UNIVERSITY OF FLORIDA
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PPP 38

Disease Control for Florida Snap Beans[1]

Ken Pernezny[2]

Snap beans are an important vegetable crop in Florida. They are produced in all regions of the state except the east central areas. Midwinter bean production, usually the most profitable for Florida, is centered in the Belle Glade and Homestead areas of the southeast coast.

Bush-type snap beans dominate commercial plantings, but pole-type beans are also produced, primarily in Dade County. In a recent year 4.2 million bushels (30 lb crates) were harvested from 30,000 acres, with a farm-gate of 50.5 million.

Disease management is an important component in successful snap bean farming in our state. Despite often vigorous control efforts, substantial losses in yield and quality sometimes still occur. This plant protection pointer suggests a sequential snap bean control program for diseases encountered in the field. Postharvest disease problems are addressed only to the extent that they are affected by practices in the field. The application of the following control program should minimize losses for the majority of plantings.

Characteristics of Pathogens Causing Snap Bean Disease

The great majority of plant problems we call diseases are caused by pathogenic microorganisms. These extremely tiny disease agents cause losses in beans by attacking the pods directly, rendering them unfit for consumption or sufficiently detracting from the appearance of pods to reduce consumer preference. They can also affect other plant parts, reducing plant vigor and carbohydrate production, with subsequent yield and monetary losses.

The pathogens attacking snap bean can be classified into three major groups: fungi, bacteria, and viruses.

Fungi are microscopic organisms that in the past have commonly been classified as plants. However, they are sufficiently different from plants that experts now classify fungi in a unique category by themselves. They have no true leaves, roots, or stems. Instead, they appear as hyphae (microscopic threads of living matter) that absorb food and water directly into their cells. Although fungi have cell walls, the chemical composing the wall of many fungi resembles the chitin in the shells of insects and not the cellulose wall material of higher plants. Because fungi have no chlorophyll, they must depend on outside sources of food, including living plants.

Many of the fungi attacking snap beans reproduce by creating large numbers of spores. Some spores are airborne by wind or moisture and spread readily within and between fields. Some fungal spores or sclerotia (hyphal aggregates), especially those causing root and stem rots, can survive one or more years in the soil between susceptible crops.

Fungi may enter plants through wounds or natural openings (for example, the stomates that allow normal

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2. Ken Pernezny, Professor, Plant Pathologist, Everglades Research and Education Center, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Belle Glade, FL 33430.

exchange of oxygen and carbon dioxide between plant cells and the atmosphere). Some can also grow directly through the cuticle and cell walls.

Bacteria are smaller microorganisms than fungi and are not at all plant-like. They are one-celled, lack chlorophyll, and the ones that cause plant disease do not form spores. The major type of reproduction for plant pathogenic bacteria is by simple cell division. They cannot penetrate the plant directly, but must enter the host through a wound or natural opening to colonize a host plant.

Viruses really shouldn't even be considered "organisms". They are simply very large molecules made up of a nucleic acid (DNA or RNA), with a wrapping or "coat" of protein. There are no cellular structures. New virus particles can only be synthesized within living plant cells. They are much smaller than bacteria and normally require the high magnification of electron microscopes to be seen.

Some bean viruses are seed-transmitted. Bean plants from these infected seed serve as sources of infection for other plants. The virus may also spread from infected weed hosts near snap bean fields. Aphids and whiteflies are usually responsible for plant-to-plant spread within Florida bean fields. When these insects probe infected plants for food, they may pick up virus particles and infect healthy plants during subsequent feedings.

Production of disease symptoms in snap bean plants requires each component of the disease triangle (Figure 1): a virulent pathogen, a susceptible variety, and weather conditions favorable for disease development. If any of these components is missing, plants will not become diseased.

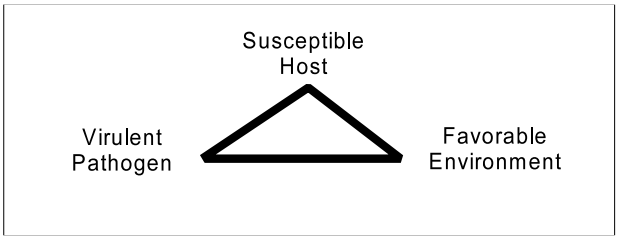

Figure 1. The disease triangle.

Effective control of snap bean diseases is based on the understanding of the concepts described above: the biology of the causal organism, the response of the host to this pathogen, and the interaction of outside forces, such as temperature and soil type, with the living systems involved. A brief outline of the characteristics of the major Florida snap bean diseases is given in Table 1.

With this essential background information we can proceed to a reasonable sequential disease control program for Florida commercially-grown snap beans.

Suggested Sequential Program for Disease Control

I. Seed Treatment

Snap beans are generally very susceptible to fungi causing damping-off. In order to minimize losses from damping-off, most commercially available bean seed have been treated with a fungicide. This is readily apparent by the distinct color imparted to the seed by the fungicide coating applied by the seed supplier. If, by chance, your seed has not been treated, a seed treatment, such as certain commercial preparations of chloroneb or metalaxyl should be made.

