

CROP PROFILE FOR SOYBEAN IN DELAWARE

Revised July 2008

General Production Information (1)

Soybean Acreage, Average Yield and Production. 2007.

Location	Acres Planted	Acres Harvested	Yield Bushels/A	Production Bushels
New Castle Co.	20,500	20,300	30	610,000
Kent Co.	57,000	54,400	21.9	1,190,000
Sussex Co	72,500	70,300	23.9	1,680,000
TOTAL	150,000	145,000	24	3,480,000

Cultural Practices (2)

Planting dates

The optimum planting period for soybeans is mid-May to early June. Planting soybeans after early June will cause a reduction in yield. July 20 is about the latest date that soybeans should be planted in Delaware.

Irrigation practices

Soybean water-use peaks during pod-set at about 0.3 inches per day or more than 2 inches per week. The most critical watering period for soybeans is the reproductive stage (flowering through pod-fill). During the critical reproductive phase, water use rate ranges from 0.2 to 0.3 inches per day.

Double-cropping

Double-cropped soybeans account for approximately 50% of the soybean acreage in Delaware. Double cropping refers to the practice of growing two crops at different times in the same field in a one-year period. Soybeans are usually double-cropped after a small grain such as winter wheat or barley. Double-cropping allows growers to spread out their harvest season; however, double-cropped soybeans are more difficult to manage than single-cropped soybeans.

Crop Rotation

In Delaware, soybean is rotated with corn and grain sorghum. Crop rotation increases yield by 10% due to reduced insect, disease, and weed pressure.

land preparation

No-till methods, reduced (conservation) tillage and conventional tillage are practiced in Delaware soybean. Tillage selection is based on equipment availability; time and labor availability; cropping sequence, field characteristics such as weed pressure; weed species present; soil drainage; and other management factors.

Worker Activities

Soybean production in Delaware is a highly mechanized system. Little or no hand work is done to the crop. The exception would be scouting, which is usually done by consultants or the farm family. Applications of fungicides (very rare), herbicides (common), and insecticides (infrequent) would be made as needed.

INSECT PESTS

In Delaware, insect pests fall into three general categories: defoliators, piercing-sucking pests, and pod feeders. The primary insect and non-insect arthropod pests attacking Delaware soybeans include grasshoppers, green cloverworms, spider mites, and corn earworm. Although sporadic in nature, soybean aphid populations have been on the increase in recent years. The following includes potential insect pests attacking soybeans ordered generally in their order of appearance during the season.

Seed Corn Maggot (SCM)

Biology and Life History: Maggots generally overwinter as puparia in the soil with flies emerging as early as late February. Flies lay eggs on seeds or just below the surface of recently plowed ground that is high in decayed organic matter. The seedcorn maggot (SCM) is primarily a pest of full season, no-till soybeans. Conditions favoring maggots include cool, wet weather at germination; heavy crop residue and the use of manures. Infestations are most often found when full season soybeans are planted in cool, wet soil using reduced tillage.

Damage: The larvae (maggots) develop in the soil and feed on decaying organic matter. They also will attack newly planted seeds both before and after emergence. If feeding occurs before germination, the seeds will die. This causes reduced plant populations in the form of skips in the field. Minor feeding damage may simply slow plant development. Moderate feeding damage to the growing point may result in two stems. Severe damage often kills the plants.

Monitoring and Decision Making: Scouting and applying rescue treatments after the damage is observed are ineffective. Management options must be applied to high-risk fields prior to planting.

Controls:

Biological: None

Cultural: The use of cultural management practices before planting can help to reduce the potential for economic problems. A combination of the following cultural strategies can be used: (1) plow down cover crops at least 3-4 weeks before planting or transplanting, (2) completely bury cover crops or previous crop residue to reduce fly attraction to rotting organic matter on the soil surface, and (3) avoid the use of heavy manure applications close to planting.

Chemical: The only available control strategies for SCM in soybeans include a permethrin hopper-box treatment (KickStart VP and Kernel Guard Supreme) and a recently labeled commercially applied thiamethoxam seed treatment (Cruiser). In both cases, less than 5% of the acreage is treated with these products.

Bean leaf beetle (BLB)

Biology and Life History: Bean leaf beetles adults (BLB) can be found in most soybean fields every year but economic damage is rare. They are important pests only

from seedling emergence until the first trifoliolate leaf has unrolled and again during pod fill.

Damage: Bean leaf beetles prefer tender plant tissue and leave rounded holes on the leaves. These beetles often invade fields shortly after plant emergence and can kill seedlings by damaging cotyledons before the first true leaves develop.

Monitoring and Decision Making: Using a drop cloth placed between 2 rows, shake the plants in 6 foot row in 10 sites in a field, count the number of beetles found in 6 foot of row in each site, and estimate defoliation at each site. A treatment is recommended from plant emergence to the second trifoliolate when you find 2 beetles per ft. row and 25% stand reduction. After the second trifoliolate, the treatment threshold is 2-3 beetles per plant and 30% defoliation.

Controls:

Biological: None

Cultural: None

Chemical:

(I) Pyrethroids

Asana XL (esfenvalerate) - Application rate: 5.8 to 9.6 fl.oz/A; Good Control; Applied to less than 1% of the acreage; PHI: 21 days; REI: 12 hours REI

Baythroid (cyfluthrin): Application rate: 1.6 to 2.8 fl.oz/ac; Good Control; Applied to less than 1% of the acreage; PHI: 45 days PHI, REI: 12 hours

Mustang MAX (zeta-cypermethrin): Application rate: 2.8- 4 fl oz/A; **PHI:** 21 days REI: 12 hours

Permethrin 3.2EC - Application rate: 2-4 fl.oz/ac.; Good control; Applied to less than 1% of the acres; PHI: 60 days; REI: 12 hours

Warrior (lambda-cyhalothrin): Application rate: 1.92 to 3.2 fl.oz/A; Good control; Applied to less than 1% of the acreage; PHI: 45 days; REI: 24 hours

(II) Organophosphates

Lorsban (chlorpyrifos): Application rate: 0.5 to 1 pt/A; Applied to less than 1% of the acreage; PHI: 28 days; REI: 24 hours

PennCap-M (methyl parathion): Application rate: 2-3 pt/A; Applied to less than 1% of the acreage; PHI: 20 days; REI: 5 days

(III) Carbamates

Lannate LV (methomyl): Application rate: 0.75 – 1 pt/A; Good control; Applied to less than 1% of the acreage; PHI: 14 days; REI: 48 hours

Larvin (thiocarb): Application rate: 18 to 30 fl.oz/A; Applied to less than 1% of the acreage; PHI: 28 days; REI: 48 hours

Sevin XLR Plus (carbaryl): Application rate: 0.5-1 qt/A; Good control; Applied to less than 1% of the acreage; PHI: 21 days; REI: 12 hours

Mexican bean beetle (MBB)

Biology and Life History: Although a significant pest of soybeans in the 1970s and early 1980s, the MBB is rarely found in soybean fields in Delaware. This beetle can be found in fields shortly after plant emergence, especially near overwintering areas, and again during the pod fill stage.

Damage: MBB often invade fields shortly after plant emergence and can kill seedlings by damaging cotyledons before the first true leaves develop. However, significant damage can occur late in the season on later planted soybeans. The MBB prefers young plant tissue and produces lacelike feeding injury.

Monitoring and Decision Making: Using a drop cloth placed between 2 rows, shake the plants in 6 foot row in 10 sites in a field, count the number of beetles found in 6 foot of row in each site, and estimate defoliation at each site. The following thresholds are used as treatment guidelines: (a) Seedling Stage: 2/plant and 30% defoliation ; (b) Prebloom: 6/ft. row and 30% defoliation; (c) Bloom to Pod-Fill: 5/ft. row and 15% defoliation or 0.5/sweep and 15% defoliation; (d) Full Green Bean to 50% Yellow Leaves: 6/ft. row and 35% defoliation or 0.5-1/sweep and 35% defoliation

Controls:

Biological: *Pediobius foveolatus* has been used for biological control of Mexican bean beetles in soybeans on a county-wide scale for the last 20 years in Maryland and New Jersey. It was also used in Delaware soybeans fields in the 1980s and early 1990s. *Pediobius foveolatus* is a tiny wasp that is a parasitoid of Mexican bean beetle larvae and squash beetle larvae. This wasp does not survive the winter in the U.S., and therefore is only present if growers buy wasps from a laboratory colony and release them. An adult female wasp lays about 20 of her eggs per Mexican bean beetle larva (2nd to 4th molt). The wasp eggs hatch inside the Mexican bean beetle larva and feed on it, eventually killing it. About ten days after the eggs are laid, the body of the Mexican bean beetle larva becomes a "mummy," with the outer skin darkened, but intact, while the wasp larvae inside develop and form pupae. When the wasps emerge as adults (about seven days after formation of the mummy), they break a small hole in the skin of the mummy and climb out. They mate, and fly off to feed at flowers and find more hosts. The females gradually lose their egg-laying capacity after 3-4 weeks. They can travel several miles over one growing season. Because *Pediobius* is expensive to rear and thus expensive to purchase, "inoculative releases" have been used. The wasps are introduced early in the season in relatively low numbers, and expected to multiply over the season in the field. This strategy works best for farms with multiple, overlapping plantings of beans during the season. If the initial population is not excessively high,

releasing *Pediobius* may help control bean beetle late in the season, and may bring down the Mexican bean beetle population in the next year. Although the parasitoid has contributed to the decline of the MBB population in Delaware, weather conditions have also played a major role in regulating populations.

Cultural: Cultural control efforts may include destruction of overwintering locations and late planting of the soybean crop. The destruction of overwintering locations increases exposure to inclement weather conditions and can greatly reduce adult numbers the following spring. Under certain conditions, a combination of a trap crop with delayed planting of a portion of the field might be used to advantage. Since overwintering beetles actively forage upon emergence in the spring, beans planted early will attract a disproportionate number of beetles feeding during their preoviposition period.

Chemical (3)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Esfenvalerate (Asana XL 0.66 EC)	0.015-0.03 lb	2.9-5.8 oz	21	Restricted Use: Esfenvalerate is extremely toxic to fish.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 fl oz	30	Restricted Use:
Methomyl (Lannate LV 2.4EC)	0.12-0.23 lb	0.4-0.75 pt	14	Restricted Use: Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
Methomyl (Lannate 90SP)	0.1-0.2 lb	0.125-0.25 lb	14	Restricted Use: Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
Microencapsulated methyl parathion (PennCap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	20	Restricted Use: Do not use screens or nozzle tips finer than 50 mesh. Mix with EC-formulated products only when compatibility is known. Do not make more than two applications per season.
Permethrin (Permethrin 3.2EC)	0.05-0.1 lb	2.0-4.0 oz	60	Restricted Use: Permethrin is

				extremely toxic to fish. Do not make more than two applications per season. Do not graze or harvest for forage.
Thiodicarb (Larvin 3.2F)	0.25-0.75 lb	10.0-30.0 oz (cloverworms)	28	Use lower rates for cloverworms and maximum protection of beneficials where moderate pest populations exist. Do not feed forage, hay, or straw.
Thiodicarb (Larvin 3.2F)	0.45-0.75 lb	18.0-30.0 oz (beetles)	28	Use lower rates for cloverworms and maximum protection of beneficials where moderate pest populations exist. Do not feed forage, hay, or straw.
Zeta-cypermethrin (Mustang MAX)	0.018-0.025 lb	2.8-4.0 oz	21	Restricted Use: Use higher rate for grasshoppers. Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Do not make applications less than 7 days apart. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.15 lb ai per acre. Restricted Use: Use higher rate for grasshoppers and low rate for green cloverworms. Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	45	

Gamma-cyhalothrin (Proaxis)	0.0075-0.015 lb	1.92-3.84 oz	45	spray volume of 2 or 10 gallons per acre by air or ground, respectively. Max per 7 day interval – 2.8 fl oz/A; Max allowed per crop season: 11.2 fl oz/A; Max # applications per season: 4 Restricted Use: NEW for 2006 - Total product allowed per acre is 0.48 pt of formulation.
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Potato Leafhopper (PLH)

Biology and Life History: PLH is a migratory insect arriving in the Mid-Atlantic by late April–early May. They generally attack soybeans late June through July but rarely reach population levels that reduce yields.

Damage: Nymphs and adults feed on plant sap from the underside of leaves. While feeding, they also inject a toxic substance that interferes with normal plant growth. The symptoms of leafhopper damage include localized stippling, curling and yellowing of leaf margins (hopperburn)

Monitoring and Decision Making: Leafhopper sampling is done with a standard 15-inch sweep net. Fields should be sampled by taking 5 sweeps in 5 locations throughout a field. A treatment should be considered if injury is observed and you can find 4 leafhoppers per sweep in drought stressed soybeans or 8 per sweep in normal growing fields.

Controls:

Biological: None

Cultural: Dense pubescent varieties tend to be less susceptible to damage.

Chemical (3)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Esfenvalerate (Asana XL 0.66 EC)	0.015-0.03 lb	2.9-5.8 oz	21	Restricted Use: Esfenvalerate is extremely toxic to fish. Do not feed or graze livestock on treated plants. Do not exceed more than four applications per acre per season.

Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 fl oz	30	Restricted Use:
Permethrin (Permethrin 3.2EC)	0.05-0.1 lb	2.0-4.0 oz	60	Restricted Use: Permethrin is extremely toxic to fish. Do not make more than two applications per season. Do not graze or harvest for forage.
Zeta-cypermethrin (Mustang MAX)	0.018-0.025 lb	2.8-4.0 oz	21	Restricted Use: Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Do not make applications less than 7 days apart. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.15 lb ai per acre.
beta-cyfluthrin (Baythroid XL)	0.0065- 0.0125 lb	0.8-1.6 oz	45	Restricted Use: Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively. Max per 7 day interval – 2.8 fl oz/A; Max allowed per crop season: 11.2 fl oz/A; Max # applications per season: 4
Gamma-cyhalothrin (Proaxis)	0.0075- 0.0125 lb	1.92-3.20 oz	45	Restricted Use: NEW for 2006 - Total product allowed per acre is 0.48 pt of formulation.

