonia root and stem rot (*Rhizoctonia solani*) appears as red, elliptical-shaped sunken lesions on roots, lower stems, or hypocotyls. Small lesions expand, become more sunken, and coalesce. As cankers deepen, root pith is damaged. Risk for infection is reduced when plants reach 4 weeks of age. Infection risk is highest between 60°F and 65°F, and disease is slowed when soil temperatures exceed 70°F. Web blight (see No.18) is caused by the same pathogen.
Management—Plant resistant cultivars, utilize seed treatments, rotate with nonhost crops, drench soil with fungicides if field has a history of disease, reduce compaction by deep tilling.

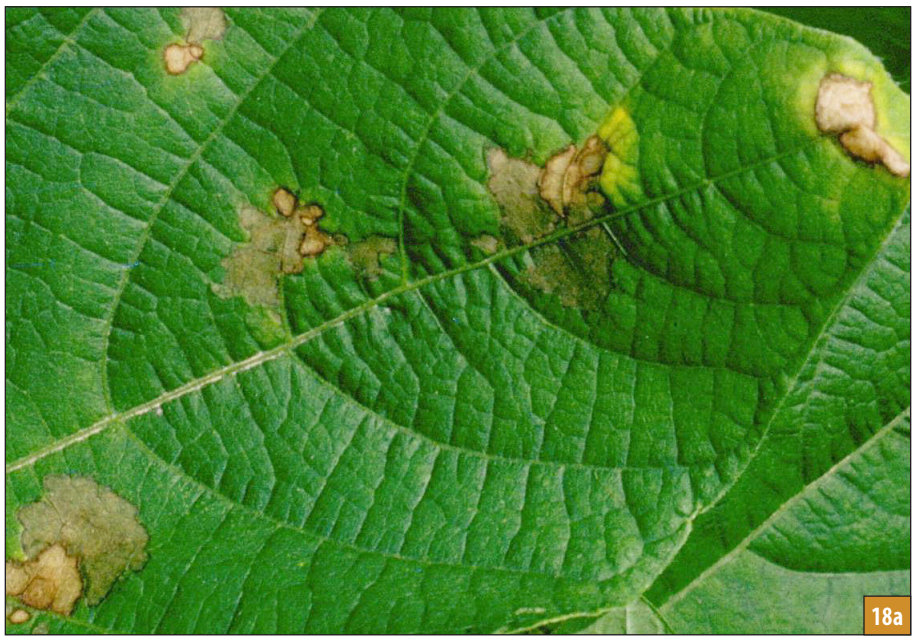
16. Sclerotinia white mold (*Sclerotinia sclerotiorum*) begins in flowers and spreads to other plant parts. Infections on leaves, pods, and stems begin as small, slimy, water-soaked spots that become light-colored and "bleached." White fluffy mycelia (stringy fungal masses) are indicative of white mold. As disease progresses, hard survival structures (sclerotia) form on infected plant tissues; these survival structures can persist for up to 5 years in soil. Tolerant cultivars are available, but complete resistance is not available.
Management—Use tolerant cultivars, select cultivars with upright open canopies for air circulation and rapid drying, rotate with nonhost crops, eliminate weeds and volunteer bean plants that can serve as reservoirs, avoid overhead irrigation, do not overwater, apply fungicides during flowering periods, refrigerate pods soon after harvest.

Sclerotinia white mold (a); *Sclerotinia* sclerotia (b).

Southern blight (a); sclerotia on stem (b).

17. Southern blight, also called Sclerotium stem rot (*Sclerotium rolfsii*), infects stems at the soil line, girdling stems and thereby restricting vascular pathways. Early symptoms include yellowing of lower leaves or entire plants. Wilting and plant death result. Fungal signs include coarse white fungal "threads" (mycelia) and very small, spherical brown survival structures (sclerotia). Warm, moist conditions and abundant organic matter are ideal environments for development of southern blight.

Management—Plant resistant cultivars, plow debris to encourage decomposition, reduce stem wounding, rotate with nonhost crops, plant when soil is still cool, apply fungicides to soil at time of planting.



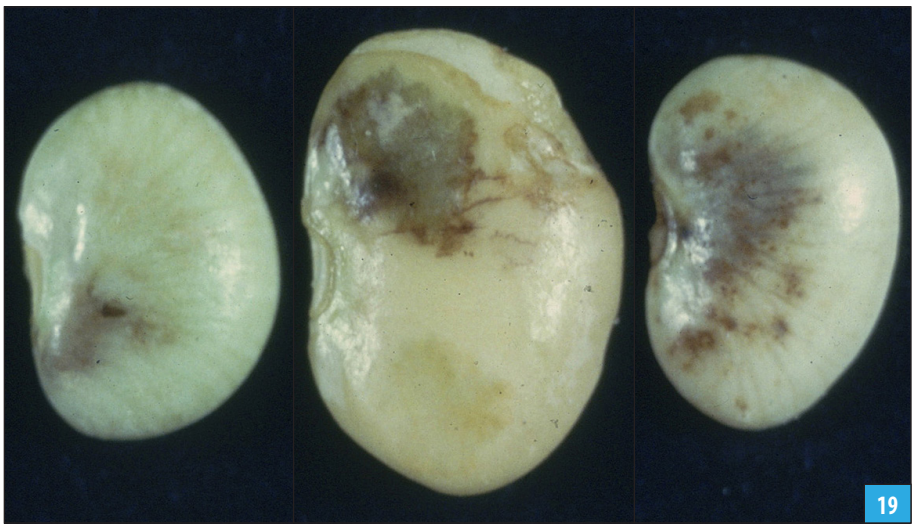
Web blight lesions (a).