Chloroneb can be applied at 4 oz of the 65% wettable powder per 100 lb of seed.

Apron 25W is a formulation of metalaxyl approved for use on snap beans as a seed treatment only. Apply 2 oz of Apron 25W per 100 lb of seed. Metalaxyl is specific only for *Pythium* and closely related fungi. Also, while this seed treatment will provide excellent protection against *Pythium* and related fungi it is **not** effective against *Rhizoctonia*, *Fusarium*, and other non-pythiaceous fungi. In addition, this fungicide will not control the aerial blight phase of *Pythium* on mature plants. NOTE: extensive use of this product may result in selection of resistant strains of fungal pathogens.

Of course, treated seed should never be used as food or fed to animals.

II. Other Pre-plant or At-planting Treatments

There are several preplant or at-planting chemical options that growers may use. One is primarily an in-furrow spray, with chloroneb and/or metalaxyl. See labels for particulars.

III. Specific Cultural Controls

A. Site Selection and Crop Rotation

The susceptibility of snap beans to soilborne diseases dictates that growers carefully choose land on which to grow crops. Fields should be well-drained and free of numerous "low spots", where water from rain and irrigation can collect. Populations of disease pathogens and other pests build up quickly in soil cropped consecutively to snap beans. Therefore, rotation with less susceptible crops or with crops grown in plastic-mulched, fumigated beds should be advantageous.

B. Plant Spacing

Work at the Homestead TREC suggests that plant spacing can be very important in disease management. Generally speaking, yields have been increased by increased plant populations per acre. Plant populations can be increased by decreasing the spacing between rows and/or the spacing between individual plants in a row. Decreasing the between-row spacing for cultivar Sprite from 36 to 18 in. generally resulted in increased yields with no adverse effects on disease incidence. However, close in-row spacings (e.g. 1.5 in. vs 4.5 in.) were associated with dramatic increases in disease levels, especially white mold (*Sclerotinia*). Therefore, the optimum arrangement of snap bean plants for maximum yields and best disease control is closer between-row spacings (e.g. 24 in.) and wider in-row spacings (e.g. 3.5 - 4.5 in.). Since white mold severity is affected greatly by plant arrangements, these horticultural recommendations are particularly appropriate for crops grown in the cool months of the cropping year (e.g. December - March in Dade County).

C. Purchase of Certified Seed

Exclusion of pathogens normally carried in seed is extremely important in the control of several diseases: common bacterial blight, halo blight, brown spot, anthracnose, and common bean mosaic. Seed crops produced in arid regions, such as the American west, are less likely to be contaminated with these pathogens. Idaho and other states, which have extensive seed industries, often have rigid seed certification programs. While they cannot guarantee absolutely clean seed, they have a fine record for minimizing seedborne pathogen problems.

Equipment and workers should not move within fields when plants are wet. Disease organisms, especially bacteria, are readily spread mechanically when there is moisture on the leaves. Farm equipment should be periodically decontaminated to prevent spread from field to field.

Plants should be grown under optimal horticultural conditions. Healthy plants that are properly fertilized and watered are less likely to be affected by many diseases. In particular, excessive nitrogen levels can make beans more susceptible to bacterial disease; if fertilizer is less than optimum, beans will be more susceptible to Alternaria leaf spot.

IV. Application of Foliar Fungicides

Periodic application of fungicides is important in snap bean disease control. Aircraft or ground application can be used, but the latter is much preferred because of superior pesticide penetration of the plant canopy and coverage of lower leaf surfaces.

Attention to application technique is as important as choice of material in the achievement of adequate control. A "typical" bush snap bean spray application would be done with a tractor-mounted boom sprayer at 200-275 psi pressure and 100 gal/acre of finished spray on mature plants. Proper equipment calibration should result in a tractor speed of about 3 miles/hr. AT THIS SPEED AN OBSERVER SHOULD BE ABLE TO WALK BEHIND THE TRACTOR AT A COMFORTABLE PACE. With properly adjusted tractor speed, most disease situations can be adequately controlled with one application of fungicide per week. A shorter interval (e.g. every 5 days) may be needed in those times of the year when rust threatens.

Care must be taken to ensure that nozzles work properly, strainers are clear, and nozzle arrangement allows for adequate coverage. Consider use of drop nozzles. Drop nozzles are especially important in control of pod problems, such as white mold and *Alternaria*. The air in the snap bean canopy must be completely displaced by a fine mist of fungicide to prevent disease outbreaks that can begin deep within the canopy.

Fungicides are primarily preventative, i.e., they must be applied before the pathogen arrives on the foliage to insure effective control. Timing of applications is very important. If fungicide sprays are started after a disease is discovered, it may be impossible to curb epidemics. This is particularly true for rust. If fungicide sprays are

delayed until rust first appears (using currently-labeled fungicides), severe economic loss can occur.

Chlorothalonil is an effective, broad-spectrum fungicide labeled for snap beans. It is an important component of a snap bean disease control program. When rust threatens, sulfur can be tank-mixed with chlorothalonil for enhanced control or Bravo-S® may be used. Maneb is also an effective, broad-spectrum fungicide for beans. However, we have found that maneb residues may exceed Canadian tolerances on pods if applications are made after blooming commences. Residues were within Canadian limits, if maneb applications were discontinued just prior to bloom.