Thrips

Biology and Life History: Thrips overwinter in Delaware and are present on soybeans throughout the season. They constitute the most abundant insect in soybean fields but cause relatively little economic damage.

Damage: Early season damage to drought-stressed plants can reduce yields. Both nymphs and adults feed on the undersides of leaves, causing small silvery streaks and whitish or yellowish discoloration.

Monitoring and Decision Making: Thrips sampling is done by collected 5 leaflets at 10 locations and counting the number of adults and nymphs per leaflet. A treatment is recommended if plants are damaged and you find 8 thrips per leaflet.

Controls:

Biological: None

Cultural: None

Chemical (3)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Lambdacyhalothrin (test-Calvin-2)	1	1	1	Restricted Use:
Lambdacyhalothrin (test-Calvin-2)	1	1	1	Restricted Use:
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 fl oz	30	Restricted Use:
Methomyl (Lannate LV)	0.23-0.30 lb	0.75-1.0 pt	14	Restricted Use: Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
Methomyl (Lannate 90SP)	0.23-0.34 lb	0.25-0.375 lb	14	Restricted Use: Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
Microencapsulated methyl parathion (Pennacap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	20	Restricted Use: Do not use screens or nozzle tips finer than 50 mesh. Mix with EC-formulated products only when compatibility is known. Do not make more than two applications per season.
Zeta-cypermethrin (Mustang MAX)	0.02-0.025 lb	3.2-4.0 oz	21	Restricted Use: Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Do not make applications less than 7 days apart. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.15 lb ai per acre.
beta-cyfluthrin (Baythroid XL)	0.0065-0.0125 lb	0.8-1.6 oz	45	Restricted Use: Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively. Max per 7 day interval – 2.8 fl oz/A; Max allowed per crop season: 11.2 fl oz/A; Max # applications per season: 4

Gamma-cyhalothrin (Proaxis)	0.0075- 0.0125 lb	1.92-3.20 oz	45
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Green cloverworm (GCW)

Biology and Life History: In general, larvae are first detected in soybeans by early July. In years of heavy populations, the peak in population generally occurs in mid-August with populations declining by early September.

Damage: The green cloverworm (GCW) is one of the most common leaf feeding insects found in Delaware soybeans. In full season soybean, it is generally of minor importance because of the soybean plant's ability to compensate for foliage losses. It can reach pest status in double crop soybeans since the leaf area index is lower. Young cloverworms scrape the leaf tissue, leaving feeding signs that resemble irregular shiny windows on the leaf surface. Older larvae eat irregular holes between the main veins giving leaves a tattered appearance.

Monitoring and Decision Making: Using a drop cloth placed between 2 rows, shake the plants in 6 foot of row in 10 sites in a field, count the number of insects found at each site and estimate defoliation. As a general guideline, treatments should be considered if you find 15/ft. row and 30% defoliation at the pre-bloom stage; 20/ft. row and 15% defoliation at the bloom–pod fill stage and 35% defoliation from full green bean to 50% yellow leaves.

Controls:

Biological: Parasites and predators can help reduce populations; however, fungal pathogens play the most important role in regulating GCW populations. If weather conditions are favorable (hot and humid), fungal pathogens can play a major role in controlling this pest.

Cultural: None

Chemical:

Chemical (3)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Bacillus thuringiensis (Agree WG, Biobit HP, Crymax, Deliver LC, Dipel DF, Xentari)	Check the label for rates	Check the label for rates	0	Use for cloverworms and other caterpillar pests only. Bacillus thuringiensis formulations are slower acting and more effective when larvae are young, but they

				are one of the safest options because their low oral and dermal toxicity. They will not control beetles or sucking insects.
Esfenvalerate (Asana XL 0.66 EC)	0.015-0.03 lb	2.9-5.8 oz	21	Restricted Use: Esfenvalerate is extremely toxic to fish.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 fl oz	30	Restricted Use:
Methomyl (Lannate LV 2.4EC)	0.12-0.23 lb	0.4-0.75 pt	14	Restricted Use: Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
Methomyl (Lannate 90SP)	0.1-0.2 lb	0.125-0.25 lb	14	Restricted Use: Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	20	Restricted Use: Do not use screens or nozzle tips finer than 50 mesh. Mix with EC-formulated products only when compatibility is known. Do not make more than two applications per season.
Permethrin (Permethrin 3.2EC)	0.05-0.1 lb	2.0-4.0 oz	60	Restricted Use: Permethrin is extremely toxic to fish. Do not make more than two applications per season. Do not graze or harvest for forage.
Thiodicarb (Larvin 3.2F)	0.25-0.75 lb	10.0-30.0 oz (cloverworms)	28	Use lower rates for cloverworms and maximum protection of beneficials where moderate pest populations exist. Do not feed forage, hay, or straw.
Thiodicarb (Larvin 3.2F)	0.45-0.75 lb	18.0-30.0 oz (beetles)	28	Use lower rates for cloverworms and maximum protection of

				beneficials where moderate pest populations exist. Do not feed forage, hay, or straw.
Zeta-cypermethrin (Mustang MAX)	0.018-0.025 lb	2.8-4.0 oz	21	<p>Restricted Use: Use higher rate for grasshoppers. Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Do not make applications less than 7 days apart. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.15 lb ai per acre.</p>
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	45	<p>Restricted Use: Use higher rate for grasshoppers and low rate for green cloverworms. Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively. Max per 7 day interval – 2.8 fl oz/A; Max allowed per crop season: 11.2 fl oz/A; Max # applications per season: 4</p>
Gamma-cyhalothrin (Proaxis)	0.0075-0.015 lb	1.92-3.84 oz	45	<p>Restricted Use: NEW for 2006 - Total product allowed per acre is 0.48 pt of formulation.</p>

Grasshoppers

Biology and Life History: In Delaware's soybeans grasshopper problems occur at 3 key times and under certain production systems: full season soybeans planted in May into not-till soybean stubble; double cropped soybeans planted behind wheat and barley and in August during drought conditions. In all cases, grasshoppers move from the existing stubble and/or ditch, road banks and waterways into soybean field.

Damage: Grasshoppers can damage seedling stage soybeans often resulting in reduced stands. Later in the season (August), defoliation from soybeans during the pod-set and pod-fill stages results in reduced yields by defoliation and direct damage to soybean pods and seeds.

Monitoring and Decision Making: Grasshoppers are monitoring using a sweep net and taking 10 sweeps in 10 sites and counting the number of adults and nymphs. A treatment is recommended if you find 1 per sweep and 30% defoliation pre-bloom and 1 per sweep and 35% defoliation during the pod-fill stages.

Controls:

Biological: Although there are a number of potential natural enemies of grasshoppers including parasites, predators, nematodes and fungal pathogens, these natural enemies have not reduced populations below economically damaging levels in recent years.

Cultural: Avoid no-tilling into pastures and grass or grass weed new production areas, especially if planting late or at double crop time could reduce the impact of grasshoppers on soybeans. However, this is not a practical or economic options.

Chemical:

(I) Pyrethroids

Asana XL (esfenvalerate): Application rate: 5.8 – 9.6 fl oz/A; Good control; Applied to 10% of the acreage; PHI: 21 days, REI: 12 hours

Baythroid (cyfluthrin): Application rate: 2.1-2.8 fl.oz/A; Good control; Applied to 5% of the acreage; PHI: 45 days; REI: 12 hours

Mustang MAX (zeta-cypermethrin): Application rate: 3.2 – 4.0 fl oz/A; Good control; Applied to less than 5% of the acreage; PHI: 21 days; REI: 12 hours

Warrior (lambda-cyhalothrin): Application rate: 3.2- 3.84 fl.oz/A; Good control; Applied to 25% of the acreage; PHI: 45 days; REI: 24 hours

(II) Organophosphates

Dimethoate (Dimethoate): Application rate: 1pt/A; Fair – good control; Applied to 20% of the acreage; PHI: 21 days; REI: 48 hours

Lorsban (chlorpyrifos): Application rate: 0.5 – 1 pt/A; Good control; Applied to 5% of the acreage; PHI: 28 days PHI; REI: 24 hours

(III) Carbamates

Furadan (carbofuran): Application rate: 0.25 – 0.5 pt/A; Good control; Applied to 5% of the acreage; PHI: 21 days; REI: 48 hours

Sevin XLR Plus (carbaryl): Application rate: ½ - 1 qt/A; Good control; Applied to 10% of the acreage; PHI: 21 days; REI: 12 hours

Japanese Beetle (JB)

Biology and Life History: Adult beetles emerging in early July and feed on the upper foliage when plants are growing rapidly. After July, populations decline and no longer pose a threat to soybeans.

Damage: Japanese beetle often is encountered as localized, heavy populations. Adult beetles feed gregariously on soybeans producing a skeletonized leaf but economic damage rarely occurs. Damaged plants appear ragged with only the large leaf veins intact.

Monitoring and Decision Making: Using a drop cloth placed between 2 rows, shake the plants in 6 foot row in 10 sites in a field, count the number of beetles found in 6 foot of row in each site, and estimate defoliation at each site. A treatment is recommended if you find 7/ft. row and 15% defoliation during the bloom to pod-fill stages.

Controls:

Biological: None

Cultural: None

Chemical:

(I) Pyrethroids

Asana XL (esfenvalerate) - Application rate: 5.8 – 9.6 fl.oz/A; Good Control; Applied to less than 1% of the acreage; PHI: 21 days; REI: 12 hours

Baythroid (cyfluthrin): Application rate: 1.6 to 2.8 fl.oz/ac; Good Control; Applied to less than 1% of the acreage; PHI: 45 days PHI, REI: 12 hours

Mustang MAX (zeta-cypermethrin): Application rate: 2.8- 4 fl oz/A; Applied to less than 1% of the acreage; **PHI:** 21 days **REI:** 12 hours

Permethrin 3.2EC - Application rate: 2-4 fl.oz/ac.; Good control; Applied to less than 1% of the acres; PHI: 60 days; REI: 12 hours

Warrior (lambda-cyhalothrin): Application rate: 3.2 – 3.84 fl oz/A; Good control; Applied to less than 1% of the acreage; PHI: 45 days; REI: 24 hours

(II) Organophosphates

PennCap-M (methyl parathion): Application rate: 2-3 pt/A; Applied to less than 1% of the acreage; PHI: 20 days; REI: 5 days

(III) Carbamates

Sevin XLR Plus (carbaryl): Application rate: 0.5-1 qt/A; Good control; Applied to less than 1% of the acreage; PHI: 21 days; REI: 12 hours

Beet Armyworm (BAW)

Biology and Life History: The beet armyworm (BAW) is a migratory pest generally first found in soybean fields in early August. Eggs are deposited on plant foliage in small, fuzzy masses. The most significant defoliation generally occurs by late August to early September.

Damage: This insect is primarily a foliage feeder; however, if populations are heavy it can also feed on pods. Early instars most frequently damage the young terminal growth of seedling soybeans. Skeletonization and, often, a profuse silk webbing which gives the plants a shiny appearance are characteristic of this species. Although soybean plants can compensate for much foliage loss before bloom, severe beet armyworm damage will retard plant growth. Later instars do not feed gregariously and the production of webbing is discontinued.

Monitoring and Decision Making: While sampling for other defoliators, be sure to note the presence of small beet armyworm larvae. Although no precise thresholds are available for beet armyworm, treatments should be based on the level of defoliation. During the bloom to pod-fill stage, a treatment should be considered if defoliation reaches the 15% level.

Controls:

Biological: None

Cultural: None

Chemical:

(I) Pyrethroids

Asana XL (esfenvalerate): Application rate: 5.8 to 9.6 fl oz/A; Label only says aids in control; Poor control; Not used to control BAW on soybeans; PHI: 21 days, REI: 12 hours

Baythroid (cyfluthrin): Application rate: 1.6 – 2.8 fl. oz/A; Label only states for control of 1st and 2nd instars only; Poor control; Not used to control BAW in soybeans; PHI: 45 days; REI: 12 hours

Mustang MAX (zeta-cypermethrin): Application rate: 3.2 – 4.0 fl oz/A; Poor control; Not used to control BAW in soybeans; PHI: 21 days; REI: 12 hours

Permethrin 3.2EC: Application rate: 4-8 fl oz/A; Poor control; Not used to control BAW in soybeans; PHI: 60 days; REI: 12 hours

Warrior (lambda-cyhalothrin): Application rate: 3.84 fl oz/A; Poor control; Not used to control BAW in soybeans; PHI: 45 days; REI: 24 hours

(II) Organophosphates

Lorsban 4E (chlorpyrifos): Application rate: 1-2 pt/A; Fair to good control; Applied to less than 1% of the acreage; PHI: 28 days; REI: 24 hours.

(III) Carbamates

Lannate LV (methomyl): Application rate: ¾ - 1 pt/A; Poor control; Not used to control BAW in soybeans; PHI: 14 day; REI: 48 hours

Larvin (thiocarb): Application rate: 10-30 fl oz/A; Fair - poor control; Applied to less than 1% of the acreage; PHI: 28 days; REI: 48 hours

(IV) Other Chemistry

***Bacillus thuringiensis* (Lepinox WDG)** – Application rate: 1-2 lbs/A; Fair control of small worms only; No used on soybeans in Delaware; PHI: 0 days; REI: 4 hours

Steward (indoxacarb) – Application rate: 5.6-11.3 oz/A; Good control; Applied to less than 5% of the acreage; PHI: 21 days; REI: 12 hours

Fall Armyworm (FAW)

Biology and Life History: The fall armyworm (FAW) is a migratory pest generally first found in soybean fields in early August. The most significant defoliation generally occurs by late August to early September. This insect eats foliage and tender stems, often taking everything as they go, and then disappear suddenly. Warm winters and early springs probably allow the FAW to reach Delaware earlier in the year. Late planted fields are most at risk, and they often occur in mixed populations with podworms.

Damage: This insect is primarily a foliage feeder; however, if populations are heavy it can also feed on pods. Although soybean plants can compensate for much foliage loss before bloom, severe fall armyworm damage can retard plant growth.

