

Crop Profile for Soybeans in Illinois

Prepared February 2000

General Production Information

U.S. Rank/Percent:	2 nd / 16.9%
Acres Planted:	10 million
Harvested:	9.95 million
Production:	427.9 million bushels
Statewide Average:	43 bushels/acre
National Average:	39.0 bushels/acre
Price per Bushel:	\$6.55
Value of Production:	\$2,802,418,000

General

Production of soybeans occurs throughout the state of Illinois but is heaviest in the central and southern two-thirds of the state. Planting may begin as early as the 25th of April in Southern Illinois and the 5st of May in Northern Illinois. Soybeans are typically grown in a rotation with field corn and sometimes in a double-crop after winter-wheat is harvested. Conservation tillage practices are regularly used for soybeans and about 25 to 30 percent of the annual acreage is no-tilled. Approximately two-thirds of all soybeans are solid seeded. This eliminates the possibility of row cultivation and late season application of pesticides by ground application. The benefits of solid seeding a soybean crop is that the canopy closes quickly and can reduce weed growth and, hence the need for late season post emergence herbicides.

Soybeans are used for oil and meal. A number of major processing centers are located in the central part of the state. Some soybeans are shipped to export markets. Group II and III soybeans are most commonly grown.

Because most farmland is owned by landlords, the tolerance for poorly managed fields is very low. This is further exacerbated by the level terrain of much of the state and the ease with which uneven stands or weeds can be seen. This low tolerance often drives farmers to maintain exceptionally clean and aesthetic fields.

Insect Pests

Insect pests are seldom a problem in soybeans for the state of Illinois. On occasion, in extremely dry years, spider mite outbreak can result in crop injury and yield reductions. During the last such outbreak in 1992, approximately 30% of all soybeans in the state were treated for the two-spotted spider mite. Treatments for other pests listed below is extremely rare and would be for localized infestations only. Less than two percent of the soybean acreage is treated for insects in a typical year.

Crop Loss and % of Area Infested by Insects

Common Name	Scientific Name	Avg. % Crop Loss	% Crop Area Infested
Bean Leaf Beetle	<i>Cerotoma trifurcata</i>	1	5
Grasshoppers	<i>Melanoplus spp.</i>	0.0	1
Green Cloverworm	<i>Plathypena scabra</i>	0.0	1
Potato Leafhopper	<i>Empoasca fabae</i>	0.0	1

Insecticide Rates, PHI, and Primary Insects (1,2)

Tradename	Common name	Rate	Unit	PHI	Primary Insects
Sevin XLR Plus	Carbaryl	1.0-4.0	pts	0	Bean leaf beetle, blister beetles, grasshoppers, green cloverworms, Japanese beetle adults, Mexican bean beetle, thistle caterpillar, thrips, woollybear caterpillars
Lorsban 4E	Chlorpyrifos	0.5-2	pts	28	Bean leaf beetle, cutworms, grasshoppers, green cloverworm, Mexican bean beetle, spider mites, woollybear caterpillars

Dimethoate 400	Dimethoate			21	Bean leaf beetle, grasshoppers, Mexican bean beetle, potato leafhoppers, spider mites
Asana XL	Esfenvalerate	2.9-9.6	oz	21	Bean leaf beetle, corn earworm, grasshoppers, green cloverworm, Japanese beetle adults, Mexican bean beetle, potato leafhoppers, woollybear caterpillar
Warrior T or 1E	Lambda-cyhalothrin	1.92-3.84	oz	45	Bean leaf beetle, blister beetles, corn earworm, grasshoppers, green cloverworm, Japanese beetle adults, Mexican bean beetle, potato leafhoppers, stink bugs, thistle caterpillar, thrips, woollybear caterpillar
PennCap-M	Methyl Parathion	1.0-4.0	pts	20	Bean leaf beetle, grasshoppers, green cloverworm, Japanese beetle adults, Mexican bean beetle, potato leafhopper, stink bugs, thrips
Ambush 2E	Permethrin	3.2-12.8	oz	60	Bean leaf beetle, corn earworm, grasshoppers, green cloverworm, Japanese bean beetle, Mexican bean beetle, potato leafhopper, thistle caterpillar, woollybear caterpillar

