

Crop Profile for Beans (Snap) in Minnesota

Prepared: August, 2001



Executive Summary – Snap Beans

In 1999, Minnesota snap bean production, for processing, exceeded 9,000 acres. However, during much of the last decade, Minnesota has averaged approximately 6,000 acres. With a current estimated value of \$525/ac for processing beans, the annual on-farm value is estimated at \$3.15 million. The value-added retail benefit to the processing industry is assumed to be about 5 times this amount, or \$15.7 million. In addition to the direct value to the processing industry, snap bean contracts between processors and growers assist in adding economic diversification for traditional corn and soybean growers in southern and west-central Minnesota. An additional 500 acres are typically grown for fresh market, with an annual value of \$1 million, bringing the average annual value of snap beans in Minnesota to \$16.7 million.

The high value of this crop, along with the potential for economic losses from insect, disease and weed pests, continue to create demand for effective integrated pest management (IPM) programs. In response to new IPM information needs generated by the Food Quality Protection Act (FQPA), this profile was developed to a) summarize current IPM practices for insect, disease and weed pests, b) highlight pesticides under review by US-EPA, c) estimate the impact of the loss of selected pesticides, and d) assess alternatives for such losses.

Insect Pests: Insect pests are usually the most damaging and difficult pests to control in Minnesota snap beans, affecting either bean quality or yield. The most important and consistent insect pest is the

European corn borer (ECB). ECB is the major pest because of the larval behavior to bore into pods, and remain in the pods during harvest and processing. Corn earworm (CEW) will also be attracted to flowering snap beans, especially late in the season; as with ECB, earworm larvae will also feed within the pods. Seed corn maggot, and other soil-borne insect pests can do considerable damage, affecting plant stand and causing delayed maturity. Potato leafhopper, if left unchecked will also cause damage by stunting the plants and reducing yield. All four insects have caused considerable damage during the past 5 years. A recent trend for the past two years in Minnesota has been increasing damage by the bean leaf beetle, particularly in early-planted fields (May). New seed treatments have recently shown good efficacy against potato leafhopper and bean leaf beetle; seed treatments, when registered, may be able to replace some foliar sprays. The recent approval of Capture (1999), allowed for significant improvements in ECB control. In recent years, processors in Minnesota have reduced their use of Asana and Orthene, in favor of Capture.

Diseases: Numerous pathogens affect snap bean production in Minnesota and throughout the upper midwest. The most common disease problems include: numerous root rots (*Fusarium*, and *Rhizoctonia*), white mold, gray mold, and several bacterial blights (brown spot, common blight and halo blight). In some years, under favorable environmental conditions (cool weather at planting, followed by hot, dry conditions), up to 100% of fields can be infected. Rust can still be a concern in warm, humid years. Selected fungicides are available for most diseases, however their efficacy is variable, and strict cultural practices such as 2-3 year rotations out of beans should be maintained. For rust, only Bravo and Nova are available. For white and gray mold, Benlate, Topsin and Rovral are available but can only be used between early and peak bloom. For seedling diseases and root rots, a seed treatment, Apron can be used, or Ridomil at planting. Treatments for bacterial diseases are very limited, essentially Copper and 2-3 year crop rotations. If and when any of these products come under review, with respect to FQPA, there will be a renewed need to assess risks/benefits.

Weeds: Many broadleaf and grass weed species are potentially very damaging. Because of the “minor use” status of this crop, few registrants are interested in pursuing labels for herbicides (as with other pesticides). Pre-emergence herbicides include: Dacthal, Dual Magnum, Trifluralin, Eptam, Prowl and Lasso (MN; not WI or IL). Post-emergence materials are limited to Basagran, Poast and Assure. Thus, growers currently have few options for weed control. However, in tandem with timely cultivation, most weeds are still controlled well with currently labeled herbicides. If these products come under review, there will be a renewed need to assess risks and benefits of each.

General Production Information

In 1999, Minnesota snap bean production, for processing, exceeded 9,000 acres. However, during much of the last decade, Minnesota has averaged approximately 6,000 acres. For example, in 1997, Minnesota

harvested a total of 5,600 acres of snap beans with production taking place at 171 farms in the state with the majority of production taking place in southern and southeastern Minnesota, near processing facilities. Counties leading the state in production in 1997 were: Dodge (2337 acres), Goodhue (1654 acres), Mower (413 acres) and Dakota (241 acres)(13, 14). The average yield for snap beans is 3-3.75 tons/A with an average value of \$174/ton from 1997-1999 (14). The Minnesota snap bean crop, averaging 6,500 ac/year, has a total annual on-farm production value of approximately \$3.5 million.