Monitoring and Decision Making: While sampling for other defoliators, be sure to note the presence of small fall armyworm larvae. Although no precise thresholds are available for fall armyworm, treatments should be based on the level of defoliation.

During the bloom to pod-fill stage, a treatment should be considered if defoliation reaches the 15% level.

Controls:

Biological: None

Cultural: None

Chemical:

(I) Pyrethroids

Baythroid (cyfluthrin): Application rate: 1.6 – 2.8 fl. oz/A; Poor - fair control; Not used to control FAW in soybeans; PHI: 45 days; REI: 12 hours

Mustang MAX (zeta-cypermethrin): Application rate: 3.2 – 4.0 fl oz/A; Poor - fair control; Not used to control FAW in soybeans; PHI: 21 days; REI: 12 hours

Warrior (lambda-cyhalothrin): Application rate: 3.2 -3.84 fl oz/A; Fair control; Applied to less than 1% of the acreage; PHI: 45 days; REI: 24 hours

(II) Organophosphates

Lorsban 4E (chlorpyrifos): Application rate: 1-2 pt/A; Fair to good control; Applied to less than 1% of the acreage; PHI: 28 days; REI: 24 hours.

(III) Carbamates

Lannate LV (methomyl): Application rate: ¾ - 1 pt/A; Fair control; Applied to less than 1% of the acreage; PHI: 14 day; REI: 48 hours

Larvin (thiocarb): Application rate: 10-30 fl oz/A; Fair - poor control; Applied to less than 1% of the acreage; PHI: 28 days; REI: 48 hours

(IV) Other Chemistry

***Bacillus thuringiensis* (Lepinox WDG)** – Application rate: 1-2 lbs/A; Fair control of small worms only; No used on soybeans in Delaware; PHI: 0 days; REI: 4 hours

Steward (indoxacarb) – Application rate: 5.6-11.3 oz/A; Good control; Applied to less than 5% of the acreage; PHI: 21 days; REI: 12 hours

Corn Earworm (CEW)

Biology and Life History: Corn earworm larvae are generally found in soybeans by early to mid-August. Outbreaks generally follow midsummer drought conditions, which causes corn to mature early and become less attractive to moths. Drought conditions also delay soybean growth, so peak moth activity coincides with blooming of open canopied fields.

Damage: Young larvae feed on terminal leaves, flowers and young pods. Unless populations are extremely heavy, this damage does not affect soybean yields. Older larvae feed on the pods and developing seeds as the pods begin to fill. When infestations are heavy, entire fields can be stripped of pods, resulting in complete yield loss.

Monitoring and Decision Making: Sampling for earworms is done with a sweep net. Take 5 sweeps in 5- 10 locations in a field while walking down the row. A treatment is recommended if you find 3 larvae per 25 sweeps in narrow row soybeans or 5 per 25 sweeps in wide row soybeans.

Controls:

Biological: If weather conditions are humid and wet in August, fungal pathogens can help to crash populations.

Cultural: Manage so that row middles are completely covered by the leaf canopy. Late blooming and late maturing varieties are at greatest risk.

Chemical:

(I) Pyrethroids

Asana XL (esfenvalerate): Application rate: 5.8 to 9.6 fl oz/A; Good control; Applied to less than 5% of the acreage; PHI: 21 days; REI: 12 hours

Baythroid (cyfluthrin): Application rate: 1.6 – 2.8fl.oz/A; Good control; Applied to less than 5% of the acreage; PHI: 45 days; REI: 12 hours

Mustang MAX (zeta-cypermethrin): Application rate: 2.8 – 4.0 fl oz/A; Good control; Applied to 5% of the acreage; PHI: 21 days; REI: 12 hours

Permethrin 3.2EC: Application rate: 4-8 fl oz/A; Fair - good control; Applied to 10% of the acreage; PHI: 60 days; REI: 12 hours

Warrior (lambda-cyhalothrin): Application rate: 1.92 – 3.2 fl oz/A; Good control; Applied to less than 20% of the acreage; PHI: 45 days; REI: 24 hours

(II) Organophosphates

Lorsban 4E (chlorpyrifos): Application rate: 1-2 pt/A; Fair control; Applied to less than 1% of the acreage; PHI: 28 days; REI: 24 hours

(III) Carbamates

Lannate LV (methomyl): Application rate: $\frac{3}{4}$ - 1 pt/A; Fair - good control; Applied to less than 1% of the acreage; PHI: 14 day; REI: 48 hours

Larvin (thiocarb): Application rate: 10-30 fl oz/A; Fair - good control; Applied to less than 1% of the acreage; PHI: 28 days; REI: 48 hours

Sevin XLR Plus (carbaryl): Application rate: ½ - 1 ½ qt/A; Fair control of small worms; Applied to less than 1% of the acreage; PHI: 21 days; REI: 12 hours

(IV) Other Chemistry

Bacillus thuringiensis (Lepinox WDG) – Application rate: 1-2 lbs/A; Fair control of small worms only; No used on soybeans in Delaware; PHI: 0 days; REI: 4 hours

Steward (indoxacarb) – Application rate: 5.6-11.3 oz/A; Good control; Applied to less than 5% of the acreage; PHI: 21 days; REI: 12 hours

Non-Insect Arthropod Pests

Twospotted Spider Mite (*Tetranychus urticae*)

Biology and Life History: Spider mites are dispersed passively by wind or can crawl from adjacent weeds and cultivated crops hosts to soybeans. As populations increase, young females disperse from infested plants by producing a fine webbing which helps to move them to other areas. In general, economic populations occur in early July through August.

Damage: Spider mites feed on the undersides, extracting the cell contents and irreversibly damaging plant cells. Numerous empty cells result in white or yellow stipples characteristic of mite feeding damage. Extensive feeding causes leaves to turn yellow or brown and eventually die and drop from the plants. Yield reductions begin when 50 percent of the plants show stippling, yellowing or defoliation over more than 1/3 of the leaf area.

Monitoring and Decision Making: Sampling should be done by collecting 5 leaflets in 10 locations and looking for the presence of stippling and mites. Concentrate on field borders and look for early signs of white stippling at the base of leaves. A treatment is recommended if you find 20-30 mites per leaflet and 10% of the plants with 1/3 of the leaf area damaged.

Controls:

Biological: Under the correct weather conditions, fungal pathogen is possibly the most important natural control. However, it is know that two spotted spider mite functions well at temperatures of 90°F and above while the fungal pathogen operates best at temperatures cooler than 85°F and relative humidity above 90%. Therefore, natural control fungal pathogens could have an impact on mite populations but these factors do not play a significant role until after the treatment threshold has been exceeded and economic loss has already occurred.

Cultural: Preliminary work with host plant resistance indicates that Group V Soybean Cyst Tolerant varieties may afford some degree of suppression of spider mite damage. However, these varieties are often late-maturing, do not yield as well as conventional varieties and do not fit into many producers production systems

Chemical: Both materials labeled for spider mite control on soybeans are organophosphates.

Lorsban (chlorpyrifos): Application rate: 1-2 pt/A; Poor control; Applied to 20% of the acreage; PHI: 28 days; REI: 24 hours

Dimethoate (Dimethoate): Application rate: 1 pt/A; Poor control; Applied to 20% of the acreage; PHI: 21 days; REI: 48 hours REI

New Pest of Special Significance

Soybean Aphid (*Aphis glycines*)

Biology and Life History: The soybean aphid was first detected in Delaware in 2002. Since that year, soybean aphid has been found in all three counties by the end of the season. Soybean aphid is a migratory pest in Delaware, arriving in most years by early July. In 2003 and 2004, economic population levels developed by August. Populations build rapidly, doubling every 2 to 3 days, and may reach several thousand aphids per plant at their peak in early August. A majority of adult aphids are wingless; they reproduce on the same or adjacent plants. Some females develop wings and fly to other plants within the same or nearby fields to lay their nymphs. Up to 15 generations may occur on soybean in the summer. The proportion of nymphs that become winged increases markedly as females respond to crowding, reduced host quality or decreasing day length.

Damage: Soybean aphids pierce the soybean's plumbing system and suck sap. Feeding impacts yield in three ways: removal of photosynthates (sap), reduction in photosynthesis, and transmission of viral diseases. Soybeans may become stunted with poor canopy development. Soybean growing in low potassium soils may also become chlorotic in upper leaves, an unusual deficiency symptom. Aphids may impact yield before plant symptoms become readily apparent. Continued feeding during reproductive stages reduces pod and seed set and potentially seed size, if pressure continues. The biggest effect is on pod set. Yield reductions may be significant, exceeding 50% in severely infested fields. Preliminary evidence suggests aphids affect photosynthetic rates as well as remove plant sap needed for growth and yield.

Monitoring and Decision Making: Sample for aphids by counting the number of aphids on 30 random plants throughout a field. If aphid populations reach an average of 250 aphids per plant in the V (vegetative) through R5 (beginning seed) stages, a treatment is recommended. Application at R6 (full seed) may, but is not likely, to have an economically positive effect. Application after R6 is not warranted.

Controls

Biological: It can be heavily preyed upon by a large assortment of lady beetles (Coleoptera: Coccinellidae) and hymenopteran parasitoids. In addition, fungal pathogens can help to crash populations. However, we have not seen beneficials provide adequate control were populations are high.

Cultural: None

Chemical.

(I) Pyrethroids

Asana XL (esfenvalerate): Application rate: 5.8 – 9.6 fl oz/A; Good control; Applied to less than 1% of the acreage; PHI: 21 days; REI: 12 hours

Baythroid (cyfluthrin): Application rate: 2.8fl.oz/A; Label only says suppression; Not used to control this insect on soybeans; PHI: 45 days; REI: 12 hours

Mustang MAX (zeta-cypermethrin): Application rate: 2.8 – 4.0 fl oz/A; Good control; Applied to 1% of the acreage; PHI: 21 days; REI: 12 hours

Warrior (lambda-cyhalothrin): Application rate: 1.92 – 3.2 fl oz/A; Good control; Applied to less than 10% of the acreage; PHI: 45 days; REI: 24 hours

(II) Organophosphates

Lorsban 4E (chlorpyrifos): Application rate: 1-2 pt/A; Good control; Applied to less than 3% of the acreage; PHI: 28 days; REI: 24 hours

Penncap-M (methyl parathion): Application rate; 1-3 pt/A; Fair control; Not used in Delaware for this pest; PHI: 20 days; REI: 5 days

WEEDS (4)

Weeds are a major factor limiting soybean production in the mid-Atlantic region. Successful weed management programs rely on well-planned and well-executed control programs. These programs consider preventative methods of cultural, mechanical, and chemical weed control with reference to specific weed infestations.

INTEGRATED PEST MANAGEMENT

Soybean fields that are weed-free for the first 3 to 4 weeks after planting will often yield the same as fields that are weed-free for the entire growing season. This approach relies on a residual soil-applied herbicide program. Weeds that germinate with the crop but are controlled in a timely (3 to 4 weeks after planting) fashion will not impact final yields. This approach relies upon effective and timely postemergence weed control. Also, it is not necessary to control all weeds in a field to achieve maximum yield.

Weed populations of 10 to 20 weeds per 10 square yards are sufficient to cause severe yield loss. However, weed populations at 1 plant per 10 square yards will have no impact on final yield. The impact of weed populations between 1 and 10 per yard is difficult to predict. The decision to treat the field depends on the weed species present, crop vigor, weather conditions, and herbicide cost.

CULTURAL WEED CONTROL

The best weed management tool available is a healthy, vigorous, crop canopy. Following good agronomic practices is a key component to weed management programs. Carefully consider seed source, agronomic traits of the variety selected, seedbed preparation, and planting procedures. Crop rotation is useful for the control of many pests, including weeds.

The use of stale seedbeds can deplete the nondormant weeds in the soil. Stale seedbeds accomplish this by early seedbed preparation followed by the elimination of one or several flushes of weed before planting the crop. One weed can produce thousands to over 100,000 seeds. Only a small percentage of the seeds germinate each year due to a dormancy characteristic to ensure the survival of the weed. Control weeds before they flower to prevent seed production.

MECHANICAL WEED CONTROL

Mechanical weed control is still one of our most valuable weed control tools. Both primary tillage and cultivation should be considered for specific weed populations. Primary and secondary tillage can be especially helpful in controlling perennial broadleaf weeds that have developed under no-till systems.

CHEMICAL WEED CONTROL

Herbicides are useful tools in most weed management programs. They should be used to supplement, not replace, other methods or tools available. The following are definitions of herbicide terms:

Early preplant (EPP) - The herbicide is applied at least 14 days before planting. Generally used in no-till systems to control existing vegetation and provide early season residual weed control.

Preplant - The herbicide is applied from 0 to 14 days before planting. Generally used in no-till systems to control existing vegetation and provide residual weed control.

Preplant Incorporated (PPI) - The herbicide is applied to the soil after primary tillage, but before planting, and mechanically mixed with the top 1 to 3 inches of soil with one of a variety of secondary tillage implements.

Preemergence (PRE) - The herbicide is applied to the soil after the crop is planted but before emergence. Rainfall or irrigation is needed to move the herbicide into the zone of weed seed germination before weed emergence for maximum effectiveness. If adequate rainfall for herbicide activation does not occur, a shallow cultivation or rotary hoeing should be done to control weeds that have germinated.

Postemergence (POST) - The herbicide is applied to the foliage of the crop and weeds after they have emerged.

Post-directed (or directed) - Refers to use of special spray equipment to direct the spray at the weeds but avoid the spray coming in contact with as much of the crop as possible.

Residual activity - Herbicides that can be taken up by plants' roots and shoots and injure or kill the plant. All soil-applied herbicides have residual activity as well as many postemergence herbicides. Length of residual activity ranges from a few weeks to the entire growing season.

Translocated herbicide – These herbicides move throughout the plant and can cause injury to parts of the plants that do not come in direct contact with the herbicide spray.

Contact herbicide - These herbicides do not move throughout the plant. They cause injury only to those parts of the plant that comes in contact with the spray. Spray coverage is more critical for contact than translocated herbicides.