Bean Leaf Beetle(*Cerotoma trifurcata*)

Adults overwinter under little near fields, and as spring temperatures rise, the beetles fly into alfalfa and cover fields but do not lay eggs there. As soon as soybean seedlings emerge, the beetles leave the forage fields and colonize soybean fields. The adults feed on emerging soybean plants and lay eggs in the soil near the plants. Larvae feed and develop in the soil but cause little damage. First generation adults emerge from mid-July and peak in late July or early August, and lay eggs in soybeans. Second generation adults occur in late August and September. As soybeans mature, the beetles return to alfalfa fields, and later return to the woods to overwinter. Heavy beetle infestations can cause significant

reductions in soybean stands. Economic damage results when defoliation by beetles exceeds 30% in July and August during pod fill. Fungal diseases may infect pods with beetle feeding scars, leading to seed staining or total seed contamination. When favorable conditions exist, up to 5% of soybean acres have been treated; on average, 1% or less are treated annually for been leaf beetle.

Grasshoppers, Differential (*Melanoplus differentialis*), **Migratory** (*M. sanguinipes*), **Redlegged** (*M. femurrubrum*), and **Twostrided** (*M. bivittatus*)

Grasshoppers overwinter as eggs in the soil. Nymphs hatch in the spring and feed for several weeks, usually completing their development by mid-summer. Adults feed throughout the remainder of the summer. Grasshoppers thrive during hot, dry summers when naturally occurring pathogens are suppressed, and tend to be more numerous the year after a drought.

Grasshoppers prefer to feed on weeds, but when these are unavailable, they will move readily into crop fields. The amount of control varies, but during outbreak years up to 11% of field edges are treated.

Green Cloverworm (*Plathypena scabra*)

Each spring, green cloverworm moths fly northward from breeding sites in the South. The adult females lay eggs on soybean plants. After hatching, the larvae feed on leaves and have six larval instars. Mature larvae pupate in the soil; moths emerge and begin another generation. There are several overlapping generations per year.

Green cloverworms are usually suppressed by natural enemies and diseases. Infestations of green cloverworm are favored by conditions that are detrimental to its predators, parasitoids and pathogens. When natural controls failed, up to 7% of soybean acres have been treated with insecticides. On average, less than 0.5% of acres are treated for green cloverworm.

Potato Leafhopper (*Empoasca fabae*)

Potato leafhoppers are carried into Illinois by prevailing spring winds off the Gulf Coast. Female leafhoppers lay eggs in stems and large leaf veins. The eggs hatch within one week, and the larvae feed on the plant. The larvae has five larval instars until adulthood. An entire generation can be completed in three weeks; there are several overlapping generations per year.

Potato leafhopper feeding injury is rarely economic, though hot and dry seasons may favor feeding. Most commercial varieties of soybeans were developed with pubescent leaves, which helps deter leafhopper feeding. If the winds and storm fronts are not especially strong, the prevalence of potato leafhopper in Illinois is reduced.