18. Web blight (*Rhizoctonia solani*) appears as necrotic leaf spots with lighter centers that may fall from leaves to irregular leaf blotches. Leaf spots spread rapidly and coalesce, and defoliation may occur. Pod infections are more irregular, and pods may be killed if infections are severe. Lesions on leaves, flowers, petioles, and stems may develop areas with fluffy white or gray fungal "threads" (mycelia). The pathogen that causes web blight on upper plant parts is the same organism that causes Rhizoctonia root and stem rot.

Management—Use tolerant cultivars, begin with clean or certified seed, plant during early parts of the season when the pathogen is inactive, rotate with nonhost crops, mulch to prevent splash, apply fungicides when symptoms begin to develop.

Web blight lesions that have expanded and coalesced (b); blight on pods, compare with healthy pod at bottom (c).

19. Yeast spot (*Nematospora coryli*) appears as small, irregular, sunken spots—tan or brown in color—on pods and seeds. Causal pathogen is spread by stinkbugs (No. 35) and tarnished plant bugs (No. 37) during feeding.
Management—Reduce weeds where insects hide and manage insect pests with insecticides (see No. 35, Stinkbugs).



Yeast spot on lima bean seeds.

Insects

Seedling pests

20. Black cutworm (*Agrotis ipsilon*) is an occasional pest of seedling beans and peas that results in cut or missing plants. Cutworms are more common in areas of reduced tillage and poor drainage. Larvae are light gray to tan in color with a faint stripe down the center of the back and dark spots on each body segment. Fully grown larvae can reach a length of 1¾ inches. They often curl up into a C-shaped position when disturbed. Cutworms are night feeders and can be found hiding under debris or in soil near plants during the day.
Management—Soil cultivation disrupts daytime hiding. Effective weed control eliminates egg-laying areas and feeding grounds for larvae. Scout frequently until first true leaves are formed.

Black cutworm larva.

21. Grape Colaspis (*Colaspis brunnea*) is an occasional pest of seedling beans. The adult grape Colaspis is common on many types of plants and may feed a bit on leaves, but it does not cause economic damage. However, serious damage can result when larvae feed on roots and underground stems. Larvae, which resemble miniature grubs, are cream-colored, C-shaped with a tan head capsule, and reach a length of about ⅛ inch. Damaged plants may be stunted and yellow due to larval feeding on roots.
Management—Economic thresholds and rescue treatments are not available, so replanting may be necessary.

Grape Colaspis larva (a); adult (b).

Seedcorn maggot.

White grub.

22. Seedcorn maggot (*Delia platura*) is an occasional pest of seedlings, particularly during cool damp weather in fields with high plant residue or organic matter. Light-colored larvae grow to ¼ inch long with blunt tails. They have a pointed head but lack a distinct head capsule. Pupae are about ⅛ inch long, brown, and generally football-shaped. Seedcorn maggot feeding on seeds and seedlings results in stand loss and weak seedlings.

Management—Planting dates can be adjusted to avoid peak emergence of seedcorn maggot flies. Plot and prepare fields at least 3 weeks before planting; seed treatments can be effective. There are no rescue treatments after injury occurs.

23. White grubs (*Phyllophaga* sp., *Cyclocephala* sp., and *Popillia japonica*) are larvae of June beetles. They damage legume crops by feeding on plant roots. White grubs are C-shaped with a distinct brown head capsule. While bodies are generally white to cream-colored, rear ends may be gray to brown. Size can range from ⅜ to 2 inches. White grubs are more common in soils high in organic matter and can be common in fields following sod, fields that had high numbers of Japanese or June beetles the previous year, or fields bordering tree lots.

Management—Soil-applied insecticides at planting can reduce damage. There are no rescue treatments.

24. Wireworms (*Melanotus* spp.) can be a problem of legumes and other vegetables by attacking seeds and seedlings. Wireworms are larvae of click beetles and can have extended life cycles that last 3 or more years. Common wireworms are hard, cylindrical, and brown; however, some wireworm species are softer with cream-colored bodies. Wireworms can reach a length of ½ to 1½ inches. Wireworms are frequently a problem in new fields following established sod.

Management—Seed treatments can reduce wireworm losses. Use wheat/corn bait traps in new fields prior to planting to estimate risk. Plant when soil temperatures are warm enough to promote rapid emergence and growth of seedlings. Soil-applied insecticides can reduce damage.

Wireworm.

Bean leaf beetles (a and b).

Japanese beetle adult.

Foliar pests

25. Bean leaf beetle (*Cerotoma trifurcata*), an occasional pest of beans, chews roundish holes in cotyledons, leaves, and pods. Adult beetles are about ¼ inch, oval in shape, and have a characteristic rear-pointing black triangle behind the head of each wing. Body color is either greenish-gray or dark red. There can be four additional back spots on wings or spots may be missing. **Management**—Monitor adult insects on seedling plants, and look for damage to cotyledons and leaves. Control with insecticides only as needed, using 20% defoliation or 10% infested plants as a guideline.