Non-selective herbicide - This refers to herbicides that control a broad-spectrum of plant species, including most crops and weeds. These herbicides are generally used with no-tillage production and are sprayed prior to planting when control of all plants is required.

Adjuvants - Products you include in the spray tank to improve the performance of your herbicides. These include non-ionic surfactants (NIS), crop oil concentrate (COC), or nitrogen solutions. Adding additional adjuvants than what is labeled can increase the chance of crop injury. Surfactants are surface-active agents that reduce the surface tension of the spray solution. Surfactants include both **non-ionic surfactants (NIS)** and **crop oil concentrates (COC)**. In general, NIS should contain at least 80% active ingredient and COC should contain at least 15% emulsifier. When a surfactant is added, spray droplets fall through hairs to wet the surface of hairy leaves, and spread and stick to waxy leaves, rather than bead up and roll off. This permits a more uniform wetting of hairy or waxy leaf surfaces. Too little or no surfactant may result in poor wetting. Too much surfactant may cause spray droplets to run together into a thin sheet, reducing spray retention. Many terms are used to describe surfactants, such as detergent, emulsifier, spreader, sticker or wetting agent.

Banded Herbicide Application - Herbicide use can be reduced by fifty to seventy-five percent by applying the herbicide in a narrow strip or band over the row. Preemergence and postemergence herbicides can be applied as banded sprays to reduce cost and the amount of herbicide used in conventional and certain minimum tillage systems. Band spraying consists of applying an herbicide in an 8- to 15-inch band over the crop row, leaving the row middles unsprayed. Weeds that emerge between the rows must be controlled by mechanical cultivation which may be done more economically than treating them with herbicides. Banding is not practical with herbicides that must be preplant incorporated, in no-till planting systems, or when rows are planted at a close spacing.

Herbicide Use Rate - The recommended use rates of soil-applied herbicides often vary with soil texture, organic matter content, and tillage systems. The use of soil-applied herbicide rates that are incorrect for the soil texture, pH, and organic matter may result in poor weed control or crop injury. Reduced rates of postemergence herbicides are another method of reducing the amount of herbicide applied. Reduced herbicide rates can be as effective as the full labeled application rate in some situations, primarily when weeds are small, the weed species present are highly susceptible to the herbicide applied, or when soil moisture and temperatures are favorable for rapid weed growth. Most of the herbicides listed in this crop profile are selective. At the recommended rate of application, they will selectively control or injure weeds but will not seriously damage the crop in which these weeds are growing. Using higher herbicide rates or additives that are not recommended may result in severe injury to the crop.

GENETICALLY ENHANCED VARIETIES

Some soybean varieties have been genetically enhanced to withstand herbicide applications that previously would have injured or killed soybean. Genetically enhanced varieties allow herbicides to be used that provide a broader spectrum of control than would otherwise be available. Herbicide programs for genetically enhanced varieties also reduce

the risk of crop injury associated with herbicide programs for conventional varieties. Genetically enhanced soybean varieties include Roundup Ready and STS.

HERBICIDE-RESISTANT WEEDS

Herbicide resistant weeds have been reported in the Mid-Atlantic region. Populations of herbicide resistant weeds are selected for by repeated use of the same or similar herbicide over a period of time. Resistance is most likely to occur with residual herbicides having one specific mode of action. Weed species with a very high amount of seed production and a variable genetic pool are more likely to develop resistant populations, for example, common lambsquarters and pigweed species. Resistance management requires using herbicides with multiple modes of action, and integrating mechanical and cultural weed control with chemical weed control.

NO-TILL WEED MANAGEMENT

Successful production of no-till soybean requires control of existing vegetation at planting (cover crops and weeds) and broadleaf and grass weeds that emerge after planting. A diversity of herbicides and cover crop and residue situations makes it impossible to utilize a single program to efficiently control weeds and grasses in all situations. Herbicide selection based on weed identification histories of each field is necessary to achieve maximum yield potential. Fields with heavy crop residues may require the maximum labeled rate of residual herbicides for acceptable performance. Encapsulated formulations, when available, may be less readily absorbed by heavy crop residues and may perform more consistently. Cultivation and mechanical weed control are very difficult or impossible and not considered an option in most no-till production systems. Existing vegetation is traditionally controlled by the nonselective herbicides, which are often tank mixed with residual herbicides.

Due to popularity of Roundup Ready soybeans, there has been less emphasis on residual herbicides and greater reliance on only glyphosate products for weed control. If soybeans are grown two out of three years (or more frequently) in the same field; **and** Roundup Ready soybeans are used; then it is recommended to **NOT** use glyphosate (Roundup, Touchdown or other formulations) prior to planting. Glyphosate-resistance weeds have been identified in our region and some winter annual weeds are not effectively controlled by glyphosate. Rather, a nonselective burndown program with 2,4-D or dicamba alone or tank-mixed with Gramoxone as the base herbicide(s) is recommended. No-till crop production tends to favor perennial weed populations, because their root systems are not disrupted by tillage. No-till also favors small-seeded broadleaf weeds and grasses (small seeded broadleaves include lambsquarters and pigweed) rather than large-seeded weeds such as velvetleaf. Escalating herbicide costs and interest in keeping herbicide use to a minimum encourages many people to consider use of postemergence herbicide programs. Experience leads us to suggest that existing vegetation should always be controlled prior to planting. In the mid-Atlantic region, soil moisture is often the factor most limiting to yield. The decision to apply postemergence herbicides early preplant, at planting, or as a delayed preemergence (spike) treatment to control existing emerged vegetation should always be made with consideration to the impact of the existing vegetation on the availability of soil moisture. Preemergence or postemergence herbicides can then be selected that will control weeds that emerge after planting. Reducing or eliminating all or some of the preemergence herbicides can reduce costs in fields that historically have required postemergence herbicide applications.

2,4-D PREPLANT USE ON FULL-SEASON, NO-TILL SOYBEAN

2,4-D is labeled for use prior to planting soybean. The following is a list of restrictions and limitations for the preplant use of 2,4-D on soybean:

Do not apply when weather conditions, such as temperature, air inversions or wind, favor drift from treated areas to susceptible plants.

Do not exceed the 2,4-D rates given on the herbicide label.

Do not apply 2,4-D prior to planting soybean if you are not prepared to accept the results of soybean injury, including possible loss of stand and yield.

Do not replant fields treated with 2,4-D in the same growing season with crops other than those labeled for 2,4-D preplant use.

Do not mow or cultivate weeds prior to treating with 2,4-D or poor control may result.

Do not cut for feed or graze soybean grown in fields that have received a 2,4-D preplant application.

DICAMBA PREPLANT USE ON FULL-SEASON, NO-TILL SOYBEAN

Dicamba (Banvel, Clarity, Sterling, and others) is labeled for use prior to planting soybean, and is effective on many annual, biennial, and perennial broadleaf weeds. It is particularly effective on horseweed at low use rates. Dicamba may cause injury to desirable trees and plants (beans, flowers, cotton, fruit trees, grapes, ornamentals, peas, potatoes, soybeans, sunflowers, tobacco, tomatoes, etc.) when contacting their roots, stems, or foliage. The following is a list of restrictions and limitations for the preplant use of Banvel or Sterling on soybean. Though the Clarity label is less restrictive, these should be observed for Clarity applications as well.

Do not treat areas where possible downward movement into the soil or surface washing may cause contact of dicamba with the roots of desirable plants such as trees or shrubs.

Avoid making applications when spray particles can be carried by wind currents to areas where sensitive crops and plants are growing, or if wind is gusty or in excess of 5 mph and moving in the direction of adjacent sensitive crops. Use spray nozzles that produce coarse sprays, and if possible keep spray pressures at or below 20 psi and spray volume at or above 20 gpa.

Do not make applications when temperature inversions exist, or when the temperature on the day of application is expected to exceed 85 degrees F.

Spray equipment used to apply dicamba should be thoroughly cleaned before reusing to apply any other herbicides, particularly to sensitive crops, or injury may occur. See label for procedures for cleaning spray equipment.

HERBICIDE TABLE: RELATIVE EFFECTIVENESS OF SOIL-APPLIED SOYBEAN HERBICIDES FOR INDIVIDUAL GRASS AND GRASS-LIKE WEED SPECIES

* indicate ratings will be improved by one rating over what is rated here with pre-plant incorporated

^ indicate a two level improvement with a pre-plant incorporated application

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

E = Excellent (>90% control)

G-E = Good to Excellent

G = Good (80-90% control)

F-G = Fair to Good

F = Fair (60-80% control)

P-F = Poor to Fair

P = Poor (20-60% control)

N = None (<20% control)

Single active ingredient products	Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtails	Goosegrass	Johnsongrass (seedling)	Johnsongrass (rhizome)	Quackgrass	Sandbur	Shattercane	Texas panicum	Yellow nutsedge
Command 3ME	F-G	P	G-E	F-G	F	F	F	P	N	P	G-E	P	G	N
Define	G	N	F	G	G	G-E	G-E	F	N	N	F	F	F	P
Dual Magnum/Chinch	G-E	N	F-G	G-	G-E	F	F	P	N	N	F	P	P	F*
FirstRate	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Lorox (PRE only)	F	N	P	F	F	F	F	P	N	N	F	P	N	N
Micro-Tech	G-E	N	F-G	F-G	F	F	F	P	N	N	F	P	P	P*
Outlook	G-E	N	G	G	G	G-E	G	P	N	N	P-F	P	P	F
Prowl / other pendimethalin formulations	G-E*	N*	F-G*	F	F-G*	G^	F^	F^	N*	N*	F^	F^	P-F^	N
Python	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Scepter	P	N	N	P	P	P-F*	P	P-F*	N	N	N	P	N	P
Sencor	P-F	N	P-F	P-F	P-F	P-F	P-F	P	N	N	P	P	N	N
Treflan / other trifluralin formulations (PPI only)	E	P	G	G	G	E	E	G	P	P	G	G	G	N
Valor SX	P	N	P	P	P	P	P	N	N	N	N	N	P	N
Premixes														
Authority First/Sonic	P	N	P	P	P	P	P	P	N	N	-	-	P	P
Authority MTZ	P	N	P	P	P	P	P	N	N	N	N	P	N	P
Boundary	G-E	N	F-G	G-	G-E	E	E	P	N	N	F	P	P	F*
Canopy	F	N	P-F	F	F	F	P	P	N	N	P	P	N	P
Gangster	P	N	P	P	P	P	P	N	N	N	N	N	P	N
Prefix	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F
Sequence	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F
Synchrony XP		P	N	P	P	P	P	P	P	N	P	P	P	P
Valor XLT	F	N	P-F	F	F	F	P	N	N	N	N	N	P	P

HERBICIDE TABLE: RELATIVE EFFECTIVENESS OF SOIL-APPLIED SOYBEAN HERBICIDES FOR INDIVIDUAL BROADLEAF WEED SPECIES

* indicate ratings will be improved by one rating over what is rated here with pre-plant incorporated

^ indicate a two level improvement with a pre-plant incorporated application

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

- E** = Excellent (>90% control)
- G-E** = Good to Excellent
- G** = Good (80-90% control)
- F-G** = Fair to Good
- F** = Fair (60-80% control)
- P-F** = Poor to Fair
- P** = Poor (20-60% control)
- N** = None (<20% control)

Single active ingredient products	Eastern black nightshade	Burcucumber	Cocklebur	Jimsonweed	Lambsquarters	Morningglory (annual spp.)	Pigweed	Giant ragweed	Common ragweed	Sicklepod	Smartweed	Spurred anoda	Prickly sida or feaweed	Tropic croton	Velvetleaf
Command 3ME	P	P	P	F-G	G	N	P-F	P-F	F	P	F-G	F	F-G	G	F
Dual Magnum	F	N	N	N	P-F	N	G	N	P	N	P	N	P	N	N
FirstRate	N	P	G	G	E	G	P	F-G	G	N	G	G	N	N	G
Lorox or Linex (PRE)	P	P	P-F	P-F	G-E	P-F	E	P	G	P-F	G	P	F-G	P	F
Micro-Tech	F-G	N	N	N	P-F	N	G	N	P	N	P	N	P	N	N
Outlook	F	N	N	N	P	N	G	N	P	N	P	N	P	N	N
Prowl / other pendimethalin formulations	N	N	N	N	F-G*	P	G	N	P	N	P	N	P	P	F
Python	P-F	P	F-G	F-G	G-E	P	E	P	P	F-G	E	F	F-G	-	G
Scepter	P-	P-	F-	F-G	F-	P-	E	F	P-	F-G	F-G	P*	F-	P	P-
Sencor	P	P	F	F	G-E	P-F	E	P	G	F-G	G	F	G	F-G	F-G
Treflan / other trifluralin formulations (PPI only)	N	N	N	N	G	P	G	N	N	N	P	N	N	P	N
Valor	G	N	N	F-G	G	F-G	G	N	N	N	P	F-G	G	F-G	P
Premixes															
Axiom	P	N	N	N	P-F	N	P-F	N	P	N	N	N	N	N	N
Backdraft	P-F	P-F	F-G	F-G	F-G	P-F	E	F	P-F	F-G	F-G	P	F-G	P	P-F
Boundary	P	P	F	F	G	P-F	E	P	G	F-G	G	F	G	F-G	F-G
Canopy / Canopy SP	P-F	F	F-	F-	G-E	F	E	F	G	F-G	G-E	F-G	G-E	F-G	F
Canopy XL	G-E	P	F-G	F-G	G*	F-G	E	P-F	G	F	E	P-F	F-G	-	F
Gangster	G	P	G	G	E	G	G	F-G	G	N	G	G	G	F-G	G
Squadron	P-F	P-	F-	F-G	F-	P^	E	P^	P-	F-G	F-G	P*	F-	P	P-
Steel	F	P-F	F-G	F-G	F-G	P	E	P	P-F	F-G	F-G	P	F-G	P	F

an A-A indicates that insufficient data or experience available.