Diseases

Avg. Crop Loss and % Crop Area Infested by Diseases

Disease	Scientific Name	Avg. % Crop Loss	% Crop Area Infested
Alternaria leaf spot	<i>Alternaria</i>		
Anthracnose, leaf and stem spot	<i>Colletotrichum spp.</i>		
Bacterial blight	<i>Pseudomonas syringae subsp. glycinea</i>	0-15%	
Bacterial pulsate	<i>Xanthomonas campestris subsp. glycines</i>	0-15%	
Bean yellow mosaic virus (BYMV)	none		
Brown stem rot	<i>Phialophora gregata</i>	17-25%	
Bud blight (TRSV and SMV)	none	25-100%	
Cercospora blight and leaf spot	<i>Cercospora kikuchii</i>		
Charcoal rot	<i>Macrophomina phaseolina</i>		
Downy mildew	<i>Peronospora manshurica</i>	up to 8%	
Frog eye leaf spot	<i>Cercospora sojina</i>	as much as 15%	
Phyllosticta leaf spot or leaf blight	<i>Phyllosticta sojicola</i>		
Phytophthora root and stem rot	<i>Phytophthora sojae</i>		
Pod and stem blight and phomopsis decay	<i>Diaporthe phaseolorum (var. sojae and phomopsis longicolla)</i>		
Powdery mildew	<i>Microsphaera diffusa</i>		
Pythium root rot	<i>Pythium</i>		
Rhizoctonia root and stem rot	<i>Rhizoctonia solani</i>	up to 10% w/ stunting up to 50% w/ extensive	
Sclerotinia stem rot	<i>Sclerotinia sclerotiorum</i>		
Septoria brown spot	<i>Septoria glycines</i>	8-15% or more	

Soybean Cyst Nematode (SCN)	<i>Heterodera glycines ichinohe</i>	5-80% depending	
Soybean mosaic virus (SMV)	none		
Stem canker	<i>Diaporthe phaseolorum (var. caulivora)</i>	20-50%	
Sudden death syndrome (SDS)	<i>Fusarium solani</i>	minor-severe	
Target spot, root and stem rot	<i>Corynespora cassiicola</i>		
Wildfire bacterium	<i>Pseudomonas syringae subsp. tabaci</i>	0-15%	

The loss of seed-treatment fungicides, with the exception of captan, would not adversely affect soybean production. Nematicides and foliar fungicides play an equally limited role in crop production. A major reason for this is that nonpesticidal management measures are equal to or better than pesticides for control of many common pathogens. A second reason is that fewer products are available when compared with herbicides or insecticides. Plant disease management has always relied more on agronomic practices than on pesticides. Thus, while it is highly unlikely that all products would lose registration, the loss of one or more would not play a highly significant role in increasing crop production costs or in decreasing yields. Since most production practices serve to reduce disease inoculum, the role of these pesticides is not as important as with other crop production chemicals. Of more importance is the need to control common pathogens for which no chemical treatments are available. The list of common pathogens previously given has many for which there are no direct controls. Thus, although crop production pesticides are important, there is a much greater need for research into alternative methods for control of these important crop production problems.

Since the cost of seed-treatment fungicides rarely exceeds \$2.00 per acre, these products do not contribute significantly to overall production costs. Materials such as captan (\$.30/acre), thiram (\$.50/acre), and carboxin (\$.60/acre) provide seedling blight control at a very affordable price. When these fungicide treatments are combined with other practices, disease control is easily maintained.

Soybean seed treatment usage is not as widespread as corn. Carboxin is a most widely used seed treatment, with captan and thiram as acceptable primary alternatives.

It is difficult to assess the impact on soybeans of replacing any primary seed-treatment fungicide because no single leading fungicide used on soybeans plays the same role as captan does on corn. Thus, if any product were withdrawn, it is likely that one or more other compounds would be an adequate substitute.

Costs of production for soybeans in the absence of seed treatments does not increase substantially, as does cost of production for corn. Costs of production were estimated to increase an average of less than 5% if all seed treatments were withdrawn. Losses if primary products were not available were similar, with less than a 5% loss expected if substitutions had to be made for the primary products.

Five primary seed-treatment products were listed for soybeans. Only one, metalaxyl, has a limited spectrum of activity. All others can substitute almost equally. Thus, elimination of any of these products will have a negligible impact on soybean stand establishment. Carboxin and thiram, for example, have almost identical activity against a wide range of seedling pathogens. If they canceled registration for either, the remaining product would adequately compensate.

For carboxin and metalaxyl the costs of using alternatives are actually expected to decrease, suggesting that other practices would suffice at lower costs. Metalaxyl seed treatment, for example, is expensive and effective against only two common seedling pathogens. Changes in planting time, soil preparation, and the selection of resistant soybean cultivars can completely replace the need for this product. In the case of carboxin, thiram can be used at a lower cost.