Cultural Practices

Snap beans are planted from May through July. Commercial growers will stagger planting dates to allow adequate time to harvest the crop over several weeks late in the summer. Seeds are typically planted 1 inch deep and plants are seeded at 8-12 plants/foot. Rows are typically spaced 18-36 inches apart. The recommended density for planting is 70-100 pounds of seed/acre or approximately 174,000 plants/acre. Seeds will germinate 6-12 days after planting with temperatures of 65-85 °F (3). Beans mature in 50-60 days and can be harvested 20-25 days after plants flower (3). Pods will be bright green and fleshy and contain small, green seeds. Later harvests result in tough-skinned and discolored pods (3).

Snap beans thrive in silt-loam fields with good soil structure and internal drainage. Fields that are crusted over and have a high salt concentration are less than ideal for snap bean production. Snap beans grow quickly with adequate moisture and nutrients. The crop will require 1-1.5 inches of water every 4-5 days for ideal growth (9). Common soil amendments used in snap bean production are: nitrogen, phosphorus, potassium, and lime. Snap beans can be grown in acidic soils where lime has been added to maintain soil pH of 6-6.8. Beans do well in neutral-slightly acidic soils (9). Nitrogen is recommended as a pre-plant treatment where fields have <3% organic matter and/or were not planted in soybean, alfalfa, or grass-legume hay crops during the previous year. When nitrogen is to be added, the recommended rate is 30 lbs./A when <3% OM and 40-60 lbs./A for fields previously planted into corn, rye, oats, wheat, or vegetables. Recommended rates of phosphorus and potassium are 0-75 lbs./A and 0-100 lbs./A, respectively. Application of potassium is not recommended early in the growing season because it can cause excess salt formation in the soil (9).

Insect Pests

There are numerous insect pests of snap beans that can damage plants at all stages of development and limit bean quality or yield. The following insects vary in the damage they inflict and in frequency of occurrence each year.

European corn borer (*Ostrinia nubilalis* Hübner)

European corn borer (ECB) is generally found in corn, but when snap beans and similar crops are planted next to corn with heavy infestations, corn borer will move into bean fields. A 1981-1983 survey found that ECB is the number one insect pest of snap beans in Minnesota, responsible for > \$915,000 of damage in absence of control (15). Larvae feed on the interior of plant stems and bean pods which makes the observation of the insect difficult, but not impossible. As corn borer larvae feed their presence can be determined through the observation of castings, or frass (excrement), protruding from small holes in stems and pods. European corn borers overwinter as larvae and emerge as adults starting in June and continuing through August as two distinct generations are typically observed. Adults have wingspans of 1 inch; females are pale-yellow in color while the males are a darker brown. Adults are active at night. In fall, winter, or early spring, it is beneficial to destroy crop residue that may harbor overwintering larvae. Early planting dates are also useful in managing European corn borer, as are resistant varieties. Additionally, rotating with legumes, controlling weeds, and avoiding planting beans next to corn all aid in management (11). Adults can be monitored using blacklight or pheromone traps. The threshold is >25 moths caught in a black light trap/night with ca 25 days left prior to harvest, e.g. at the onset of peak flower and early pod formation (9).

Also see factsheet: <http://www.ent.iastate.edu/pest/cornborer/htm>

Corn Earworm (*Helicoverpa zea* Boddie)

Corn earworm, similar to European corn borer, is usually found in sweet corn. However, the insect can be attracted to snap bean, as well. Adults originate from the southern U.S. because they are unable to overwinter in northern climates. Adults are 0.75-1 inch long with a wingspan of 1.5-2.0 inches and are tan/buff colored with characteristic green eyes. Adult females lay eggs on foliage, eggs hatch in 5-7 days, and larvae pass through six instars before pupating. Larvae can possess green, tan, pink, dark brown or black coloration and inhabit stems and/or pods. Proper timing of insecticide application is critical as there are no control options once larvae enter the protective covering of the stem or pod. In addition to reducing pod quality, heavy infestations have been shown to reduce yield.