HERBICIDE TABLE: RELATIVE EFFECTIVENESS OF POSTEMERGENCE SOYBEAN HERBICIDES FOR INDIVIDUAL GRASS AND GRASS-LIKE WEED SPECIES

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

E = Excellent (>90% control)

G = Good (80-90% control)

F = Fair (60-80% control)

P = Poor (20-60% control)

G-E = Good to Excellent

F-G = Fair to Good

P-F = Poor to Fair

N = None (<20% control)

Single active ingredient products	Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtails	Goosegrass	Johnsongrass (seedling)	Johnsongrass (rhizome)	Quackgrass	Sandbur	Shattercane	Texas panicum	Yellow nutsedge
Basagran	-	-	-	-	-	-	-	-	-	-	-	-	-	F
Classic	-	-	-	-	-	-	-	-	-	-	-	-	-	P-F
Fusilade DX	E	G	G	F-G	E	E	G	E	G-E	G	G	E	G	N
Glyphosate products	E	G	E	E	G-E	E	E	E	G	G-E	E	G	G	P-F
Poast, Poast Plus	E	F-G	G	G-E	E	E	G-E	E	G	G	G	G	G	N
Pursuit	F	N	F-G	F-G	F	F-G	P	G	P-F	N	P-F	G	P-F	P
Raptor	F-G	N	F-G	F-G	F-G	G	P	G	P-F	N	F	G	P-F	P
Scepter	-	-	-	-	-	-	-	-	-	-	-	-	-	P-F
Select/Select Max	E	G-E	G-E	E	E	E	G	E	G-E	G-E	G	E	G	N
Targa/Assure II	G-E	G	G	F-G	E	G	G	E	G-E	G	G	E	G	N
Premixes														
Extreme	E	G	E	E	G-E	E	E	E	G	G-E	E	G	G	P-F
Fusion	E	F-G	G	G	E	E	G	E	G	G	G	E	G	N
Sequence	E	G	E	E	G-E	E	E	E	G	G-E	E	G	G	P-F
Synchrony XP (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	F
Synchrony XP (b)	-	-	-	-	-	-	-	-	-	-	-	-	-	P

an A-A indicates that insufficient data or experience available.

(a) For use in STS soybeans only at 0.75 oz/A rate

(b) For use in non- STS soybeans only at 0.375 oz/A rate

The following herbicides are not recommended for postemergence grass control: 2,4-DB, Basagran, Blazer, Classic, Cobra, FirstRate, Flexstar, Harmony GT, Reflex, Resource, Scepter, Storm, Synchrony XP, Ultra Blazer, or Unity WDG.

HERBICIDE TABLE: RELATIVE EFFECTIVENESS OF POSTEMERGENCE SOYBEAN HERBICIDES FOR INDIVIDUAL BROADLEAF WEED SPECIES

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

E = Excellent (>90% control)

G = Good (80-90% control)

F = Fair (60-80% control)

P = Poor (20-60% control)

G-E = Good to Excellent

F-G = Fair to Good

P-F = Poor to Fair

N = None (<20% control)

Single active ingredient products	Eastern black nightshade	Burcucumber	Cocklebur	Jimsonweed	Lambsquarters	Morningglory (annual spp.)	Pigweed	Giant ragweed	Common ragweed	Sicklepod	Smartweed	Spurred anoda	Prickly sida or teaweed	Tropic croton	Velvetleaf
Basagran	P	P	G-E	E	P-F	P ^a	P	P-F	F-G	P	G-E	F	F	F	G
Blazer / Ultra Blazer	F-G	F	F ^a	E	P-F	G-E	E	F-G	E	P	G	P	N	F-G	P
Classic	P	G	E	E	P	P-F ^a	E	G-E	F	F-G	F-G	N	P	P	P-F
Cobra	F-G	F-G	F ^a	E	P	P-F ^a	E	G	E	P	P	P-F	F	F-G	F-G
FirstRate	N	F	E	E	N	G	P	G	G-E	P	G	P	P	-	F-G
Flexstar	F-G	F	F ^a	E	F	F-G ^a	E	G-E	E	P-F	F	P-F	N	F	P-F
Glyphosate products	F-G	E	E	E	F-G	G	E	G	F-G	F-G	F-G	F	F-G	G	F-G
Harmony GT/Unity WDG	N	P-F	F	P	E	P	E	N	N-P	P	G	N	P	P	G
Pursuit	F-G	P-F	E	G	P	F-G	E	F	P-F	P	F-G	F	P	P	F-G
Raptor	F-G	P-F	E	G	F	F-G	E	F	F	P	F-G	F	F	-	F-G
Reflex	F-G	F	F ^a	G	P	F-G ^a	E	G	E	P-F	F	P	P	F-G	P
Resource	P	F	P	P	F	F	F	P	P	N	P	P	N	P	E
Scepter	P	P	E	F	N	P	E	P	P	F	P	N	P	P	P
Premixes															
Extreme	F-G	E	E	E	F-G	G	E	G	F-G	F-G	F-G	F	F-G	G	F-G
Sequence	F-G	E	E	E	F-G	G	E	G	F-G	F-G	F-G	F	F-G	G	F-G
Storm	F-G	P-F	G	E	P	F-G ^a	F	P-F	F-G	P	G	F	F	P	F-G
SynchronyXP (b)	N	G	E	E	E	F	E	F-G	F	F-G	G	N	P	P	G
SynchronyXP (c)	N	P-F	G	G	F-G	P	G	P	P	P	F	N	P	P	F-G

an A-A indicates that insufficient data or experience available.

^acontrol can be improved by the addition of 2 fl oz of 2,4-DB.

(b) For use in STS soybeans only at 0.75 oz/A rate

(c) For use in non- STS soybeans only at 0.375 oz/A rate

The following herbicides do not provide control of broadleaf weeds: Assure II, Fusilade DX, Fusion, Poast, Poast Plus, Select, Select Max, and Targa.

HERBICIDE TABLE: RELATIVE EFFECTIVENESS OF VARIOUS POSTEMERGENCE SOYBEAN HERBICIDES FOR INDIVIDUAL PERENNIAL BROADLEAF WEED SPECIES

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

- E** = Excellent (>90% control)
- G-E** = Good to Excellent
- G** = Good (80-90% control)
- F-G** = Fair to Good
- F** = Fair (60-80% control)
- P-F** = Poor to Fair
- P** = Poor (20-60% control)
- N** = None (<20% control)

Single active ingredient products	Canada thistle	Dewberry species	Dock species	Field bindweed	Groundcherry	Hemp dogbane	Honeyvine milkweed	Horsenettle	Common milkweed	Mugwort	Pokeweed	Trumpet creeper
Basagran	P-F	-	P-F	-	-	-	-	P	-	-	-	-
Blazer, Reflex	P	-	P	P ^a	P	P	P	P	P	-	-	P-F
Classic	P	F	P-F	-	-	-	-	P	F	-	P	-
Cobra	P	-	P	P ^a	P	P	P	P	P	-	-	P
Glyphosate products	G	F-G	G	F-G	F-G	F-G	F	F	F-G	F	F	F
Pursuit	P	P-F	P-F	N	-	-	-	P	-	-	-	N
Premixes												
Extreme	F-G	P-F	F-G	P-F	F	F	P-F	P-F	F	-	P-F	P-F
Sequence (c)	F	P-F	F	P-F	P-F	P-F	P	P	P-F	P	P	P
Synchrony XP (b)	P	F	P-F	P	-	-	-	P	F	-	F	N

an A-A indicates that insufficient data or experience available.

^acontrol can be improved by the addition of 2 fluid oz of 2,4-DB.

Sequence (c) – control can be improved by tank-mixing with additional glyphosate.

Synchrony XP (b) – for use in STS soybeans only at 0.75 oz/A rate.

Herbicide Table: Comments for the Respective Herbicides

Herbicides arranged alphabetically by trade name within timing of application (pre-plant, soil-applied, or postemergence) with rate and remarks concerning their use.

PPI= pre-plant incorporated

PRE= preemergence

POST= postemergence

Herbicide	Application timing	Rate	Remarks
active ingredient trade name		lbs a.i./A product/A	
2,4-D 2,4-D 4L formulations <i>**</i> <i>many trade names</i>	PREPLANT	0.25 - 1.0 lb 0.5 - 2.0 pt	Add 2,4-D to paraquat or glyphosate for added burndown of hard to control broadleaf weeds. Apply 7 to 30 days prior to planting, depending on rate and formulation (ester or amine). Refer to Table 1. Use 2,4-D for added control or suppression of mustard spp., plantains, horseweed, and 2,4-D susceptible annual broadleaf weeds.
dicamba Banvel 4S Clarity 4S Sterling 4S <i>or other available formulations</i>	PREPLANT	0.125 - 0.5 lb 8.0 - 16 oz 4.0 - 16 oz 8.0 - 16 oz	Add dicamba to paraquat or glyphosate for added burndown of hard to control broadleaf weeds, particularly marestail (horseweed). Apply Banvel or Sterling 30 days prior to planting. Following Clarity applications, a minimum accumulation of one inch of rainfall or overhead irrigation followed by a 14 day waiting period for the 4 to 8 oz/A rates or a 28 day waiting period for the 16 oz/A rate is required (refer to Table 1). Dicamba is an excellent alternative for glyphosate-resistant horseweed.
chlorimuron + tribenuron Canopy EX 29.5DG	PREPLANT	0.016 - 0.047 lb 0.0047 - 0.013 lb 1.1 - 3.3 oz	Apply with glyphosate or Gramoxone to no-till fields, or alone to clean conventional-tillage fields anytime after harvest at 2.2 to 3.3 oz/A up to 14 days before soybean planting, or 1.1 to 2.2 oz/A up to 7 days before soybean planting; consult label for details. For best results apply to annual weeds less than 3 inches in height or diameter and perennial weeds less than 6 inches in height or diameter. The addition of 1 pint/A of 2,4-D ester is recommended, and is required for some species. Applications must include either a crop oil concentrate or a nonionic surfactant. Crop oil concentrate is the required adjuvant unless tank-mixing with a product that precludes its use. On soils with pH 7.0 or less, Canopy EX can be applied at rates of 1.5 - 3.3 oz/A., and

Herbicide	Application timing	Rate	Remarks
active ingredient trade name		lbs a.i./A product/A	
			will provide residual control or suppression of several winter and summer annual weeds through normal planting dates, but will not provide season-long control.
paraquat Gramoxone Inteon 2L **	PREPLANT	0.48 - 1.0 lb 2.0 - 4.0 pt	<i>Restricted Use Pesticide.</i> Apply in 20 to 60 gallons of water per acre. Rate is dependent on weed size (see label). Paraquat may not control weeds taller than 6 inches. Increase gallonage as density of stubble, crop residue or weeds increases. 2,4-D at 0.5-0.75 pint per acre may be added to this program for additional control of marestail (horseweed), common lambsquarters, common ragweed, and other emerged, susceptible broadleaf weeds.
glyphosate ae formulations Roundup Original Max 4.5L ** Roundup PowerMax or WeatherMax 4.5 L ** Touchdown Hi Tech 5SL ** Touchdown Total 4.17 SL ** <i>or other available formulations</i>	PREPLANT	0.36 - 3.0 lb ae 2.0 - 3.0 pt 1.25 - 2.5 pt 1.0 - 2.0 pt 1.0 - 4.0 pt 0.7 - 5.8 pt	Glyphosate is effective in heavy annual weed infestations and with large weeds where thorough coverage with paraquat is not possible. Higher rates will control perennial species, but those species often are not present or susceptible at the time of planting. Use rates vary by product, formulation, and weed size. Higher rates are usually recommended for annual weeds taller than 6 inches. Horseweed taller than 6 inches may not be controlled. Applications with fan-type nozzles generally have been more effective than with flood nozzles. Use 10 to 40 gallons of water per acre. To aid in the control of marestail/horseweed, common lambsquarters, common ragweed, and other emerged, susceptible broadleaf weeds, 2,4-D or dicamba may be added. Glyphosate is available in some pre-packaged mixtures, but glyphosate rate may not be adequate for Aburndown@ control.

Soil-applied Herbicides:

Herbicide	Application timing	Rate	Remarks
active ingredient trade name		lbs a.i./A product/A	
sulfentrazone Authority 75DF	PPI/PRE	0.188 - 0.25 lb 4.0 - 5.3 oz	Soybean stunting may occur if excessive rainfall occurs after application but before soybeans emerge. Do not apply if there are visible signs of cracking due to soybean emergence, or serious crop injury may result. Observe labeled rotational crop restrictions for all products containing sulfentrazone.
chlorimuron + metribuzin Canopy 75DF	PPI/PRE	0.027 - 0.08 lb 0.16 - 0.48 lb 4 - 7 oz	Apply prior to soybean emergence. Do not use on sand or loamy sand or any soil with less than 0.5% om. Do not apply if soil pH is 6.8 or higher. Observe rotational crop restrictions. Use of STS soybeans may allow application of higher Canopy rates with reduced risk of crop injury. Mechanical incorporation will improve weed control when no rainfall or irrigation occurs within 10 to 14 days after planting. Apply to the soil and uniformly incorporate into the top 2 inches within 14 days before planting using a disk, harrow, rolling cultivator, or similar implement. Observe labeled rotational crop restrictions for all products containing chlorimuron (Classic).
clomazone Command 3ME	PRE	0.5 - 1.0 lb 1.3 - 2.7 pts	Command 3 ME formulation is labeled for PRE application only. Clomazone is very prone to offsite movement due to volatility. Refer to label for precautions. Do not apply during temperature inversions or when wind speed is greater than 10 mph. Apply in a minimum spray volume of 10 gal/A. Use coarse sprays to reduce drift. Do not apply Command 3ME within 1,200 feet of areas listed on label including towns, subdivisions and commercial fruit and vegetable production. Observe labeled rotational crop restrictions.
cloransulam FirstRate 84WG Premix Gangster Multi-Pack	PPI/PRE	0.032- 0.04 lb 0.6 - 0.75 oz 3 - 3.6 oz	FirstRate water-dispersible packets are not soluble in liquid fertilizer solutions; premixing in water is required. A pre-packaged mixture of FirstRate and Valor is available as Gangster. Gangster can be applied as a fall (after October 15) or spring preplant treatment or preemergence. See Valor