26. Grasshoppers (*Acridid* spp.) can be common bean pests, particularly during dry conditions or when other food sources become scarce. Both adults and nymphs may feed on bean foliage; they are more problematic along field margins with large plantings. Feeding damage appears as ragged holes in leaves or pods. While grasshopper species vary in size and color, they have long straight wings and enlarged femurs on their hind legs. Nymphs are similar in appearance to adults except wing buds are smaller. **Management**—During dry conditions, monitor plants weekly and use insecticides as needed to keep defoliation below 20%.

27. Japanese beetle (*Popillia japonica*) is a sporadic, foliar pest of beans. Japanese beetle adults begin to emerge in early June and remain active through early August. They feed on the surfaces of upper leaves that are exposed to full sun. These beetles chew tissue between leaf veins to skeletonize leaves. They are copper and green, ½ inch long, and have tufts of white hairs beyond the wings on the abdomen. While defoliation by Japanese beetle can appear severe, beans can tolerate up to 20% loss of leaves. **Management**—Monitor plants weekly and use insecticides only as needed to keep defoliation below 20%. Do not use Japanese beetle traps.

Grasshoppers (a and b).

Kudzu bug.

Mexican bean beetle larva (a); pupa (b); adult (c).

28. Kudzu bug (*Megacopta cribraria*) is an invasive pest that was first detected in Kentucky during 2013. While reported to be a serious pest of all types of beans, it has not reached damaging levels in our state. This pest feeds on bean pods and stems using piercing-sucking mouthparts; this can reduce pod production. The adult is small (about ¼ inch) with a roughly square shape and convex body. Nymphs are greenish-gray and hairy. Scout plant stems and underneath leaves for the presence of nymphs and adults.

Management—Weekly monitoring and use of insecticides will be the primary strategy for this pest. Watch for up-to-date information from the University of Kentucky Cooperative Extension regarding this new pest.

29. Mexican bean beetle (*Epilachna varivestis*) is a common foliar pest of beans. Damage is often observed before the pest is seen because Mexican bean beetles feed on the undersides of leaves. The beetles characteristically chew partially through the leaf, resulting in a skeletonized window-pane symptom. Larvae are yellow, spiny, oval in shape, and reach about ⅓ inch long. Yellow pupae attached to undersides of leaves do not move or feed. Adults are round, ⅓ inch, red to reddish-tan in color with 16 black spots on wing covers arranged in three rows.

Management—Monitor plants weekly and use insecticides only as needed to keep defoliation below 20%.

30. Pea aphid (*Acyrthosiphon pisum*) feeds on a number of legume species, including pea and broad bean. It is a relatively large aphid (about ⅛ inch), light to dark green in color, and with noticeably long slender cornicles (rear-pointing secretion tube) near the end of abdomens. Winged and wingless adult forms are common. Cool, dry weather and use of broad-spectrum insecticides can favor population growth of this aphid. Inflated, off-color individuals may be parasitized by wasps and are termed 'aphid mummies.'

Management—Monitor peas when conditions are favorable for aphid development; honeydew and molting "cast skins" assist with identification. Use broad-spectrum insecticides sparingly.

Pea aphids.

31. Potato leafhopper (*Empoasca fabae*) can be a pest of beans, using piercing-sucking mouthparts to feed on plants. Feeding by both nymphs and adults can damage vascular plant tissues as the pests' toxic saliva reduces movement of food and water. They migrate into Kentucky from southern areas during late spring. Adults are light green in color, wedge-shaped, and about ⅛ inch in size. Hopperburn (discolored "V" shaped areas on leaf margins) or downward cupping of leaves can be characteristic of potato leafhopper damage.
Management—Avoid plantings near alfalfa. Monitor for adults and treat if populations reach more than 2 adults per foot of row or 5 nymphs per row foot.

Potato leafhopper adult.

Two-spotted spider mite.

32. Two-spotted spider mite (*Tetranychus urticae*) is a common mid- to late-season pest of beans in Kentucky, particularly during prolonged hot, dry weather. Adults and nymphs feed with piercing-sucking mouthparts to remove cell contents; feeding results in stippling of leaves. Foliage may appear bronze when damage is extensive; webbing may be noticeable when mite populations are large. Adult mites are tiny (only about 1/20 inch) with a dark spot on each side of their yellowish-green bodies. Broad-spectrum insecticides can deplete natural enemies of mites and lead to mite outbreaks.
Management—Limit use of broad-spectrum insecticides. Monitor regularly for mites and signs of leaf damage, particularly along field margins.

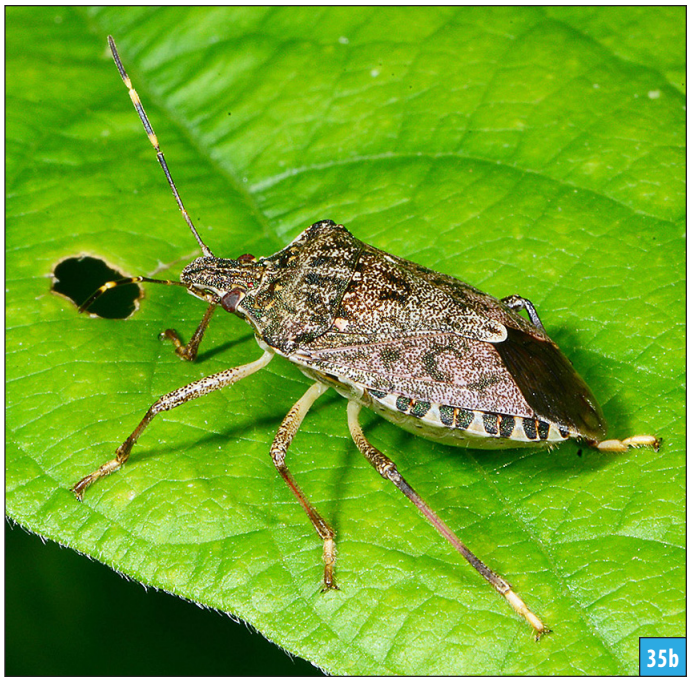
Bean lycaenid caterpillar.