Also see factsheet: <http://www.vegedge.umn.edu/vegpest/cewbean.htm>

Mites

Mites, including the two-spotted spider mite, are extremely small and light tan in color. Mite feeding damage causes small white spots on leaves, and when infestations are high, damage will cause foliage to turn brown (8). In the upper Midwest, mites only reach outbreak levels during very hot, dry summers.

Seed Corn Maggot (*Hylemya platura*)

Seed corn maggots are the larval form of small flies. Maggots feed on germinating seeds and are more prevalent during cool, wet summers. Seed corn maggots are attracted to rotting plant debris, recently manured, or recently plowed fields. It is good practice to plow under winter cover early in the spring

(9). Removing plant debris also decreases egg-laying sites. Later planting dates and shallow seeding depths encourage fast and early germination, which also shortens the time seed is susceptible to corn seed maggot feeding and damage. Additionally, seeds should be handled carefully so they do not develop cracks as they encourage seed corn maggot damage (11).

Also see factsheet: <http://www.vegedge.umn.edu/vegpest/seedmag.htm>

Potato leafhoppers (*Empoasca fabae* Harris)

Leafhoppers are approximately 1/8 inch in length and can be green, light brown or grayish in color. They inflict damage with their piercing-sucking mouth parts which, in extreme cases, cause foliage to discolor and die. Eggs are deposited inside plant tissue as opposed to on the surface. It can take from a few weeks to over a year for eggs to hatch and for larvae to begin feeding on plant sap. The larvae go through a total of five nymph stages, and all of the stages including the adults, feed on the sap. Examples of damage include: stripping the plant of its nutrients, transmitting viruses and the feeding damage itself (7). Controlling weeds is an important way to decrease the leafhopper population. Chemical control includes use of pyrethroids and insecticidal soaps (8, 9).

Also see factsheet: <http://www.vegedge.umn.edu/vegpest/plh.htm>

Bean leaf beetle (*Cerotoma trifurcata*)

Bean leaf beetles are red, orange, tan, or gray with dots or strips on their backs. The adults overwinter in leaf debris in wooded areas next to fields and have a characteristic black triangle behind their thorax. Adults emerge in the spring and lay eggs in the soil. Upon hatching, larvae feed on the parts of the plant that are under the soil for 3-6 weeks. They will pupate and emerge as adults one week later in mid July. These adults will mate and lay eggs and a second generation will occur in September. The second generation will overwinter (2). Adults inflict the most severe damage by feeding on the underside of leaves and pods making small round holes. Beetles can clip off entire pods if feeding occurs at the base of the pod and other tissue damage on pods allows moisture to enter which allows disease to enter which causes mold, discoloration, and shrunken pods. The bean leaf beetle serves as a vector for these pathogens (2).

Mexican bean beetle (*Epilachna varivestis*)

These beetles are 1/4 inch long and copper brown in color. In addition, they possess eight black spots on each wing (8). Mexican bean beetle adults overwinter in plant debris and as such, it is very important manage crop debris to minimize infestations. This species is most common in the southern region of the Midwest. Upon plant emergence, beetles will move from their winter shelters and begin feeding on the underside of the leaves only, leaving the top-side intact. Larvae also feed on foliage, but the damage creates a lace like appearance on the leaves. With a heavy infestation, beetles will also feed on stems and pods, sometimes killing the host plant (15). Plowing crop debris after harvest helps minimize attractive sites for beetles. Chemical treatments and altered planting dates can be effective means of controlling beetles. Use of early or late maturing varieties can be very effective as most damage is done during July and August (15).

Aphids (e.g. *Aphis fabae*)

Aphids are small, green, yellow, or black colored insects that can be either winged or wingless (11). They reproduce both sexually and asexually. During the summer months, reproduction occurs asexually by females who produce live offspring. At the end of the season, as fall approaches, females and males will reproduce sexually. Eggs produced by male/female mating will overwinter in the host crop (1). Aphids inflict damage with their piercing-sucking mouthparts making leaves curl and appear wilted due to the honeydew (waste) substance they excrete. Aphids have not previously caused much damage to snap beans in the Midwest. However, recent infestations in Wisconsin (2001) indicate that the incidence of several bean viruses may be increasing. Many of these are vectored by aphids.