It is extremely important that specific chemical treatments be applied for white mold (*Sclerotinia*) control. Benlate® is labeled at a rate of 1.5 - 2 lbs to be applied at 25-50% bloom and again at peak bloom. Topsin-M® is labeled at 1.5 - 2 lbs to be applied at 10-30% bloom and again 4-7 days later (or one application at 50-70% bloom). Both Benlate® and Topsin-M® have long preharvest intervals of 14 days. These compounds also may aid in control of Rhizoctonia aerial blight and pod rot, powdery mildew, Cercospora leaf spots, and anthracnose.

When these specific bloom sprays are applied for white mold, it is important that chlorothalonil be included in the tank in order to maintain control of other diseases, **especially** the pod-blight damage phase of Alternaria leaf spot. Benlate® and Topsin-M® are **not** effective against *Alternaria*. Sprays of copper bactericides may be warranted if evidence of bacterial disease is found.

Bean golden mosaic is a relatively new and devastating virus disease of snap bean in Florida. It has caused severe damage in may fields especially in Dade County, sometimes forcing growers to abandon whole plantings. It is transmitted by the silverleaf whitefly.

The management of BGMV requires strict adherence to an integrated program. Isolate bean fields as much as possible from other susceptible crops that might serve as virus reservoirs. These include tomato, squash, okra, and several ornamentals (e.g. poinsettia and hibiscus). Many weeds may also harbor the virus and its vector.

Promptly, destroy crops so that virus titer and whitefly populations do not build up and provide a source of inoculum for newly planted crops.

Scout fields intensely and spray effective insecticides to reduce whitefly populations.

Readers are urged to consult their county extension agent or the Florida Plant Disease Control Guide for current, specific fungicide recommendations. They also may want to see the plant pathology fact sheets listed in Appendix I for information on correct diagnosis of several bean diseases.

Table 1. Characteristics of major snap bean diseases in Florida. [1]

Disease	Pathogen(s)	Type of Organism	Seed Transmission	Soil Survival	Insect Transmission	Favorable[2] Conditions	Areas Most Likely to Occur
Common bacterial blight	*Xanthomonas campestris* pv. *phaseoli*	bacterium	++	+	+	W, R	All
Halo blight	*Pseudomonas syringae* pv. *phaseolicola*	bacterium	++	+	+	C, R	All
Brown spot	*Pseudomonas syringae* pv. *syringae*	bacterium	++	+	+	C, R	All
Anthracnose	*Colletotrichum lindemuthianum*	fungus	++	+	+	C, R	All
Alternaria leaf spot	*Alternaria alternata*	fungus	-	+	-	All	All
Fusarium disease	*Fusarium solani* f. sp. *phaseoli* *Fusarium oxysporum* f. sp. *vasinfectum*	fungi	-	++	-	All	Sand lands
Gray mold	*Botrytis cinerea*	fungus	-	++	-	C,R	Sand lands
Powdery mildew	*Erysiphe polygoni*	fungus	-	-	+	C	All
Pythium root and stem rot (aerial blight); damping off	*Pythium* spp.	fungus	+	++	-	W,R	All

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Rhizoctonia root, stem, and pod rot; damping off	*Rhizoctonia solani*	fungus	-	++	-	W,R	All
Rust	*Uromyces phaseoli*	fungus	-	++	-	C	All
Southern blight	*Sclerotium rolfsii*	fungus	-	++	-	W	Sand lands
White mold	*Sclerotinia sclerotiorum*	fungus	-	++	-	C,R	Dade
Wet rot	*Choanephora cucurbitarum*	fungus	-	+	+	W,R	All
Cercospora leaf blight	*Cercospora canescens* & *C. cruenta*	fungi	+	+	_	W.R	All
Common bean mosaic	Common bean mosaic virus	virus	++	-	++	C	All
Bean yellow mosaic	Bean yellow mosaic virus	virus	-	-	++	C	All
Bean golden mosaic	Bean golden mosaic virus (BGMV)	virus	-	-	++[3]	Late spring	Palm Beach to Dade County

[1] + = may occur occasionally, of some importance.
++ = occurs often, important to know for proper disease control.
- = not known to occur or relatively unimportant.

[2] W = warm weather; C = cool weather; R = favored by extended rainfall.

[3] vectored by the silverleaf whitefly

Appendix I

1) Kucharek, T. *Rhizoctonia* seedling blights of vegetables and field crops. Plant Path. Fact Sheet No. 1.

2) Kucharek, T. Stem rot of agronomic crop and vegetables (southern blight, white mold). Plant Path. Fact Sheet No. 14.

3) Pohronezny, K., and W. M. Stall. Powdery mildew of vegetables. Plant Path. Fact Sheet No. 14.

4) Pohronezny, K., and L. H. Purdy. *Sclerotinia* diseases of vegetable and field crops in Florida. Plant Path. Fact Sheet No. 22.

5) Pohronezny, K., and T. Kucharek. 1987. Rust disease of several legumes and corn in Florida. Plant Path. Fact Sheet No. 37.