Herbicide	Application timing	Rate	Remarks
active ingredient trade name		lbs a.i./A product/A	
			entry for additional comments.
linuron Lorox 4L	PRE	0.34 - 1.75 lb 0.67 - 3.5 lb 0.67 - 3.5 pt	Provide good agitation in tank before and during application. Follow labeled directions regarding soybean planting depth. Do not use on sandy or loamy sand or any soil with less than 0.5% o.m. Do not plant any crop not on label within 4 months of application.
alachlor Micro-Tech 4L <i>or other available formulations</i>	PPI/PRE	1.75 - 3.0 lb 1.75 - 3.0 qt	<i>Restricted Use Pesticide.</i> Mechanical incorporation will improve weed control when no rainfall or irrigation occurs within 10 to 14 days after planting. Apply to the soil and uniformly incorporate into the top 2 inches within 14 days before planting using a disk, harrow, rolling cultivator, or similar implement. For surface applications: if adequate soil moisture is not received within 7 to 10 days after application, use of a rotary hoe or shallow cultivation is recommended. Alachlor is not recommended for incorporation on coarse soils in the Southeast.
dimethenamid dimethenamid-p Outlook 6.0 EC	PPI/PRE	0.56 - 1.50 lb 0.38 - 0.98 lb 12 - 32 oz 8 - 21 oz	Do not exceed a rate of 20 oz/A of Frontier or 12 oz/A of Outlook on coarse soils with less than 1.5% organic matter. PPI applications are not recommended on these soils. Mechanical incorporation will improve weed control when no rainfall or irrigation occurs within 10 to 14 days after planting. Apply to the soil and uniformly incorporate into the top 2 inches within 14 days before planting using a disk, harrow, rolling cultivator, or similar implement. For surface applications: if adequate soil moisture is not received within 7 to 10 days after application, use of a rotary hoe or shallow cultivation is recommended.
flumetsulam Python 80WDG	PPI/PRE	0.04 - 0.07 lb 0.8 - 1.33 oz	If incorporating, do so to a depth of 2 inches. Rainfall or irrigation is needed to activate Python. Observe rotational restrictions for products containing flumetsulam.
metribuzin Sencor 75 DF	PPI/PRE	0.25 - 0.375 lb	Plant at least 1.5 inches deep. Do not use on sand or sandy loam soils or soils with less than 0.5 percent organic matter. If used on coarse

Herbicide	Application timing	Rate	Remarks
active ingredient trade name		lbs a.i./A product/A	
Sencor 4L Premixes Boundary 6.5EC Canopy 75DF		0.33 - 0.50 lb 0.50 - 0.75 pt 7 -13 oz 1.2 - 3.6 pt 4 - 12 oz 5.2 - 15.4 oz	textured soils with less than 2 percent organic matter or if heavy rainfall follows soon after application, severe and stand losses can occur. Certain organophosphate soil insecticides placed in contact with seed also may result in increased soybean injury from metribuzin. Do not use on Altona, Coker 102 and 156, Gervin, Semmes, Tracy or Varosy varieties. The lowest rates have not effectively controlled cocklebur, jimsonweed or morningglory. Rainfall (0.25-0.50 inches) within 2 weeks after application is necessary to activate herbicide. Do not replant treated areas to any crop other than soybeans within 4 months after treatment. Read and follow the label for such use.
trifluralin Treflan 4EC <i>or other available formulations</i>	PPI	0.5 - 1.0 lb 1.0 - 2.0 pt 1.0 - 2.0 pt	Incorporate within 24 hours after application. Plant soybeans after early season adverse weather has passed. Do not plant deeper than 2 inches. Follow label for proper soil incorporation procedures.
flumioxazin Valor 51WDG Premix Gangster Multi-Pack	PRE	0.063 - 0.095 lb 2.0 - 3.0 oz 3.0 - 3.6 oz	Do not mechanically incorporate Valor into the soil after application. Valor has some burndown activity, but it is often not adequate by itself, it should be tankmixed with glyphosate or paraquat. Rate is dependent upon weed species targeted, soil type, and soil organic matter, refer to label. Do not use Valor in fields where flufenacet (Axiom, Define) alachlor (Lasso, MicroTech), metolachlor (Dual, Boundary) or dimethenamid (Frontier or Outlook) will be used due to soybean injury. Do not apply if beans have begun to emerge. Splashing soil from irrigation or heavy rainfall may cause injury to newly emerged soybeans. A pre-packaged mixture of Valor and FirstRate is available as Gangster. Gangster can be applied as a fall (after October 15) or spring preplant treatment or preemergence. The restrictions above for Valor also apply to Gangster.

Postemergence Broadleaf Herbicides:

Herbicide	Rate	Remarks
Active ingredient trade name	lbs a.i./A product/A	
<p>2,4-DB</p> <p>Butyrac 200 2L</p> <p><i>many formulations available</i></p>	<p>0.175 - 0.22 lb</p> <p>0.7 - 0.9 pt</p>	<p>2,4-DB is not recommended for use by itself due to limited control and potential for crop injury. Rather 2 oz of 2,4-DB can improve morningglory, cocklebur, and jimsonweed control when tank-mixed with other postemergence herbicides. Potential for crop injury is increased under hot, dry growing conditions. If more than 2 oz/A rate is used, apply as directed spray into rows when soybeans are 8 to 12 inches high and cocklebur, morningglory, jimsonweed and pigweed have not exceeded a height of 3 inches. Top of weed seedling must be sprayed. Use precision directed spray application equipment. Apply with sprayer nozzles mounted on skids or gauge wheels. Do not spray more than one-third of the base of soybean as severe injury may occur.</p>
<p>bentazon</p> <p>Basagran 4L **</p> <p>Premixes</p> <p>Storm 4S **</p>	<p>0.75 - 1.0 lb</p> <p>0.75 - 1.0 qt</p> <p>--</p> <p>1.5 pt</p>	<p>Apply to weeds when they are small and actively growing. Weed growth stages generally correspond to soybean growth stages of one- to two-trifoliolate leaves. Yellow nutsedge may be controlled best when the application is followed in 7 to 10 days with a repeated application or by cultivation in 10 to 14 days. Soybeans may exhibit a slight yellowing, bronzing or speckled appearance, which generally is soon outgrown. Do not apply to soybeans growing under unfavorable conditions and exhibiting stress symptoms.</p>
<p>acifluorfen</p> <p>Blazer 2L **</p> <p>Ultra Blazer 2L **</p> <p>Premixes</p> <p>Storm 4S **</p>	<p>0.25 - 0.38 lb</p> <p>1.0 - 1.5 pt</p> <p>1.0 - 1.5 pt</p> <p>--</p> <p>1.5 pt</p>	<p>Apply when weeds are 2 to 4 inches high and actively growing and when soybeans are in the one- to two-trifoliolate leaf stage. Do not apply when crop and weeds are under stress. Apply with 10 to 50 gallons of spray volume per acre, and a minimum of 40 to 60 pounds per square inch. Addition of surfactant to the 2L formulation may improve control on drought-stressed or slightly oversized weeds; but applications made under these conditions generally will be less satisfactory than those made under optimum conditions.</p>
<p>chlorimuron</p> <p>Classic 25WG **</p> <p>Premix</p>	<p>0.008 - 0.012 lb</p> <p>0.5 - 0.75 oz</p>	<p>Apply to young, actively growing weeds within labeled weed growth stages. Classic label states that the first trifoliolate leaf of the soybean is fully expanded before the application is made. Apply with a minimum of 10 gallons per acre. Flood-type,</p>

Herbicide	Rate	Remarks
Active ingredient trade name	lbs a.i./A product/A	
Synchrony STS 25DF **	0.5 oz	low-pressure nozzles are not recommended. Use of STS varieties will reduce the risk of injury. Synchrony STS should be used with STS varieties only. Observe labeled rotational crop restrictions for all products containing Classic.
lactofen Cobra 2EC ** Premix	0.20 lb 12.5 oz 5 - 7 oz	Cobra is currently labeled for control of large (15 to 36 inches) broadleaf weeds, such as velvetleaf, giant ragweed, jimsonweed and burcucumber [State Local Need (SLN's) labels for Maryland, Delaware and Virginia]. Expect some crop injury when using Cobra. The addition of 2,4-DB (2 ounces) is recommended for help in controlling morningglories.
cloransulam FirstRate 84DF **	0.016 lb 0.3 oz	FirstRate water-dispersible packets are not soluble in liquid fertilizer solutions; premixing in water is required. Apply before 50 percent flowering stage of soybeans. UAN will improve velvetleaf control.
Flexstar see Reflex		
thifensulfuron Harmony GT 75DF ** Premix Synchrony STS 25DF **	0.004 lb 0.083 oz 0.5 oz	For adequate velvetleaf control, add 1 gallon of liquid nitrogen solution per acre. Use of STS varieties will reduce the risk of injury. Synchrony STS should be used with STS varieties only. Harmony GT and Synchrony STS labels state that the first trifoliolate leaf of the soybean is fully expanded before the application is made.
imazethapyr Pursuit 2AS ** or Premix Extreme 2.17EC	0.063 lb 0.25 pt 1.44 oz 1.5 qt	Apply early POST when weeds are actively growing and before most exceed a height of 3 inches and before soybeans begin to bloom. Only one application of Extreme can be made per soybean growing season. Extreme can only be applied to soybean varieties designated Roundup Ready. Observe rotational restrictions for products containing imazethapyr.
imazamox Raptor 1AS **	0.039 lb 5.0 oz	Apply early POST when weeds are actively growing and before most exceed 3 inches in height and before soybeans begin to bloom. Occasionally, internode shortening and/or temporary yellowing of soybeans may occur, especially if under environmental stress. When adequate soil moisture is present, Raptor will provide residual activity of susceptible germinating weeds. Observe rotational restrictions for products containing imazamox.
fomesafen	0.25 - 0.375	Apply when weeds are small and before weeds

Herbicide	Rate	Remarks
Active ingredient trade name	lbs a.i./A product/A	
Reflex 2LC ** Flexstar HL 1.88ME ** Premix	lb 1.0 - 1.5 pt 0.75 - 1.5 pt 1.6 qt	reach maximum growth stages described on the label. Apply Reflex, Flexstar, or Typhoon before soybeans begin to bloom. Do not apply Reflex or Flexstar more than once every 2 years. Observe labeled rotational crop restrictions. The addition of 2,4-DB (2 ounces) is recommended for help in controlling morningglories. Flexstar can cause more soybean injury than Reflex.
flumiclorac Resource 0.86EC ** Premix	0.027 - 0.054 lb 4.0 - 8.0 oz 5 - 7 oz	Apply 4 to 8 ounces of Resource as a broadcast POST spray to 6- to 10-leaf velvetleaf using higher rates for larger velvetleaf. Resource has activity against several other weeds when they are in the two- to three-leaf stage, including cocklebur, lambsquarters, common ragweed, jimsonweed, pigweed species, and prickly sida, but control declines on larger weeds.
glyphosate ae formulations Roundup Original 3L ** Roundup UltraMax 4L ** Roundup WeatherMax 4.5 L ** Touchdown IQ 3SL ** Touchdown Total 4.17 SL ** <i>or other available formulations</i> Premixes Extreme 2.17EC	0.38 - 1.6 lb ae 2 - 4 pt 1.6 - 3.25 pt 1.4 B 2.8 pt 1.0 - 4.0 pt 0.75 - 3.0 pt 1.5 - 2.0 qt 1.5 qt	For use only on soybean varieties designated Roundup Ready. This program is most effective in narrow-row or drilled soybeans. Roundup may be applied POST from cracking through the full flowering stage. Make initial POST applications of glyphosate at the following per acre rates (Roundup Original 2 to 3 pt; Roundup UltraMax 26 to 40 oz; Roundup WeatherMax 22 to 35 oz; Touchdown IQ 2 to 3 pt; Touchdown Total 24 to 36 oz), and if necessary, sequential treatments at these per acre rates (Roundup Original 1 to 2 pt; Roundup UltraMax 13 to 26 oz; Roundup WeatherMax 11 to 22 oz; Touchdown IQ 1 to 2 pt; Touchdown Total 12 to 18 oz). Adjust application rates for individual weed species and weed size as directed by the label. For control or suppression of perennial weeds, apply glyphosate at the following per acre rates (Roundup Original 2 to 4 pt; Roundup UltraMax 26 to 52 oz; Roundup WeatherMax 22 to 44 oz; Touchdown IQ 2 to 4 pt; Touchdown Total 24 to 48 oz). Use a nonionic surfactant at 0.5 percent v/v in all applications of Roundup Original. Do not use surfactant with Roundup UltraMax or WeatherMax. Adjuvants are optional with Touchdown products. Care must be used to avoid drift to adjacent crops or other desirable vegetation. Single in-crop applications must not exceed 2.0 qt/A of Roundup Original or Touchdown IQ, 1.6 qt/A of

Herbicide	Rate	Remarks
Active ingredient trade name	lbs a.i./A product/A	
		Roundup UltraMax, 44 oz/A of Roundup WeatherMax, or 48 oz/A Touchdown Total. Combined total in-crop applications must not exceed 3.0 qt/A per season of Roundup Original or Touchdown IQ, 2.4 qt/A/season of Roundup UltraMax, 2 qt/A/season of Roundup WeatherMax or 2.2 qt/A/season of Touchdown Total. Only one application of Backdraft or Extreme can be made per soybean growing season.
<p style="text-align: center;">imazaquin</p> <p>Scepter 70DG **</p> <p style="text-align: center;">Premix</p>	<p>0.06 - 0.125 lb</p> <p>1.4 - 2.8 oz</p> <p>1.5 - 2.0 qt</p>	Apply after crop emerges but before weeds are 12 inches high. Do not apply when weeds and soybeans have been subjected to temperature or moisture stress. Only one application of Backdraft can be made per soybean growing season. Backdraft can only be applied to soybean varieties designated Roundup Ready. Observe rotational restrictions for products containing imazaquin.
<p style="text-align: center;">chlorimuron + thifensulfuron</p> <p>Synchrony STS 25DF **</p>	<p>0.006 lb</p> <p>0.002 lb</p> <p>0.5 oz</p>	Synchrony is for use only on soybean varieties designated as ASTS@ in the variety name. These soybeans contain a trait that enhances tolerance to sulfonylurea herbicides. Make applications to small, actively growing weeds after the first trifoliolate of the soybean has fully expanded. A sequential application of Classic may be required for certain weeds, including burcucumber, morningglory species and sicklepod. Carefully observe crop rotation intervals, and note that extended crop rotation intervals apply when Synchrony STS is applied following preemergence applications of other sulfonylurea or imidazolinone herbicides.