Pod feeders

33. Bean lycaenid (*Strymon melinus*) is an occasional bean pest that eats through pods in order to feed on seeds; as a result, large conspicuous holes are left in pods. The green velvety caterpillars (larvae) are slug-like in shape and about ½ inch in length when fully grown. The adult is the gray hairstreak butterfly.
Management—Control with *Bacillus thuringiensis* (Bt) insecticides, if possible, to preserve natural enemies of other insect pests.

34. Corn earworm (*Heliocoverpa zea*) is a cosmopolitan pest of many types of vegetables. It is an occasional pod feeder of legumes. Earworms vary in color (including yellowish-green, red, and brownish-black) and have a brown head without conspicuous markings. They have numerous microscopic spines covering their body and feel rough to the touch. Earworms chew holes in pods and are more of a risk late in the season.
Management—Monitor for larvae and watch for damage when picking; use insecticides for control only as needed.

Corn earworm larvae also feed on bean pods.



Green stinkbug (a), brown marmorated stinkbug (b), brown stinkbug (c), stinkbug nymph (d). The spined soldier bug is a beneficial stinkbug (e).

35. Stinkbugs (*Euschistus sp., Halyomorpha halys, Chinavia hilaris*). Several species of stinkbugs (as nymphs and adults) attack beans and feed on developing pods with their piercing-sucking mouthparts. Stinkbugs are recognized by their distinctive shield-shaped appearance. Stinkbug nymphs, which have short wing pads, may be more common than adults in legumes. Feeding by stinkbugs can leave a 'sting' at the feeding site on bean pods and discolored spots on the seeds. When disturbed, stinkbugs release an odor similar to that of cilantro.

Green stinkbug is the most common type in legume vegetables, while the brown marmorated stinkbug is a new invasive pest that is rapidly expanding its range in Kentucky. Several species of brown stinkbugs are plant-feeding pests; they are similar in appearance to spined soldier bugs, which are beneficial natural enemies of insect pests. The spined soldier bug has small black marking at the tips of the front wings.

Management—Monitor for stinkbugs beginning in mid-summer and control with insecticides as needed.

Spotted cucumber beetle, also known as the southern corn rootworm.

Tarnished plant bug.

36. Spotted cucumber beetle (*Diabrotica undecimpunctata*) is a pest of many commercial vegetables and field crops, including legumes. Adults are yellow to green in color with twelve black spots on wing covers. Spotted cucumber beetles are sometimes mistaken for ladybugs. The beetle can defoliate vines as well as attack flowers and chew holes in pods. Fortunately, they rarely concentrate their attack on just one crop.

Management—Monitor for adults and keep defoliation below 20%. Watch for damage to flowers and pods, using insecticides as needed.

37. Tarnished plant bug (*Lygus lineolaris*) is a pest of a wide variety of crops, including legumes, and can reduce yields through flower and pod feeding. Flower feeding can result in blossom drop while pod feeding can appear as discolored "stings" to pods. Adults are just under ¼ inch, a mottled tan and brown color, and with a distinctive yellow "Y" marking near the base of wings.

Management—Reduce overwintering habitats around fields (debris, hedge rows, etc.). Practice effective management of broadleaf weeds around fields.

Weeds

Bermudagrass stems and foliage (a); underground stolon (b).

38. Bermudagrass (*Cynodon dactylon*) is a drought tolerant, warm-season, perennial grass that actively spreads vegetatively by both rhizomes and stolons. It also has the ability to spread by seed. Spikelets on seed heads (typically 3 to 6) are similar to crabgrass and can be observed from mid-summer until fall. While extremely vigorous, bermudagrass favors warm weather, so it will not be a problem early in the season.
Management—Avoid cultivation, which spreads rhizomes and stolons. Chemical control is recommended.

39. Carpetweed (*Mollugo verticillata*) is a summer annual that forms circular mats. It germinates late in the season when pre-emergent herbicides are no longer active.
Management—Till weeds before seeds develop. Utilize post-emergent herbicides.

Carpetweed foliage and bloom (a); growth habit (b).

Common purslane foliage and bloom (a); growth habit (b).

40. Common purslane (*Portulaca oleraceae*) is a succulent summer annual with a prostrate (lateral) growth habit. Its wedge-shaped leaves are ¼ to 1 inch long and up to ½ inch wide. Leaves may be clustered at tips but are alternate near the base of a smooth, branched, often reddish stem. This weed is particularly troublesome in plasticulture production systems. It is slow to germinate in cool soils but germinates readily in warm soils. It is a prolific seed producer.
Management—Because leaves and stems are succulent, cultivation is ineffective in controlling this weed and simply results in more weed growth. Work fields in infested areas last to avoid spreading. Post-emergent herbicides can be very effective.

41. Entireleaf morning glory (*Ipomoea hederacea* var. *integriuscula*) is one of several species of morning glory. It is a summer annual climbing vine with heart-shaped leaves. Bigroot morning glory (*Ipomoea pandurata*), a different species than entireleaf morning glory, is a perennial and managed differently.