However, the increases in costs for lost yield may be significant. Costs of yield reductions from stand losses for the use of alternatives to captan are expected to be about \$17 million and for carboxin about \$69 million. The cost of yield losses where substitutes are used for metalaxyl is estimated at \$12 million and at \$14.7 million for thiram.¹⁰

Unlike insecticides and herbicides, fungicides and nematicides are not primary methods of disease control. Most pathogens of field crops can be managed through a combination of plant resistance, crop rotation with non-hosts, high seed quality, and similar practices. For many common plant diseases (viruses, bacteria, and many fungi), no pesticides are available. Thus, the use of these materials is of less consequence than for other types of pesticides. Although there would be additional potential dollar costs if registration were canceled, only captan appears to be of major economic importance.

Diseases

Common name(s): Soybean cyst nematode (SCN)

Scientific name(s): *Heterodera glycines ichinohe*

Aggravating factors:

-Low fertility soils

-Moist, warm weather (optimum temp. 80-84°)

How disease is spread:

-Anything that moves through an infested field that comes in contact with the soil is capable of picking up cysts and transporting them.

-By wind, runoff water, livestock, and wildlife.

Comments:

-SCN populations were reduced between 50-90% each year a non-host crop was planted.

-Make sure the adequate levels of phosphorus and potash are present before initiating a SCN control program.

Loss range:

5-80%: Depending on rainfall, soil fertility, and other diseases.

Control:

1. Identify the problem through scouting and soil analysis.
 2. Use crop rotation (a grower will receive higher yields on all crops involved than if no crop rotation was used at all).
 3. Use resistant varieties (jack and bell, plus some from the private sector, will provide resistant varieties with higher yield potential).
 4. Use nematicide Temik 15G-which is labeled for SCN control-but only where adapted resistant varieties are unavailable and where susceptible varieties are planted when the SCN population is above the threshold level.
 5. Clean all equipment thoroughly after use on an infested field.
 6. Seed purchased from infested areas should have been cleaned by a spiral cleaner before planting.
- (RPD : no. 501)
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Common name(s): Bacterial blight

Scientific name(s): *Pseudomonas syringae subsp. glycinea*

Aggravating factors:

-Cool, wet, windy weather (optimum temp. 75-77°).

How disease is spread:

-Seedborne through air currents.

-Overwinters in infected surface crop residue.

Loss range:

0-15% w/ 1-2% common

Control:

1. Plant only high-quality, pathogen-free seeds.
 2. Rotate with corn, sorghum, alfalfa, clovers, or cereals for one year or more.
 3. Completely cover the stubble and other plant residue by clean plowing after harvest.
 4. Don't cultivate fields when the foliage is wet.
 5. Grow well-adapted soybean cultivars recommended for the area.
- (RPD : no. 502)
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Common name(s):Bacterial pustule

Scientific name(s):*Xanthomonas campestris subsp. glycines*

Aggravating factors:

-Warm, moist weather (optimum temp. 86-98°)

How disease is spread:

-Overseasons in crop residue on the soil surface, on seeds, and in the rhizosphere of wheat roots and other crops.

-By splashing and windblown rain.

-By cultivation when foliage is wet.

Loss range:

0-15% w/ 1-2% common

Control:

1. Plant only high-quality, pathogen-free seeds.

2. Rotate with corn, sorghum, alfalfa, clovers, or cereals for one year or more.

3. Completely cover the stubble and other plant residue by clean plowing after harvest.

4. Don't cultivate fields when the foliage is wet.

5. Grow well-adapted soybean cultivars recommended for the area.

(RPD : no. 502)

Common name(s):Wildfire bacterium

Scientific name(s): *Pseudomonas syringae subsp. tabaci*

Aggravating factors:

-Warm, moist weather (optimum temp. 75-82°)

How disease is spread:

-Overwinters in infected crop residue and seeds.