Postemergence Grass Herbicides:

Herbicide	Application timing	Rate	Remarks
active ingredient trade name		lbs a.i./A product/A	
fluazifop Fusilade DX 2EC ** Premixes Fusion 2.56EC **	POST	0.09 - 0.19 lb 6 - 12 oz 1.6 qt 6 - 12 oz	Apply to actively growing grasses at the rate and growth stage indicated on the label for the individual grass species with a minimum of 10 gallons of water per acre and 30 to 60 pounds per square inch. Do not use flood nozzles. Apply before soybeans begin to bloom.
sethoxydim Poast 1.5L ** Poast Plus 1L ** Premix	POST	0.19 - 0.38 lb 1 - 2 pts 1.5 - 3.0 pts --	Apply to actively growing grasses at the rate and size indicated on the label for the individual grass species with 10 to 20 gallons of water per acre and 40 pounds per square inch. Do not use flood-type nozzles.
clethodim Select 2EC **	POST	0.094 - 0.125 lb 6 - 8 oz	Apply to actively growing grasses in 10 to 40 gallons of water. See label for tank-mix instructions and grass growth stages.

DISEASES

Chemical Control for foliar diseases (3)

Disease	Fungicide common name	Fungicide trade name	Production rate per acre	Remarks
Pod and stem blight, anthracnose, Cercospora leaf blight, frog-eye, purple seed stain, and brown spot	Thiophanate methyl	Topsin M 70WP Topsin M WSB	0.5-1.0 lb	Make first application when pods begin to form and second application 14 days later. Do not use treated vines or plants for forage or for hay. Do not make more
	Chlorothalonil	Bravo 500 Bravo Weather Stik Bravo Ultrex	2.0-3.5 pt 1.5-2.25 pt 1.4-2.2 lb	
	Azoxystrobin	Quadris	6.2-15.4 fl oz	

				than 2 applications per season of Topsin or Quadris. Bravo products may be applied up to three times per season but PHI is 6 weeks. See labels for other restrictions.
Rust	Azoxystrobin	Quadris	6.2 - 15.4 fl oz	Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Other products contain this ingredient. Do not apply more than 1.5 lb of the active ingredient per season. Do not apply within 14 days of harvest.
Rust	Chlorothalonil	Bravo Weather Stik Echo 720	16-36 fl oz 16-40 fl oz	Make first application at

		Echo 90DF	0.875-2.0 lb	<p>the first sign of rust in the immediate area or based on regional advisories. This product has no systemic activity and works on the plant surface as a protectant against infection. There is no after-infection activity. See chart Soybean Rust Fungicide use guidelines for timing, alternation of products and tank mixes. Do not exceed 3 applications per season. Do not exceed 6 pints per season. Do not apply within 6 weeks of harvest.</p>
Rust	Pyraclostrobin	Headline	6-12 fl oz	<p>Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust</p>

				Fungicide Use Guidelines for timing, alternation of products and tank mixes. Other products contain this ingredient. Do not apply more than 0.4 lb of active ingredient per season. Do not apply within 21 days of harvest.
Rust	Tebuconazole	Folicur 3.6F Orius 3.6F	3-4 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Other products contain this ingredient. Do not apply more than

				two applications of products containing this active ingredient. Do not apply within 30 days of harvest.
Rust	Myclobutanil	Laredo EC	4-8 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Do not apply more than two applications of this product. Do not apply within 28 days of harvest.
Rust	Tetraconazole	Domark 230ME	4-6 fl oz	Section 18 approved product registered through 10 Nov 2007.

				<p>Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed for disease control. Only one application of this product is permitted. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Do not apply after growth stage R5 (beginning seed at upper nodes).</p>
Rust	Pyraclostrobin + Tebuconazole	Headline SBR	7.8 fl oz	<p>Section 18 approved product registered through 10 Nov 2007. Make an application at first sign of rust in immediate area or based on regional advisories. More than one application may be needed. See chart Soybean</p>

				Rust Use Guidelines for timing, alternation of products and tank mixes. Do not make more than two applications of products containing either active ingredient. Do not make applications within 30 days of harvest.
Rust	Trifloxystrobin + Propiconazole	Stratego	5.5-10.0 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at first sign of rust in immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Use Guidelines for timing, alternation of products and tank mixes. Do not make more than two applications of products containing either active

				ingredient. Do not make applications after growth stage R6 (full seed).
Rust	Azoxystrobin + propiconazole	Quilt	14.0-20.5 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at first sign of rust in immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Use Guidelines for timing, alternation of products and tank mixes. Do not make more than two applications of products containing propiconazole. Do not apply more than 1.5 lb of azoxystrobin per season. Do not make applications after growth stage R6 (full seed).

Asian Soybean Rust (*Phakopsora pachyrhizi*)

Just introduced into the US in the fall of 2004, Asian Soybean Rust (ASR) is spread by windblown spores that can travel long distances. *P. pachyrhizi* is not seedborne. Symptoms begin on the lower leaves of the plant as small lesions that increase in size and change from gray to tan or reddish brown on the undersides of the leaves. Lesions can occur on petioles, stems, and pods. When soybeans are infected in the reproductive stages of development soybean yield can be severely impacted. It is too early to tell how severe the disease will be in the U.S. and what conditions will favor it. It is known that prolonged leaf wetness combined with temperatures between 59° and 86°F and humidity of 75-80% is required for spore germination and infection.

Controls:

Biological: None available

Cultural: There are no resistant cultivars currently available. It will overwinter on legume hosts in the south and blow north as the season progresses, so sanitation and other cultural practices will not be effective for soybean rust.

Chemical: See table above

Monitoring. Scouting and checking disease progress in the areas to our South will help determine when fungicide sprays are needed. Fungicides to be effective need to be applied preventatively or when less than 10% of the foliage is infected or yield loss can occur. Applications need to be made during the reproductive growth stages from R1- R6. Applications after R-6 are not effective and not recommended.

Anthracnose (*Colletotrichum dematium* var. *truncatum* + and *Glomerella* spp.)

Symptoms for Anthracnose can develop in soybeans at any stage of crop development. Most commonly, however, symptoms appear in the later reproductive stages. Stems, leaf petioles and pods are covered with small to large, irregular, brown blotches. Blotches are embedded with black fungal bodies which have small, but visible, spines. Foliage develops brown lesions on the veins and cankers on leaf petioles. Leaves may roll and defoliate prematurely. Plants can be stunted. Infected pods may be shriveled and contain no seed (pod blanking); or more two-seeded pods, with shriveled moldy seed, may be evident. Anthracnose and pod and stem blight frequently occur together on the same plants late in the season.

The fungi survive between seasons in infested crop residue and seed. Plants can become infected at any stage of development, but are especially susceptible

during bloom and pod fill. Disease is favored during prolonged periods of wet weather and is evident to one degree or another every time soybeans are grown. Disease is most severe on soybean cultivars that mature during late summer; thus, it tends to be more of a factor on early maturing cultivars.

Controls

Biological: None available.

Cultural: Sow high-quality, disease-free seed (e.g., certified seed). (Resistance to various phases of anthracnose exists in soybeans, but the reactions of the most commonly grown cultivars are poorly defined. For practical purposes, all soybean cultivars are susceptible to anthracnose.) Rotating fields out of soybeans and plowing infested soybean residue will help in overall anthracnose management on the farm.

Chemical: See table above

Monitoring: Treating seeds with fungicides, such as thiram alone or in combination with other materials, will help to improve emergence of infected seed. Treating fields with certain foliar fungicides can protect seed quality of early- to mid- maturity soybean cultivars. Applications made during mid-pod fill have given the most consistent results when conditions favor anthracnose development.

Brown Spot (*Septoria glycines*)

Pin-point to small, angular, brown spots form on unifoliate leaves 2-3 weeks after planting. Spots are more pronounced on lower leaf surfaces. Numerous spots cause leaves to yellow and drop off plants. Trifoliate leaves develop numerous, irregular, tan lesions that later turn dark brown. Leaf yellowing is usually prominent. Individual spots frequently coalesce to form large blackish-brown blotches. Defoliation typically occurs from the bottom of the plant to the top. Early season brown spot will appear annually in almost every field in Delaware. Late-season brown spot is much more variable in occurrence and severity and depends on rainfall.

The brown spot fungus overwinters in infested crop residue. Infections take place when fungal spores are splashed onto foliage. Infections early in the season are frequently the source of late-season infections. Disease is most severe during periods of cool, wet weather.

Controls

Biological: None available.

Cultural: No resistant cultivars. Rotate soybeans with other crops and plow under infested residue, where practical.

Chemical: Foliar fungicides listed in the table above can be used to control brown spot and prevent yield loss, but the cost of the necessary treatments usually exceeds the benefit.

Cercospora Leaf Blight (*Cercospora kikuchii*)

Infected seedlings are stunted and may die as a result of stem girdling. Infected seed leaves may shrivel, turn purple and drop prematurely. Late in the season, upper leaves of plants develop extensive blighting over large portions of fields. Blighting is the result of numerous pin-point spots to irregular blotches that are red-purple in color. Affected foliage defoliates prematurely. Small reddish-purple, slightly sunken lesions form on stems and leaf petioles. Rarely does this disease cause yield loss in Delaware. Infected seed exhibit varying degrees of pink to purple seed coat discoloration. Only the leaf blight phase of this disease affects yield. Seed discoloration is a cosmetic seed quality problem, primarily affecting marketability. It occurs commonly on early maturing soybeans.

The fungus survives between seasons in seed and infested crop residue. Infected seed give rise to diseased seedlings, infested crop residue and certain weeds. Spores are blown or splashed onto upper plant parts, and infection occurs during warm, wet weather.

Controls

Biological: None available.

Cultural: Plant high-quality, disease-free seed (e.g., certified seed). Resistant soybean cultivars are available, but the disease reactions of commonly grown cultivars are poorly defined. Plant late-maturing cultivars, or delay planting early- to mid-season cultivars. Rotate soybeans with other crops.

Chemical: Foliar fungicides given in the table above can control both the foliar and seed phases of this disease, but the practice is rarely economical and, thus, is not recommended. Seed producers may benefit the most from fungicide applications.

Charcoal Rot (*Macrophomina phaseolina*)

Infected seed may rot prior to germination or give rise to diseased seedlings which soon die. Older diseased plants turn yellow and wilt, especially during hot, dry weather. Severely diseased plants die; dead leaves turn brown and remain attached. Ash-gray to black lesions may be evident at the bases of affected plants. Small black bodies, resembling ground pepper, will be evident under the

outer tissue of the bases of plants and tap roots. Black streaks will be evident in the lower stem when it is split open.

The charcoal rot fungus survives from season to season in soil and infested soybean, corn and grain sorghum stubble. It can also be transmitted on seed. Plants are often infected early in the season, but the disease generally goes dormant until the onset of hot, dry weather in mid- to late season. Charcoal rot may not be evident in years where moisture is adequate throughout the growing season.

Controls

Biological: None available.

Cultural: Avoid continuous soybean production which maintains the fungus at high levels. Rotate soybeans with other crops to reduce such levels and lower the potential for serious damage. Rotation with corn and grain sorghum reduces levels of fungus, but is not as effective as growing non-host crops. Fertilize fields according to soil test recommendations. Plant high-quality, disease-free seed (e.g., certified seed). Late maturing full season soybean may escape damage. Early season varieties (Group III, IV) have had the most damage when it occurs. Planting soybeans no-till into wheat stubble (double crop) may reduce disease by reducing water stress in the soybean crop. Where possible, irrigate soybeans to avoid drought stress. Avoid injury to crops and manage soybean cyst nematode if it is a problem. Tillage of infested corn and soybean stubble may help reduce populations of the fungus.

Chemical: None available.

Downy Mildew (*Peronospora manshurica*)

Foliage develops yellow spots that enlarge slightly into irregular gray-brown spots with a yellowish margin. When viewed from the underside of leaves, spots have a slightly gray, fuzzy appearance. Leaves become resistant to infection with age. When pods become infected, the fungus is visible inside the pods as an encrusted fungal mass. Infected seed has a dull white appearance and is partially or completely encrusted by the causal fungus, but germination will be little affected. Downy mildew is rarely a serious problem in Delaware; nonetheless, low levels of the disease, primarily foliar infections, are very common.

The causal fungus overwinters in infested crop debris or seed. Spores are spread to and infect soybeans during periods of high humidity/moisture and relatively cool temperatures. Excessive soil moisture may encourage disease development.

Controls

Biological: None available.

Cultural: Plant high-quality, disease-free seed (e.g., certified seed). Rotate soybeans with other crops. Plow under infested residue where downy mildew has been a serious problem. Resistance to downy mildew is available, but the reactions of commonly grown soybean cultivars are poorly defined.

Chemical: Not necessary.

Frogeye Leaf Spot (*Cercospora sojina*)

Small, circular to angular, reddish-brown spots develop on leaves in mid- to late season. As spots enlarge (up to ¼ in.) they develop off-white centers with a red-brown border. Older spots become papery thin and frequently become tattered. Numerous spots may coalesce and cause leaves to drop prematurely. Pods, seed and stems can become infected, but frogeye is primarily a foliar disease. Soybean leaves are immune to infection once the leaves are expanded, but susceptibility returns late in the season as plant senescence sets in. In Delaware frogeye is seen when rainfall occurs frequently in late season.

Frogeye survives the winter in seed and infested residue. Spores are carried by air currents and infect soybeans during warm, wet weather.

Controls

Biological: None available.