Insect Control Options: Chemical Control

Control options for snap beans insect pests (type of control/insecticide class) (4, 5, 9):

Alternative:

Spinosad (SpinTor 2SC) This product is biologically derived from the fermentation of the soil organism *Saccharopolyspora spinosa* and can be used to control lepidoptera larvae on a variety of crops, including snap beans. The product is applied at a rate of 0.05-0.10 lbs/AI/Ac. Treatment should begin prior to egg hatch for best control. There is a 3 day pre-harvest interval for this product.

Insecticidal control options:

Carbamates

Carbaryl (Sevin XLR Plus) Sevin can be used to control corn earworm, Mexican bean beetle, bean leaf beetle and potato leafhopper. There is a 12-hour REI for Sevin and ears can not be harvested for 3 days following the last application. The labeled rate for Sevin in snap beans is 0.5-1.5 qts/A with total field-applied product not to exceed 8 quarts/A in a single growing season.

Methomyl (Lannate LV) *Lannate is a restricted use product (RUP) that is labeled for use in controlling European corn borer larvae and eggs, corn earworm larvae, Mexican bean beetle, leafhopper and aphid. The labeled rate is variable depending on pest to be controlled but the product is applied at a rate of 0.75-3 pts./A. There is a field REI of 48 hours for this product and pre-harvest interval varies: < 1.5 lbs/AI =1 day, >1.5 lbs/AI=3 days.

Pyrethroids

Esfenvalerate (Asana XL) *Asana is a restricted use product that is labeled for use on snap bean to control European corn borer and corn earworm larvae, pea aphid, potato leafhopper, and Mexican bean beetle. The labeled rate is 0.03-0.05 lb. AI/A with total annual applied product not to exceed 0.2 lb AI/A EXCEPT for Mexican bean beetle: 0.015-0.03 lb AI/A. Asana can be applied up to 3 days before harvest.

Bifenthrin (Capture 2 EC) *Capture is a restricted use product that is labeled to control European corn borer and corn earworm larvae, aphids, sap beetles and leafhoppers. Application rate is 1.6-6.4 fl. oz/A depending on the insect being treated for, see label for specific information. There is a three day pre-harvest interval and total applied product must not exceed 0.2 lb AI/A/year.

Organophosphates

Diazinon (Diazinon 50W) *Diazinon is a restricted use product that can be used to control beetles, leafminers and leafhopper. The product is applied at a rate of 0.5-1.5 lbs/A depending on the insect targeted that can be foliar-applied. There is a 5-day pre-harvest interval for Diazinon.

Acephate (Orthene 75S) *Orthene is a restricted use product that can be used to control European corn borer and corn earworm larvae, beetles and leafhopper. It is applied at rates of 0.66-1.33 lbs/A. There is a 14 day PHI for Orthene. Treatments should start once eggs or adults are observed on foliage and continue every 7-10 days.

New products/registrations

A new product, marketed by Eden Bioscience Corporation, called ‘Messenger’ is touted as enhancing plants’ natural suppression systems, thereby minimizing insect feeding damage. The AI in Messenger is a byproduct of bacteria, thus it is considered a biological or biochemical product. An additional claim made by the manufacturer is added disease suppression.

Table 1. Insect control options: chemical products

| Foliar Products | Field Rate | A.I. Rate | PHI/REI | Application Schedule | Remarks |
|---------------------------|-------------------|------------------|------------------|-------------------------------------|--|
| <i>Spinosad</i> | | | | | |
| SpinTor 2SC | 3-6 oz/A | 0.05-0.10 lb/A | 3 d 4 h | Prior to egg hatch, 3 day intervals | ECB, CEW, looper, leafminer; total <29 oz/A/year |
| <i>Carbamates</i> | | | | | |
| Lannate LV | 0.75-3 pts/A | 0.23-0.92 lb/A | Variable 48 h | 5-7 d | ECB, CEW, beetles, mites; total <4.5 lb/AI/A/year AND <10 applications |
| Sevin XLR Plus | 0.5-1.5 qts/A | 0.5-1.5 lb/A | 3 d 12 h | 7+ d | ECB, CEW, beetles, leafhopper, aphids; total <8 qt/A/year |
| <i>Pyrethroids</i> | | | | | |