-By splashing and windblown rain.

Comments:

-Almost always associated with bacterial pustule.

-There is a halo that distinguishes wildfire from other bacterial diseases in soybeans.

Loss range:

0-15% w/ 1-2% common

Control:

1. Plant only high-quality, pathogen-free seeds.

2. Rotate with corn, sorghum, alfalfa, clovers, or cereals for one year or more.

3. Completely cover the stubble and other plant residue by clean plowing after harvest.

4. Don't cultivate fields when the foliage is wet.

5. Grow well-adapted soybean cultivars recommended for the area.

(RPD : no. 502)

Common name(s):Septoria brown spot

Scientific name(s):*Septoria glycines* (teleomorph: *Mycosphaerella uspenskajae*)

Aggravating factors:

-Warm, wet weather.

How disease is spread:

-Overwinters in diseased crop debris and in diseased seeds.

-Airborne by air currents.

-Rain, and poor drainage.

Comments:

-The spread of disease is checked by hot, dry weather.

Loss range:

8-15% or more

Control:

1. Grow only well-adapted, disease-resistant cultivars.

2. Plant high-quality, certified, disease-free seed.

3. Cleanly plow down all crop residues after harvest.

4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.

5. If warranted, apply an EPA-approved foliar fungicide from late bloom to pod fill.

6. Harvest as soon as the soybeans mature.

(RPD : no. 503)

Common name(s):Downy mildew

Scientific name(s): *Peronospora manshurica*

Aggravating factors:

-High humidity (optimum temp. 68-72°)

How disease is spread:

-Soilborne

Loss range:

up to 8%

Control:

1. Grow only well-adapted, disease-resistant cultivars.

2. Plant high-quality, certified, disease-free seed.

3. Cleanly plow down all crop residues after harvest.

4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.

5. If warranted, apply an EPA-approved foliar fungicide from late bloom to pod fill.
 6. Harvest as soon as the soybeans mature.
- (RPD : no. 503)
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Common name(s): Frog eye leaf spot

Scientific name(s): *Cercospora sojina*

Aggravating factors:

-Warm, humid weather.

How disease is spread:

-Overwinters in crop residue and seed.

-By air currents and splashing rain.

Loss range: as much as 15%

Control:

1. Grow only well-adapted, disease-resistant cultivars.
2. Plant high-quality, certified, disease-free seed.
3. Cleanly plow down all crop residues after harvest.
4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.
6. Harvest as soon as the soybeans mature.

(RPD : no. 503)

Common name(s): Cercospora blight and leaf spot and purple seed stain

Scientific name(s): *Cercospora kikuchii*

Distribution: worldwide

Aggravating factors:

-Warm, humid weather (optimum temp. 73-81°)

How disease is spread:

-Overseasons in diseased leaves, stems, and seeds

-Windborne and rain splashed.

Comments:

-Infects soybean plants at flowering.

-No public soybean varieties are currently recommended for growing in Illinois that are highly resistant.

Control:

1. Grow only well-adapted, disease-resistant cultivars.
2. Plant high-quality, certified, disease-free seed.
3. Cleanly plow down all crop residues after harvest.

4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.
5. If warranted, apply an EPA-approved foliar fungicide from late bloom to pod fill.
6. Harvest as soon as the soybeans mature.

(RPD : no. 503)

Common name(s): Alternaria leaf spot

Scientific name(s): *Alternaria*

Aggravating factors:

-Warm, moist weather late in the growing season.

-By wounding, insect feeding, and frost injury.

How disease is spread:

-Seedborne

Comments:

-Infection increases as harvesting is delayed.

Control:

1. Grow only well-adapted, disease-resistant cultivars.

2. Plant high-quality, certified, disease-free seed.

3. Cleanly plow down all crop residues after harvest.

4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.