Leaves of various morning glories; entireleaf morning glory is at the arrow.

Management—Morning glories are difficult to control with herbicides; apply herbicides when plants are small and susceptible. Cultivating young plants will only suppress growth unless plants are cut below the cotyledons.

Goosegrass.

Hairy galinsoga in bloom.

42. Goosegrass (*Eleusine indica*) is a summer annual often mistaken for large crabgrass (see No. 47), but goosegrass germinates when temperatures increase, usually in mid-summer. Goosegrass leaves are smooth and plants are silvery green in the center. Plants grow in a circular to bunchy arrangement, often in dry, compacted soils.
Management—Competitive crops often smother out goosegrass. Use herbicides specific for grassy weeds. Tillage during summer months is effective.

43. Hairy galinsoga (*Galinsoga quadriradiata*) is a highly invasive annual that grows 4 to 30 inches tall. It prefers warm, nitrogen-rich, heavy soils. Plants are coarsely hairy with many branches. Coarsely toothed simple leaves are also hairy and oppositely arranged on stems.
Management—Mulch and pre-emergent herbicides prevent seed germination, while tillage and post-emergent herbicides destroy plants.

Honeyvine milkweed.

44. Honeyvine milkweed (*Cynanchum laeve* or *Ampelamus albidus*) is a vining weed that is difficult to control because of its large perennial taproot, rapid growth rate, large annual production of seeds, and minimal treatable surfaces. This weed grows rapidly making it difficult to manage with post-emergent herbicides.

Management—Pre-emergent herbicide help prevent seed germination, while post-emergent herbicides must be applied persistently and repeatedly after germination.

Johnsongrass foliage and stems (a); growth habit (b).

45. Johnsongrass *(Sorghum halepense)* may reach a height of 3½ feet and competes heavily with other plants for nutrients and water. It reproduces by seed and perennial rhizomes, making it difficult to control.
Management—Post-emergent herbicides applied persistently and repeatedly after germination are most effective on seedling Johnsongrass. Herbicides selective for grasses can also be applied. Once established as a perennial, control is difficult.

46. Lambsquarters (*Chenopodium album*) is a rapidly growing summer annual that can reach 6 feet in height and is adaptable to most environmental conditions. Erect stems branch freely and are often reddish or striped with pink, purple, or yellow.
Management—Mulch and pre-emergent herbicides prevent seed germination, while tillage and post-emergent herbicides destroy plants.

Lambsquarters.

47. Large crabgrass (*Digitaria sanguinalis*) is purplish-green with hairy leaves. Leaves are ¼ to ⅓ inch wide and 2 to 6 inches long. Plants branch heavily and form large mats. Plants tolerate dry, compacted soil. Large crabgrass is often mistaken for goosegrass (see No. 42). **Management**—Mulch and pre-emergent herbicides prevent seed germination, while tillage and post-emergent herbicides destroy plants. Because it does not tolerate shade well, a dense canopy will help manage this weed.

Large crabgrass.

48. Marestail/horseweed (*Conyza canandensis*) germinates throughout spring and early summer and will mature and set seed the same year. Seed that germinates in fall overwinters in the rosette stage. Plants reach heights of 3 to 6 feet, and one plant may release 200,000 seeds that disperse easily by wind. Marestail is becoming more commonly glyphosate-resistant. **Management**—Pre-emergent herbicides prevent seed germination. Burn-down herbicides during seedling or rosette stages destroy young plants.

Marestail (a) and marestail flowers (b).

Palmer amaranth foliage (a) and stem (b).

49. Palmer amaranth (*Amaranthus palmeri*) is an extremely competitive invasive weed that is highly adaptive. One plant can produce 100,000 to 500,000 seeds that may remain viable for 5 years. Under ideal conditions, amaranth can set seed as early as 4 weeks after germination. Older leaves differ from other amaranth species in that the petiole is as long as or longer than the leaf blade and the plant lacks hairs. Some populations have developed resistance to glypohosate and ALS herbicides; amaranth also has shown resistance to HPPD inhibitor and dinitroanaline herbicides in other areas.

Management—Use herbicides before plants reach 4 inches in height. Use a combination approach of a pre- and post-planting herbicide. Note: Some populations may have developed resistance to certain herbicides.

50. Yellow nutsedge (*Cyperus esculentus*) is an erect, perennial member of the sedge family often confused for a grass. The leaves arise from a central triangular stem to form a clump that grows 1 to 3 feet high. Leaves are up to ½ inch wide, yellow-green, smooth, and shiny on the upper surface. While it can reproduce from seed, underground tubers that form at the end of each rootlet are the primary means for reproduction.
Management—Because the tubers can be spread by cultivation, it is important to work infested field areas last to avoid spreading them. Herbicides for grasses are ineffective on this plant because it has a different physiology than a grass. Contact herbicides can be used to suppress nutsedge; a dense plant canopy will also help to suppress it. A few pre-emergent herbicides are effective.

Yellow nutsedge in bloom (a); tubers (b); stem cross section—notice the triangular shape (c).