Cultural: Rotate soybeans with other crops. Plant high-quality, disease-free seed (e.g. certified seed). Plant resistant soybean cultivars where frogeye had been a serious problem. Resistance is best developed in late-maturing soybean cultivars. Avoid excessive seeding rates.

Chemical: Foliar fungicides listed in the table above may be of benefit on farms where frogeye leafspot is a consistent problem.

Pod and Stem Blight (various Species of *Diaporthe* and *Phomopsis*)

Infected seed give rise to diseased seedlings that frequently become blighted and die. Stems and leaf petioles of older infected plants have tiny black specks (pycnidia) which are usually arranged in rows. Infected pods also have scattered pycnidia, and pods may be poorly developed. Infected seed are shriveled, cracked and may be encrusted by a white fungal mass. Seed may be externally infected and show no symptoms. Pod and stem blight has little effect on crop

yield, but seed quality can be greatly affected. Thus, the disease is principally of concern to soybean seed producers.

The fungi survive the winter in both infected seed and crop residue. Infected crop residue can set the stage for high levels of pod and stem blight in fields. Seed infection occurs only if pods become infected. Pod infection occurs anytime from flowering onward, but extensive seed infection does not take place until plants have pods that are beginning to mature (R7 stage). Infection is favored during warm, wet weather. Also, damage of pods by insects favors both pod and seed infection. Early maturing soybean cultivars and early plantings tend to be more affected than later maturing cultivars and later plantings. This is because the former mature during more disease-favorable conditions than the later. Delayed harvest significantly increases pod and stem blight levels in both early- and late-maturing cultivars.

Controls

Biological: None available.

Cultural: Rotate soybeans with other crops. Plant high-quality, disease-free seed (e.g., certified seed). Avoid planting in cool, wet soils. Plant late-maturing cultivars, or delay planting of early- and mid-season cultivars. Plow under infested crop residue to reduce pod and stem blight levels in subsequent soybean crops.

Chemical: See the table above.

Monitoring: Germination of moderately diseased can be improved by treating seed with protectant fungicides containing captan, carboxin and/or thiram. Seed production fields will benefit the most from fungicide applications that improve seed quality when *Phomopsis*/*Diaporthe* infections are likely to occur.

Virus Diseases

Not much is known about incidence and severity of virus diseases of soybean in DE. Soybean mosaic and budblight caused by Tobacco ringspot virus occur occasionally and are thought to be primarily seed borne. Soybean severe stunt virus is only known to occur in Delaware and has not been identified in the last five years. It was only ever seen in Sussex county. Other important soybean viruses such as bean pod mottle probably occur but have not been positively identified or confirmed.

Soybean Mosaic (Soybean Mosaic Virus)

Infected plants are stunted. Leaves will show a yellowish vein clearing, curled leaf margins, mosaic patterns and leaf crinkling. Pods of infected plants may be

abnormally small and somewhat flattened. Seed may be reduced in size and may show a brown to black mottling pattern. SMV is primarily a seed quality problem, especially relative to export markets.

The virus is primarily transmitted by seed, but may also be transmitted by aphids to some extent. This virus has no overwintering hosts in Delaware and can survive the winter only in infected seed.

Controls

Biological: None available.

Cultural: Plant high-quality, disease-free seed (e.g., certified seed). Some resistant varieties are available. Early plantings will escape yield damage, but seed quality may still be a problem for seed and grain produced for export markets.

Chemical: None available.

Seed and Seedling Diseases (Various fungi)

Seed rot prior to germination. Seedlings rot and die before they emerge from the soil. Emerged seedlings have varying degrees of root rot, lower stem cankering and rot, seed leaf lesions and stunting. Plants may die or survive infection, depending on the severity of disease and the growing conditions. Frequent skips in fields of 1 ft. or more may lead to significant yield losses and or weed competition.

Depending on the fungus involved, they can survive in the seed, soil and infested crop residue. Disease is usually promoted by adverse growing conditions and stress during seed germination and emergence. Cool, wet soil conditions are the most common predisposing factors. Heat and drought stress especially in double crop soybeans following wheat can predispose soybeans to pre and post emergence damping-off. Herbicide injury or insect damage to young seedlings may also increase seedling diseases, especially those caused by *Rhizoctonia* and *Pythium*.

Controls

Biological: None Available

Cultural: Plant high-quality, disease-free seed (e.g., certified seed). Avoid planting in cool, wet soils. Maintain balanced soil fertility. Avoid any herbicide injury to the developing crop. Tile or rip fields to enhance the internal drainage of soil. Improve surface drainage problems by limiting equipment traffic when soils are wet. Rotation of soybeans with other crops may reduce the levels of some

causal fungi. However, rotation will have little effect on fungi such as *Rhizoctonia*, *Pythium*, *Phytophthora* and *Fusarium*. Seed and seeding diseases are generally encouraged by reduced tillage systems.

Chemical Control (3):

Situation	Required Active Ingredient	Fungicide Trade Name	Remarks
Early planting into cold (less than 55°F) and potentially wet soil	Metalaxyl Mefenoxam	Allegiance FL Soygard Apron XL LS Maxim XL	Pythium damping-off is the primary target for this situation. Metalaxyl and mefenoxam are by far the best active ingredients to control Pythium damping-off. Allegiance and Apron should not be used alone. Use Soygard or Maxim XL or combine Allegiance or Apron with other general-use registered seed treatment fungicides like captan or thiram. To avoid adverse effects on nitrogen-fixing bacterial inoculants, add inoculant to seed within 4 hrs of planting or apply in-furrow. Do not use treated seed for food, feed, or oil.
Fungal infested seed lot (germination 75 to 85 percent)	Azoxystrobin Fludioxanil Thiabendazole Captan Thiram	Soygard Maxim XL Rival Captan 400 42-S Thiram	Many other formulations are available. To avoid adverse effects on nitrogen-fixing bacterial inoculants, add inoculant to seed within 4 hrs of planting or apply in-furrow. Do not use treated seed for food, feed, or oil.
Seed lot germination > 85% and normal planting conditions	None		No seed treatment required.
Seed lot germination < 75%	None		Regardless of planting conditions, no seed treatment can compensate for a poor seed lot. Clean the seed lot and test germination again. If germination cannot be brought above 75%, do not use for planting.

Sudden Death Syndrome (SDS) (*Fusarium solani f.sp. glycines*)

SDS is a new disease in Delaware. It was first found on Delmarva in 2000 and again in 2004. Initial foliar symptoms are evident as random yellow blotches between the veins of leaves. Spotting may be preceded by a virus-like, mosaic pattern that degenerates into spots. Yellow spots run together and tissue between the veins dies, but the veins remain green. Diseased leaves may be distinctly curled due to excessive drying of diseased tissue. Infected leaflets drop from plants, but the leaf petioles usually remain attached to plants. Flowers and young, developing pods only rarely abort. Stems of diseased plants show a milky-brown discoloration. Roots of plants are completely rotten in the later disease stages. Root rot precedes the development of foliar symptoms. Rotted roots may exhibit small specks of intense sapphire blue, which are masses of spores of the causal fungus.

SDS is a root rot disease and the causal fungus is confined to soil and crop residue in soil. Root infection occurs in the early vegetative stages when soil moisture is high. The fungus in rotting roots is thought to produce a plant toxin that causes aboveground symptoms. Aboveground symptoms can occur in the late vegetative stages, but usually appear at mid-pod fill or later. Foliar symptoms are the result of plant toxins produced by the causal fungus. Yield loss due to SDS is most significant when symptoms occur prior to the mid-pod fill or later. Yield loss due to SDS is most insignificant when symptoms occur prior to the mid-pod fill stages. Late symptom development can look bad, but yields may be reduced very little. SDS is favored by plant stress. Plants killed prematurely by SDS frequently have reduced seed quality because of prolonged exposure prior to crop harvest.

Controls

Biological: None available.

Cultural: Delay planting full-season soybeans until late May/early June, or stagger planting dates of full-season soybeans. Spread risk by planting moderately resistant varieties that represent at least two, and preferably three, different maturity groups. No highly resistant varieties are available. Avoid crop stress or injury and manage the soybean cyst nematode, if present. Avoid production practices that encourage soil compaction. Improve internal and surface drainage of fields where problems exist. Full-season soybeans planted no-till may be more susceptible to SDS problems. Crop rotation will have little value in the control of SDS. Harvest affected fields in a timely manner.

Chemical: None available.

Stem Canker (*Diaporthe phaseolorum var. caulivora*)

Reddish-brown stem lesions develop during the early reproductive stages, usually in the vicinity of a stem node. Initially, green stem tissue will be evident both above and below the lesions. Lesions expand both up and down the stem and eventually develop into dark brown to black sunken cankers. Cankers, which coalesce, may be confused with stem discoloration caused by *Phytophthora*. However, stem canker usually forms higher on the plant than does *Phytophthora*. Severe stem cankering results in premature, and often sudden, plant death. Foliage of diseased plants initially exhibits inter-veinal yellowing. This is followed by tissue death between the veins. Eventually, leaves die and usually remain attached to stems. Stem canker can result in the death of scattered plants or an entire field in severe outbreaks.

The stem canker fungus survives the winter in seed, but survival in infested crop residue is critical to the development of stem canker epidemics. Spores are produced and infections occur during the early vegetative stages of crop development. The disease then goes dormant until the reproductive stages, at which time symptoms are produced. The severity of stem canker is highly dependent on the weather conditions during early crop development. Wet weather favors disease development.

Controls

Biological: None available.

Cultural: Plant high-quality, certified seed. Rotate crops, especially where full-season soybeans are grown using no-till or minimum tillage methods. Delay planting operations for full-season soybeans until late May. Plant resistant varieties.

Chemical:

Treating seed with fungicides containing carboxin, thiram and/or captan may help reduce seed transmission, but will not help to avoid stem canker epidemics.

Treatment of soybean with foliar fungicides is not recommended because of the unreliable results.

Nematodes:

Soybean Cyst Nematode (*Heterodera glycines*)

When symptoms occur, they will be evident as plant stunting, reduced growth rate (i.e., canopy closure), wilting, general yellowing, yellowing of leaf margins, reduced nodulation on roots, and occasionally premature plant death. When symptoms occur, they are usually evident as groups of plants that follow oblong, circular or streaked patterns. Cysts (bodies of female nematodes about the size of a pinhead and white to golden-brown in color) are visible on diseased roots

four weeks after planting and throughout the rest of the season. Cyst numbers are greatest on small roots, so plants must be dug, not pulled, when looking for cysts.

Soybean cyst nematode (SCN) survives the winter as eggs in cysts. Eggs can remain viable in cysts for many years in the absence of soybeans. Eggs give rise to worm-like juveniles in the spring when soil temperatures are warm enough to allow soybean planting. Juveniles enter roots, go through several growth stages, and break through the root surface as a visible cyst. A large number of cysts on a root system inhibit water and nutrient uptake from plants. The resultant stress leads to yield loss. Yield loss due to SCN is related to the number of nematodes that are present at planting; the most significant damage to soybeans occurs early in the season. Other crop stresses will increase damage due to SCN. SCN completes two to three life cycles in the course of a growing season. Thus, SCN can reach high and damaging levels in a single year when susceptible soybeans will sustain little or no yield damage if SCN populations are low at planting. SCN populations decrease significantly (60-80%) when exposed to non-host crops and appropriate resistant soybean cultivars.

Controls

Biological: None available.

Cultural: Sample all soybean fields for SCN in the fall, winter or early spring prior to planting. If an SCN analysis indicates a field has moderate to high nematode levels, plant a non-host crop, such as corn or grain sorghum, or a resistant soybean cultivar. Use a resistant cultivar that has resistance to multiple SCN HG types (i.e., races). If resistant cultivars are planted more frequently than once every three years, be certain to use a different SCN resistant variety each time soybean is grown. Periodically planting susceptible cultivars when SCN populations are low, may help in SCN management programs to maintain the effectiveness of resistant varieties when they are planted at a later date. Generally susceptible cultivars should not be grown any more often than once every four years. More frequent usage may be possible where susceptible cultivars are double cropped behind wheat using no-tillage methods. Always base soybean cropping decisions on the results of SCN analyses. Maintain balanced soil fertility and fertilize fields according to soil test recommendations. Use any production practice that enhances overall crop health.

Chemical:

Nematicides can be used to control SCN, but the cost of chemicals is great compared with the cost of alternative control measures.

Application: Not recommended.

Southern Root Knot Nematode (*Meloidogyne incognita*)

Southern Root Knot Nematode (RKN) produces galls on the roots of infected plants. Some stunting can occur and yield can be reduced. Along with SCN these are two nematode diseases that can be diagnosed from the presence of the nematode on the roots. Carefully dig up suspected plants and observe for galls on the roots. During mild winters the nematode can survive in the soil and populations can increase and cause damage. Damage occurs in irregular areas of a field similar to SCN. Soybeans planted after previous crops of susceptible vegetable such as lima beans, snap beans, cucurbits, and tomatoes are most at risk if soil samples are not taken.

Controls

Biological: none available

Cultural:

Crop rotation with non-host crops can be practiced along with planting RN resistant soybeans. Green manure crops or antagonistic crops can also be planted in rotation with soybeans and other susceptible crops to reduce root knot populations. Sorghum sudangrass, castor bean, winter rape, and others show promise in reducing RKN populations in the Mid-Atlantic region. Always base soybean cropping decisions on the results of nematode analyses. Soil samples for root knot should always be taken in the fall before any tillage takes place.

Chemical:

Nematicides can be used to control RKN, but the cost of chemicals is great compared with the cost of alternative control measures.

Application: Not recommended.

References

(1) USDA-NASS Quick Stats (Crops).

http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/

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(3) EB237 Online. 2006-2007 Pest Management Recommendations for Field Crops. <http://extension.umd.edu/publications/EB237online/index.cfm>

(4) 2008 Soybean Weed Management Guide for Delaware and New Jersey. Mark VanGessel and Brad Majek. http://www.rec.udel.edu/weed_sci/DE-NJ%20Soy%20Guide_08Web/SOY_2008_WEEDGUIDE_all.pdf

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