5. If warranted, apply an EPA-approved foliar fungicide from late bloom to pod fill.

6. Harvest as soon as the soybeans mature.

(RPD : no. 503)

Common name(s): Anthracnose, leaf and stem spot

Scientific name(s): Caused by two fungi: *Colletotrichum truncatum* and *C.destructivum* (telemorph *Glomerella glycines*)

Aggravating factors:

-Warm, moist weather (below 95°)

How disease is spread:

-Over seasons in diseased crop residue or in infected seeds.

Comments:

-Usually fungi attacks older, mature plants in the late reproductive stages.

Control:

1. Grow only well-adapted, disease-resistant cultivars.
 2. Plant high-quality, certified, disease-free seed.
 3. Cleanly plow down all crop residues after harvest.
 4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.
 5. If warranted, apply an EPA-approved foliar fungicide from late bloom to pod fill.
 6. Harvest as soon as the soybeans mature.
- (RPD : no. 503)
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Common name(s):Phyllosticta leaf spot or leaf blight

Scientific name(s): *Phyllosticta sojicola*

How disease is spread:

-Disease rarely spreads beyond first few leaves.

Comments:

-Minor disease in IL.

Control:

1. Grow only well-adapted, disease-resistant cultivars.
 2. Plant high-quality, certified, disease-free seed.
 3. Cleanly plow down all crop residues after harvest.
 4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.
 5. If warranted, apply an EPA-approved foliar fungicide from late bloom to pod fill.
 6. Harvest as soon as the soybeans mature.
- (RPD : no. 503)
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Common name(s):Powdery mildew

Scientific name(s): *Microsphaera diffusa*

Aggravating factors:

-Warm, dry days and cool, damp nights (optimum temp. 65-76°).

How disease is spread:

-Windborne

Comments:

-Minor disease of soybeans

-Temps. above 86°-check the growth and reproduction of the fungus.

Control:

1. Grow only well-adapted, disease-resistant cultivars.
2. Plant high-quality, certified, disease-free seed.

3. Cleanly plow down all crop residues after harvest.
 4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.
 5. If warranted, apply an EPA-approved foliar fungicide from late bloom to pod fill.
 6. Harvest as soon as the soybeans mature.
- (RPD : no. 503)
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Common name(s):Target spot, root and stem rot

Scientific name(s): *Corynespora cassiicola*

Aggravating factors:

- Wet or very humid weather (above 80% humidity).
- Optimal temp. of soil 59-64°.

How disease is spread:

- Over seasons in infected soybean debris and seeds.

Comments:

- Can survive in fallow soil for more than two years.

Control:

1. Grow only well-adapted, disease-resistant cultivars.
2. Plant high-quality, certified, disease-free seed.
3. Cleanly plow down all crop residues after harvest.
4. Rotate soybeans at least one year or more with sorghum, corn, small grains, alfalfa, or forage grasses.
5. If warranted, apply an EPA-approved foliar fungicide from late bloom to pod fill.
6. Harvest as soon as the soybeans mature.

(RPD : no. 503)

Common name(s):Phytophthora root and stem rot

Scientific name(s): *Phytophthora sojae*

Aggravating factors:

- Reduced tillage.
- Heavy clay soil that is poorly drained.
- Early planting.
- Optimum temp. 75°.

How disease is spread:

- Over seasons in crop debris or soil.
- Soilborne by wind or rain splash.

Comments:

-Fields with heavy residues tend to warm more slowly in the spring and may have higher soil moisture levels.

Control:

1. Grow in well-adapted, high-yielding, resistant or highly tolerant cultivars.
2. Plant in warm soil (65° or more) that is well-drained and fertile.
3. Use a tillage, or tiling to improve drainage and soil water absorption.
4. Apply a seed and/or soil fungicide to fields with known history of disease.

RPD : no. 504

Common name(s):Brown stem rot

Scientific name(s): *Phialophora gregata*

Aggravating factors:

- Cool weather in July-Aug. followed by hot, dry weather.
- Optimum temp. 59-81°.

How disease is spread:

- Seedborne as mycelium within the seed coat.
- Fungus survives in soybean debris and in soil.