| | | | | | |
|-------------------------|------------------------|-------------------------|--------------|-----------|--|
| Asana XL | 5.8-9.6 oz/A | 0.03- 0.05 lb/ A | 3 d 24 h | 3+ d | CEW, beetles, leafhopper, mites, aphids; total <0.2 lb/AI/ A/year |
| Capture 2EC | 1.6-6.4 oz/A | 0.025- 0.10 lb/ A | 3 d 24 h | As needed | ECB, CEW, beetles, leafhopper, mites, aphids; total <0.2 lbAI/ A/year |
| Organophosphates | | | | | |
| Diazinon 50WP | 1-1.5 lbs/A | 0.5-0.75 lb/A | 7 d 24 h | 5 d | Beetles, leafminer, leafhopper, seed corn maggot; 3 applications MAX |
| Orthene 75S | 0.66- 1.5 lbs/ A | 0.5-1.13 lb/A | 14 d 24 h | 7-10 d | ECB, CEW, beetles, leafhopper; <2 lb/AI/A/year |

Insect Management: Biological Control

There are several biological control agents available for control/suppression of numerous snap bean insect pests. These range from other insects to fungi and protozoans. Some of these are commercially available for release by growers.

| Pest | Biological Control Agent |
|---------------------|---------------------------------------|
| European corn borer | <i>Lydella thompsoni</i> |
| | <i>Macrocentrus grandii</i> |
| | <i>Beauveria bassiana</i> (Fungus) |

| | |
|---------------------|--|
| | <i>Perezia pyraustae</i> (Protozoan) |
| | <i>Nosema pyrausta</i> (Micro sporidan) |
| Mexican bean beetle | Spined soldier bug |
| Bean leaf beetle | Tachinid fly, <i>Calatoria diabroticae</i> |

Diseases

Anthracnose (*Colletotrichum lindemuthianum*)

Anthracnose is transferred to plants through rain, dew, contaminated seeds or air and produces rust-colored specks that enlarge to 5-7mm in length. Red to purple lesions develop on the leaf petioles and affected plants will possess dry, shriveled pods. Anthracnose survives in crop debris and can be transmitted among a number of crops. Damage can result in as much as 100% yield loss (10). Because anthracnose persists in soil debris, specifically infected plant matter at or below the soil surface, managing this layer with proper field sanitation will provide some control. Two cultural practices that reduce plant debris are deep plowing and modifying tillage practices by reducing conservation tillage. Rotating crops on a 2-3 year schedule and the use of resistant varieties ('Dade' and 'Kentucky Wonder') provide control against anthracnose (9).

Rust (*Uromyces appendiculatus*)

Rust can appear on and damage any above ground part of beans but most often occur on the leaves. Warm, humid climates favor rust development (10). The symptoms signaling its presence includes initially small whitish raised pustules found under leaves (8). These spots turn into reddish-brown circular fruiting bodies that will rupture the leaf making powdery vegetative spores ranging 1-2 mm in diameter (10). Rust management includes using resistant varieties ('Dade' and 'Kentucky Wonder') and treating affected fields with appropriate fungicides (8).

Common Bacterial Blight (*Xanthomonas phaseoli* Smith)

This disease produces small water-soaked lesions that increase in size as the disease progresses. Lesions become reddish-brown in color and can affect both stems and pods, eventually causing necrosis of the affected plant tissue (8). Rotating crops on a 2-3 year schedule and the use of resistant varieties reduces the occurrence of the blights. Seed treatments and foliar-applied fungicides also minimize the impact of bacterial blight (9).

White Mold (*Sclerotinia sclerotiorum*)

White mold is spread by tissue contact and is capable of surviving in a field for more than five years being a continuous problem if not dealt with. Initial symptoms include the presence of white cottony flowers. Small, round, dark green and water soaked lesions will also appear on pods, leaves, branches, and stems of the affected plants. Lesions increase in size and become slimy, ultimately becoming cottony in texture. Infected tissue has a lighter color that ranges from pale brown to white. Severe white mold can result in yield losses up to 100%. Disease severity increases in fields where plants form a dense canopy and there has been a history of white mold. Cool damp weather during and after flowering also aid the development of the disease (10).