Abiotic Disorders

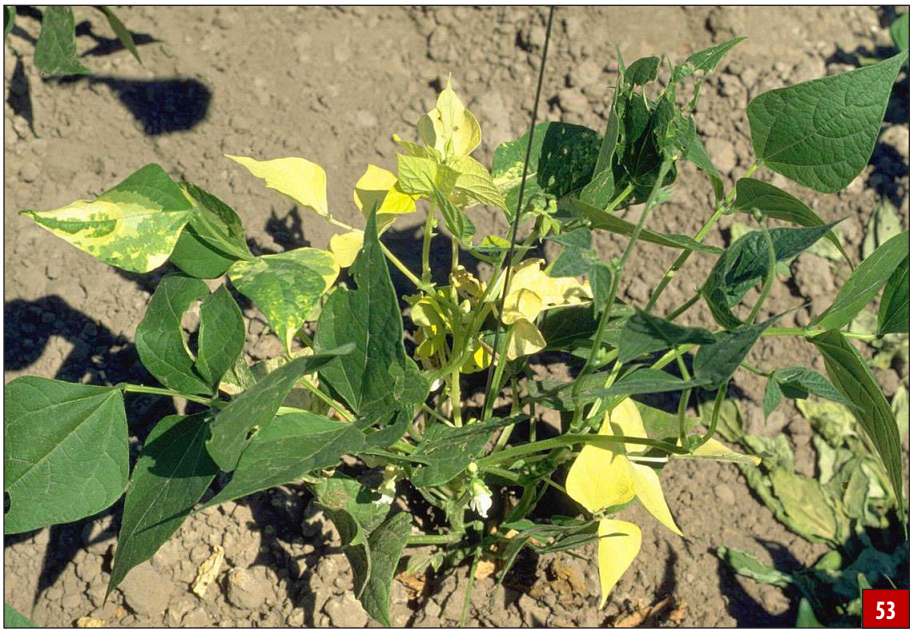
Baldhead due to soil crusting.

51. Baldhead results when the growing point of the bean plant is damaged as it emerges from the seed coat and from the soil, leading to early branching, stunting, and poor yield. Baldhead has been associated with various conditions occurring at plant emergence, such as crusted soil, inconsistent moisture, or a cracked seed coat. Plants with baldhead have lower yields than healthy plants.
Management—Select quality seed in which the seed coat is intact. Maintain consistent soil moisture to prevent surface crusting.

52. Excess heat (high temperatures exceeding 92°F) can cause significant plant stress. The most common symptom is leaf scorch in the upper canopy. High temperatures can also lead to flower abortion (blossom drop) and reduce the viability of pollen.

53. Genetic abnormalities, such as chimeras, typically appear as variegations in leaf color; they are generally manifested as varying shades of yellow and green. Leaves may be entirely affected, only partially affected along defined lines, or a mixture of both. At first appearance, symptoms may be mistaken for a nutrient deficiency. However, occurrences of genetic abnormalities tend to be isolated, while nutrient deficiencies are generally more widespread in a planting.

Leaf scorch symptoms due to high temperature.



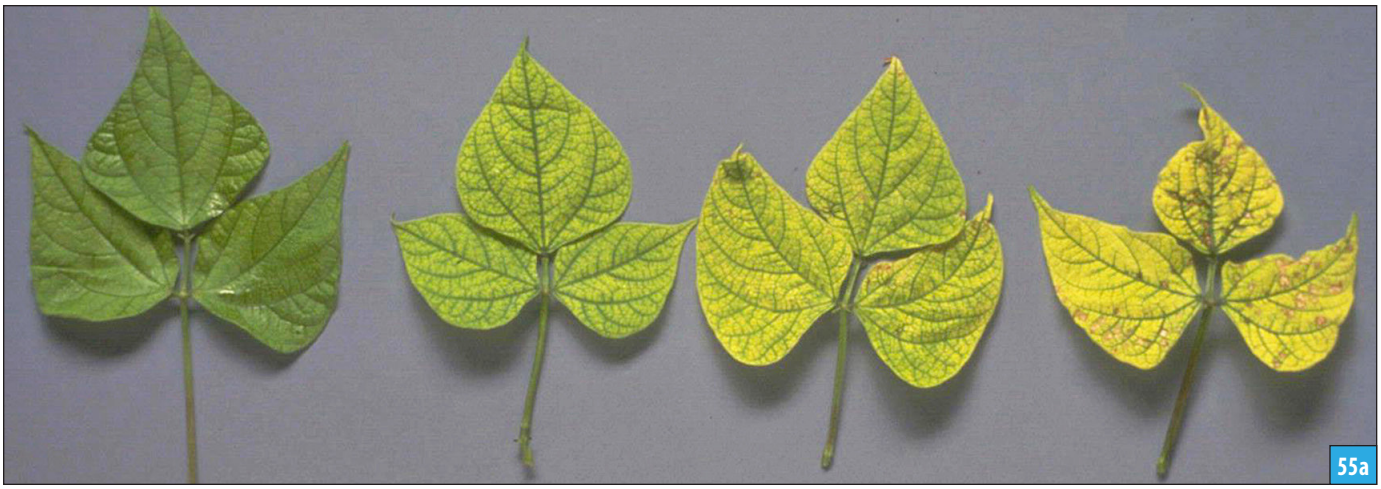
Genetic abnormality (chimera).

Management—Chimeras cannot be prevented through grower practices, and they cannot be reversed once they develop.

54. Herbicide injury can occur from chemical drift, residue from an application on a preceding crop, or improper application method/rate used on the current legume crop. Many different herbicides can cause damage, but legumes are most sensitive to 2,4-D and other phenoxy type herbicides. These growth regulator herbicides can cause malformation of plant tissue and can lead to an irregular growth habit.