Gray Mold (*Botryotinia fuckeliana*)

Similar to white mold, gray mold is more frequent in fields that have dense canopies during cool, humid weather. Flowers that remain on the pod after senescence also are a cause of this mold. Rain and wind are what spread the mold to plants. Plants that have tissue damage are at a higher risk of becoming infected, as the damaged tissue serves as an entry point for disease development. Initial symptoms include the appearance of dark, water soaked lesions which eventually become slimy. The lesions may take on different appearances depending on their location on the plant (10). Treatment options for Gray mold are identical to those for White mold (9).

Seedling Diseases: Rhizoctonia Root Rot, Pythium diseases, Fusarium Root Rot, Black Root Rot (*Rhizoctonia solani*, *Pythium spp.*, *Fusarium solani*, *Thielaviopsis basicola*)

Seedling diseases (root rots) persist in the soil and infect both seed and root structures. The soil born fungi can persist for extended periods of time in the soil, several years in some cases (10). Cold, wet weather after planting followed by hot, dry conditions can lead to severe yield losses. Seeds affected by these fungi will become soft and fail to germinate while seedlings affected by will have dark, water soaked lesions on their stems. Seedlings will most likely die soon after infection. Infection by root rot in mature plants is usually isolated in the roots and causes the plants to become stunted, wilt, and die (12). The use of certified seed can minimize effects of root rot as can the application of fungicides containing metalaxyl (Ridomil) (9).

Also see factsheet: <http://www.ag.ohio-state.edu/~ohioline/hyg-fact/3000/3110.html>

Mosaic Virus

Aphids and leafhoppers can vector alfalfa mosaic virus from plant to plant. Leaves can become yellow, dark or light green mosaic colored, and may become deformed. Plant stunting and blossom drop may also be observed. Control can be achieved by using resistant varieties (Bush Blue Lake 274, Provider, Tendercrop, Cherokee, and Goldcup) and by controlling insect vectors (9).

Table 2. Disease control options: chemical products

| Foliar Products | Field Rate | A.I. Rate | PHI/REI | Application Schedule | Remarks |
|-----------------|--------------------------|--------------------------|--------------|--|--|
| Bravo Ultrex | 1.25-2.7 lb/A | 1-2.25 lb/A | 7 d 48 h | Weekly (as needed) | Rate varies for gray mold/rust; <11 lb/A/year |
| Nova 40W | 4-5 oz/A | 1.6-2 oz/A | 0 d 24 h | 7-10 d (as needed) | Controls rust; <0.5 lb/AI/A/year |
| Topsin M WSB | 1-2 lb/A | 0.7-1.4 lb/A | 14 d 12 h | 1-2 applications depending on % of crop in bloom | Controls white/gray mold, Anthracnose |
| Ridomil Gold EC | 0.5-1 pt/A | 1-2 lb/A | -- 48 h | Applied at planting | Incorporated into soil at planting; controls seedling diseases |
| Apron XL | 0.32-1.28 oz/100 lb seed | 0.10-0.42 oz/100 lb seed | -- 48 h | Seed treatment | Rate varies for Pythium, Phytopthera and downy mildew (see label) |
| Benlate SP | 8-32 oz/A | 4-16 oz/A | 14 d 48 h | 7-10 d (as needed) | Apply at 10% bloom and 7 d post 10% bloom; for control of Fusarium, Anthracnose, white/gray mold |

Nematodes

The two most common nematodes to infect snap beans are the root-knot nematode, *Meloidogyne spp.*, and the lesion nematode, *Pratylenchus spp.* Stand loss for each can be severe ranging from 10-80% for the lesion nematode and 45-90% for the root-knot nematode. Nematodes overwinter as both adults and larvae in roots or soil (10). Damage by the root-knot nematode is more detrimental in light-textured soils and well-drained fields. Infested plants will appear chlorotic, stunted, necrotic, or wilted. Knots or galls are also commonly associated with nematodes. When the nematodes take up a permanent feeding locations on roots, the surrounding area will produce enlarged cells that increase in number and produce knots. Knots are generally 1-10 mm in diameter and can cause wilting, defoliation, and/or death. The

root-knot nematode population decreases in both very dry and very wet field conditions. Control options include flooding fields with water, rotating with non-host crops, weed control, deep plowing and long fallow periods. Although available, nematicides are quite expensive and may not prove economically viable.

Damage caused by the feeding of lesion nematodes includes underdeveloped roots with lesions, stunting, chlorosis, and wilting. The lesion nematode prefers cool (10-15°C), moist soils. Crop rotation is not a control option for lesion nematodes as once a field becomes infested, the population can persist several years. Field flooding and summer fallow are two control options. Fumigant and non-fumigant nematicides also provide control but are very expensive and in most cases, not financially advantageous (10).

Weeds

There are numerous weed pests that affect snap bean fields. Weeds compete with snap beans for available resources including soil nutrients, moisture, and light. They can be divided into annual broadleaf weeds and annual or perennial grasses (4, 5, 9). A number of herbicide are used to manage weeds in snap beans in Minnesota. Table 3 (below) describes herbicide use in MN in 1996 for select products (16).

Table 3. Selected herbicides and use rates for MN, 1996

| Chemical | Acreage (% Crop) | Treated Acres | Rate (lb/ AI/A) | # Apps./ Year | Total Applied (lb/AI/ year) | Weeds Controlled |
|------------------------|-----------------------------|--------------------------|--------------------------------|------------------------------|--|---|
| Bentazon (Basagran) | 40-100 | 2200- 5500 | 1-2 | 1-2 | 1650- 11,000 | Coclebur, lambsquarters, velvetleaf, yellow nutsedge |
| EPTC (Eptam) | 75 | 4125 | 3 | 1 | 14,293 | Foxtail, wild proso millet, wooly cupgrass |

| | | | | | | |
|--------------------------|--------|---------------|-------|-----|-----------|--|
| Metolachlor (Dual II) | 50 | 2750 | 2 | 1 | 5225 | Barnyardgrass, crabgrass, foxtail, wild proso millet, shattercane |
| Pendamethalin (Prowl) | 50 | 2750 | 1.88 | *NA | *NA | Foxtail, lambsquarters, pigweed, wild proso millet |
| Sethoxydim (Poast) | 40-50 | 2200- 2750 | 1-1.5 | 1 | 413-775 | Barnyardgrass, crabgrass, wooly cupgrass, fall panicum, foxtails, shattercane, wild proso millet |
| Trifluralin (Treflan) | 75-100 | 4125- 5500 | 1 | 1 | 2062-2750 | Barnyardgrass, crabgrass, foxtail, wild proso millet, shattercane, pigweed, velvetleaf |

*NA-not available

Broadleaf Weeds

Many broadleaf weeds adversely affect snap beans in Minnesota. Examples are: velvetleaf (*Abutilon theophrasti*), common lambsquarters (*Chenopodium album*), giant and common ragweed (*Ambrosia trifida* and *Ambrosia artemisiifolia*, respectively), and pigweed (*Amaranthus retroflexus*). These weeds can reach heights comparable to snap beans and compete with the beans for available light and soil nutrients. In absence of control, weeds can and do reduce snap bean yield.

Grasses

Annual grasses cause significant problems with snap bean production because of their fast growth and ability to compete for resources. Additionally, they are tolerant to extreme moisture and temperature variation once established. They can be very difficult to eliminate from production areas and given their reproductive potential, they require management/control prior to seed-set. Examples are: foxtail (*Setaria spp.*), wild proso millet (*Panicum miliaceum*), and crabgrass (*Digitaria spp.*).

Table 4. Weed control option: chemicals

| Pre-emergence Products | Field Rate | A.I. Rate | REI | Remarks* |
|--------------------------------|-------------------|------------------|------------|--|
| Dacthal 75WP | 6-14 lb/A | 4.5-10.5 lb/A | 12 h | G, BL**; applied at planting |
| Eptam 7E | 3.5-4.5 pt/A | 3-4 lb/A | 12 h | G, BL; <9.75 pt/A/year; apply before/ immediately after planting |
| Dual II Magnum (Metolachlor) | 1.3-2 pt/A | 1.25-2 lb/A | 24 h | G, BL**; applied fall or spring and can be tank mixed with other products--see label |
| Gramoxone Extra (Paraquat) | 1.5-3 pt/A | 0.5-1 lb/A | 12 h | G, BL |
| Prowl 3.3EC (Pendimethalin) | 1.2-3.6 pt/A | 0.5-1.5 lb/A | 24 h | G, BL**; rate varies by soil type; can be applied with Dual, Lasso, Eptam |
| Post-emergence Products | | | | |
| Poast 1.5E | 0.5-2.5 pt/A | 0.06-0.3 lb/A | 12 h | Not to exceed 4 pt/A/year; 15 d PHI |
| Assure II 0.88E | 5-12 oz/A | 0.03-0.08 lb/A | 12 h | G; not to exceed 14 oz/A/year; 15 day PHI |
| Basagran (Bentazon) | 1.2 pt/A | 0.6 lb/A | 48 h | 4 pt/A/year MAX, second application 10-14 days post first treatment; 30 day PHI |