Management—Follow individual herbicide label instructions for determining rate and application method. Avoid spray drift by using shielded sprayers and by applying products only on calm days. Information on herbicides registered for legumes can be found in *Vegetable Production Guide for Commercial Growers* (ID-36).

Phenoxy herbicide injury (a) and Dicamba herbicide injury (b).



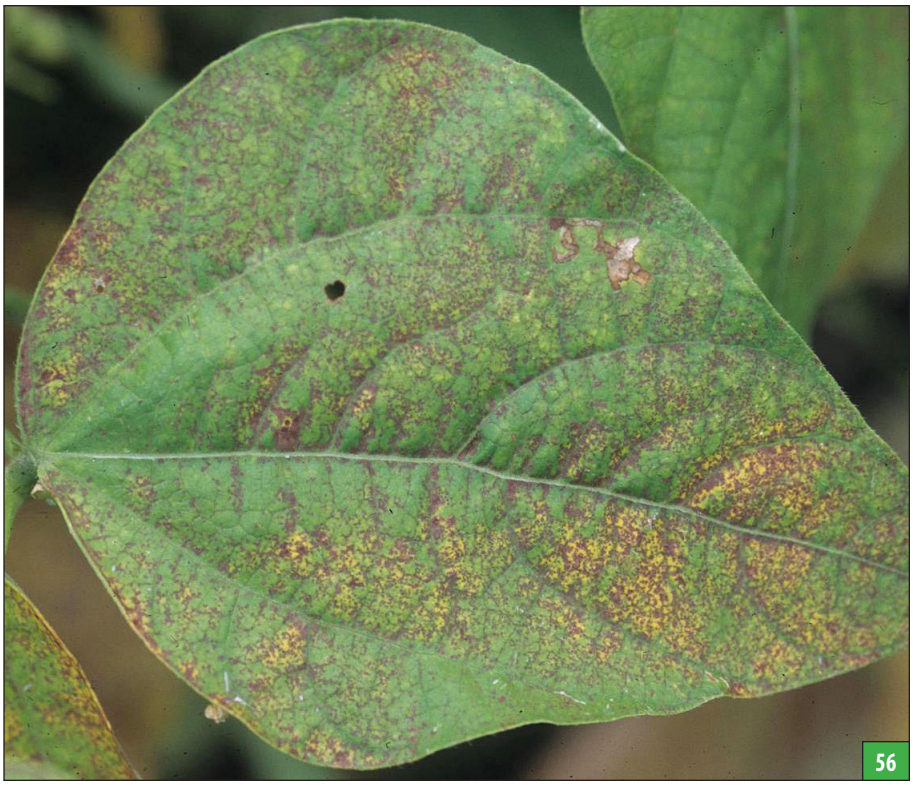
Iron deficiency symptom range (a); iron chlorosis due to over irrigation (b); nutrient imbalance due to high soluble salts and high soil pH (c).

55. Nutrient deficiencies produce characteristic symptoms depending on the nutrient(s) deficiencies in the plant. In addition to a lack of certain nutrients, nutritional problems can develop due to an *imbalance* in soil nutrients, improper soil pH, high soluble salts, or fluctuations in soil moisture.

Iron deficiency, also known as iron chlorosis, can be due to an insufficient supply of iron, but it also can be caused by an imbalance of soil nutrients. For example, high levels of phosphorus can change iron to an insoluble form that plants cannot take up, resulting in iron deficiency. Improper soil pH can also result in iron chlorosis. Symptoms appear as interveinal yellowing of varying severity.

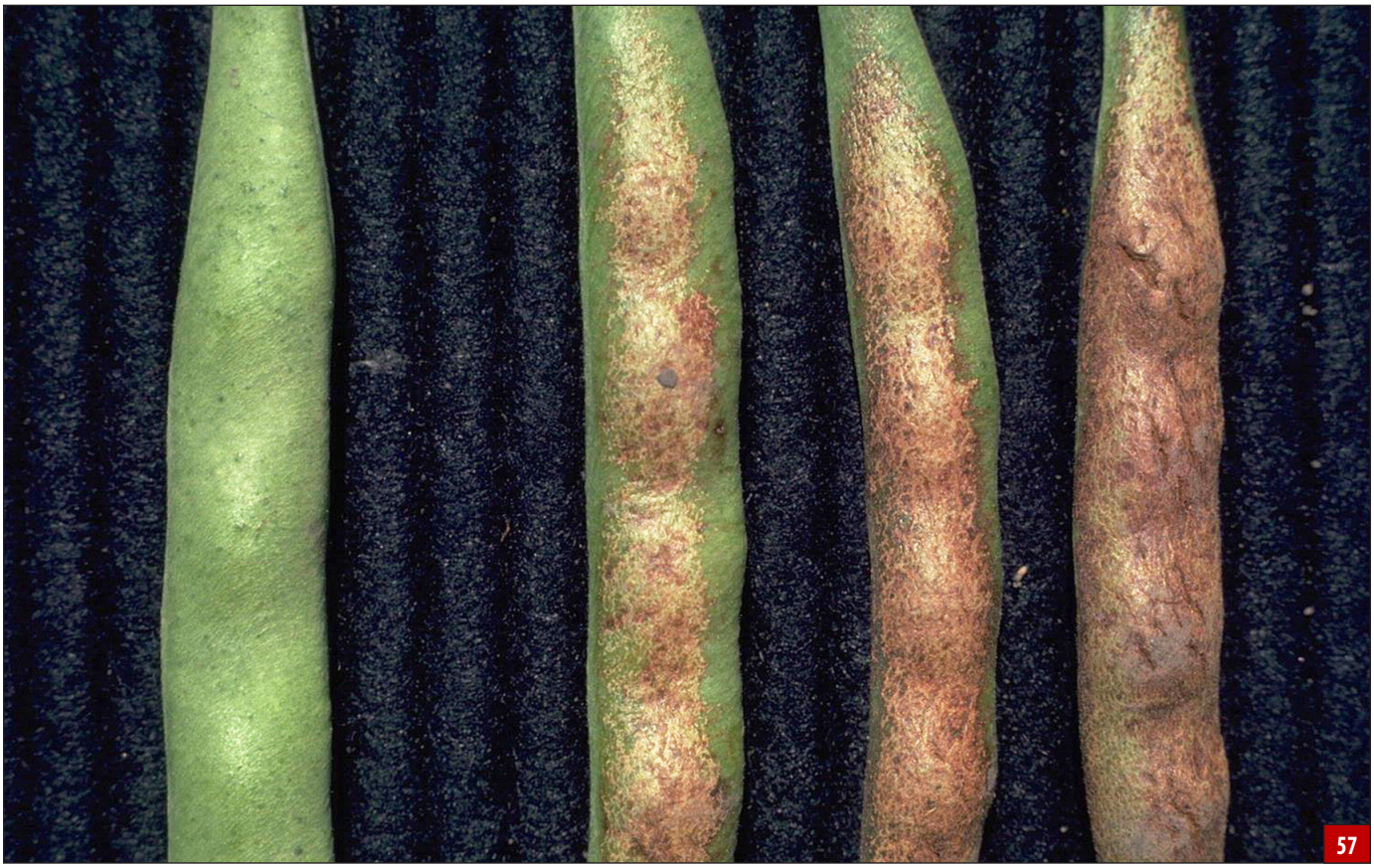
Management—Obtain a soil test annually and amend soil accordingly. Maintain proper soil pH.

56. Ozone injury symptoms appear as small necrotic spots on the upper leaf surface. Spots may eventually coalesce, giving leaves a reddish-brown or bronzed coloration. Severely affected plants may defoliate prematurely, which ultimately affects yield and quality. While other air contaminants may affect legumes, ozone is the pollutant most likely encountered. Ozone pollution is produced by the burning of fossil fuels (e.g., diesel engines or power plants) and is also a byproduct of lightning.



Ozone injury.

57. Sunscald on pods occurs when pods are exposed to periods of high solar radiation and high temperatures immediately following cloudy, humid conditions. Symptoms first appear as small papery brown spots that may eventually cover large areas of the pods as hot conditions prevail. Similar symptoms can also be observed on foliage.



Various degrees of sunscald injury, with the severity increasing from left to right.

Stem breakage due to high winds.

58. Wind damage from high winds can lead to plant breakage, ultimately reducing crop quality and yield. Damage can vary based on crop age. Non-trellised plants with a heavy pod set are vulnerable to being blown over or broken. High winds also can cause loss of blossoms, damage fruit in early developmental stages, and increase difficulty of harvest.

Management—Use plant trellises to support weight and windbreaks to reduce wind intensity.

Photo Credits

Many of the images in this manual came from the personal collections of the UK Vegetable IPM Team. However, in some instances images were used from outside sources. Credits for those images are listed as follows:

Bugwood
M.E. Bartolo, Bugwood.org—40a
Mary Ellen Harte, Bugwood.org—48b
California Polytechnical State University at San Luis Obispo
Gerald Holmes, Bugwood.org—56
Colorado State University
Howard F. Schwartz, Bugwood.org—1a, 1b, 2a, 2b, 3, 4a, 4b, 5a, 5b, 5c, 6a, 6b, 7a, 7b, 7c, 7d, 9a, 9b, 10a, 10b, 10c, 12, 13a, 13b, 17a, 18a, 18b, 18c, 40b, 50a, 51, 52, 53, 54a, 54b, 55a, 55b, 55c, 57, 58
Doronicum Kft
Robert Videki, Bugwood.org—46, 48a
Dow Agrosciences
Joe Eger, Bugwood.org—28
Illinois Wildlife Action Plan
Chris Evans, Bugwood.org—45a
Mississippi State University
John D. Byrd, Bugwood.org—42
Southern Weed Science Society
James H. Miller and Ted Bodner, Bugwood.org—45b
The Ohio State University
Bruce Ackley, Bugwood.org—43, 49b, 50c
University of California-Davis
Joseph M. DiTomasco, Bugwood.org—50b
University of Georgia
David B. Langson, Bugwood.org—14b, 16a
Rebekah D. Wallace, Bugwood.org—39a, 39b, 47, 49a
University of Kentucky
Cheryl Kaiser—15a, 16b
John Hartman—8a, 8b, 15b
John Strang—44
Ken Yeargan—33
Kenneth Seebold—14a
Ric Bessin—20, 21a, 21b, 22, 23, 24, 25a, 25b, 26a, 26b, 27, 29a, 29b, 29c, 30, 31, 32, 34, 35a, 35b, 35c, 35d, 35e, 36, 37
USDA Clemson
Bugwood.org—11a, 17b
USDA-ARS
Theodore Webster, Bugwood.org—41
Utah State University
Steve Dewey, Bugwood.org—38a, 38b
Virginia Polytechnical Institute
Robert Lambe, Bugwood.org—19
Bugwood.org—11b

Issued 1-2015