*G: grass, BL: broadleaf

**Certain broadleaf weeds, see label

Contacts

Mr. Patrick O'Rourke
 MN Pesticide Survey & Impact (PSI) Group
 Dept. of Entomology
 219 Hodson Hall

1980 Folwell Avenue
St. Paul, MN 55108
Phone: 612-624-9292
Email: orour010@tc.umn.edu

Insects:

Dr. William D. Hutchison
University of Minnesota
Pesticide Survey & Impact Group
Department of Entomology
219 Hodson Hall
1980 Folwell Avenue
St Paul, MN 55108
Phone: 612-624-1767
Email: hutch002@maroon.tc.umn.edu

Mr. Eric Burkness
University of Minnesota
Department of Entomology
219 Hodson Hall
1980 Folwell Avenue
St Paul, MN 55108
Phone: 612-624-3670

Plant Diseases:

Dr. James Percich
University of Minnesota
Department of Plant Pathology
316 Stakman Hall
1519 Gortner Ave
St Paul, MN 55108
Phone: 612-625-6240

Weeds:

Dr. Roger Becker
University of Minnesota
Department of Agronomy/Plant Genetics
Agronomy and Plant Genetics
A 203A Hayes Hall
1509 Gortner Ave
St Paul, MN 55108
Phone: 612-625-5753

Acknowledgements

The Minnesota snap bean crop profile was compiled by and edited by Patrick O'Rourke, Amber Genetzky and W. D. Hutchison, Minnesota Pesticide Survey and Impact Group, Department of Entomology, University of Minnesota.

References

1. Aphid alert: <http://ipmworld.umn.edu/aphidalert/alert3.htm>
2. Boyd, M. L. and W. C. Bailey, Soybean pest management: Bean leaf beetle: <http://muextension.missouri.edu/xplor/agguides/pests/g07150.htm>
3. Cantwell, M. and T. Suslow, Snap beans: <http://postharvest.ucdavis.edu/ProduceFacts/Veg/snapbeans.html>
4. C&P Press, Greenbook Search: <http://www.greenbook.net/free.asp>
5. Crop Data Management Systems: <http://www.cdms.net/manuf/manuf.asp>
6. Delahaut, K.A., S.E.R. Mahr and J. Wyman. 2001. Processing snap bean production. University of Wisconsin, Madison.
7. Dietrich, C. H., Leaf hopper FAQs: <http://www.inhs.uiuc.edu/~dietrich/lfhFAQ.html>
8. Dhinbil, M., Growing snap beans: <http://www.hort.uconn.edu/ipm/homegrnd/htms/47beans.htm>
9. Foster, R. 2000. Midwest vegetable production guide for commercial growers 2001. University of Minnesota Extension Service, BU-7094-S. St. Paul, MN. <http://www.entm.purdue.edu/entomology/ext/targets/ID/index2001.htm>.
10. Hall, R. 1991. Compendium of bean diseases. American Phytopathological Society, Eagan, MN.
11. Metcalf, R. L and R. A. Metcalf. 1993. Destructive and Useful Insects: Their Habits and Control, 5th Ed. McGraw-Hill, New York.
12. Miller, S. A., R. M. Riedel, and R. C. Rowe, Damping-off and root rot of beans: <http://www.ag.ohio-state.edu/~ohioline/hyg-fact/3000/3110.html>
13. Minnesota Agricultural Statistics Service. 2000. Minnesota agricultural statistics, 2000. St. Paul, MN.
14. NASS (National Agricultural Statistics Service): <http://www.usda.gov/nass/pubs/agr00/acro00.htm>
15. Scout info. Kentucky IPM scout information sheets: <http://www.uky.edu/Agriculture/IPM/scoutinfo/scout.htm>
16. Wisconsin PIAP program. 2000. Processing snap bean production. <http://ipcm.wisc.edu/piap/snapbeans/sbprod.htm>