Comments:

- Little or no disease develops above 90°.

Loss range: 17-25%

Control:

1. Grow soybeans in the same field only once in 3 or 4 years.
- Rotate with corn, sorghum, small grains, forage grasses, legumes, or other crops.
2. Plant resistant cultivars in fields where brown rot is a severe problem.

(RPD : no. 504)

Common name(s):Pythium root rot, damping-off, seed decay

Scientific name(s): *Pythium*

Aggravating factors:

- Cool weather starts cycle (50-59°)
- High levels of rainfall.
- Poorly drained soil.

How disease is spread:

- Soilborne through soil water. **Loss range:**
- Causes little reduction in yield

Control:

1. Plant high-quality, crack-free seed capable of at least 85% germination in a warm or standard test and 70% in a cold test.
2. Plant in warm soil (above 65°) that is well drained, fertile, and well-prepared.
3. Apply a seed or soil fungicide.
4. Do not carryover seed or seed that has a high percentage of cracked seed coats.
5. Avoid excessive irrigation for the first 10-15 days after planting.

(RPD : no. 504)

Common name(s): Rhizoctonia root and stem rot

Scientific name(s): *Rhizoctonia solani*

Aggravating factors:

- Rainfall followed by cool and then warm, humid weather.
- Optimum temp. 77-85°, occasionally at 59-76°.

How disease is spread:

- Mechanical or hail injury.
- Over seasons on soil and crop debris.

Comments:

- The fungus can also survive many years in the absence of a soybean crop.

Loss range:

- up to 50% reported if stand losses are extensive.
- up to 10% where stunting occurs.

Control:

1. Ridge the soil around the base of plants during contamination.
2. Treat seed with a protecting fungicide.
3. Plant certified, high-quality, crack-free seed capable of at least 85% germination in a warm or standard test and 70% in a cold test.
4. Plant in warm soil (above 65°) that is well-drained, fertile, and well prepared.
5. Do not plant carryover seed or seed that has a high percentage of cracking.
6. Avoid excessive irrigation for the first 10-15 days after planting.
7. Apply only suggested herbicides at recommended rates.

(RPD : no. 504 / 511)

Common name(s): Sudden death syndrome (SDS)

Scientific name(s): *Fusarium solani*

Aggravating factors:

- Cool temps. and rainy weather throughout the early flowering season.
- Midsummer for soybeans with a high yield potential, usually after blooming.
- Through wounds caused by insects, nematodes or mechanical injury.
- Saturated soil.

How disease is spread:

- Soilborne through crop debris.

Comments:

- The disease tends to be most severe on well-managed soybeans with a high yield potential.
- The disease can exist for many years in soil or debris without a host crop.

Loss range: minor-severe

Control:

1. Learn to identify SDS in the field.
 2. Grow well-adapted, high-yielding varieties in warm, well-drained, fertile soil.
 3. Maintain balanced soil fertility based on a soil test.
 4. Control other diseases, weeds, and insects.
 5. Do not save seed from SDS-infected areas.
 6. Extend planting times so that all beans are not at the same growth stage at the same time.
 7. Improve drainage in the field and reduce soil compaction.
 8. Use sanitation guidelines. (e.g. clean tires, combines and other equipment of soil and crop debris.
- (RPD : no. 504 / 511)
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Common name(s): Charcoal rot

Scientific name(s): *Macrophomina phaseolina*

Aggravating factors:

- Hot, dry weather (optimum temp. 82-95°)
- Fertility deficient soils.

How disease is spread:

- Over seasons as sclerotia in dry soils and plant residues.
- Seedborne.

Comments:

- Attacks roots and base portion of plant.

Control:

1. Plant high-quality, certified seed that is disease-free.
2. Plant soybeans at a recommended rate.
3. Fertilize, based on soil test.
4. Rotate with non-host crops (cereals) for 1 or 2 years.
5. Where feasible, irrigate during extended periods of dry, hot weather.
6. Plow down infected crop residue, where erosion is not a problem.

(RPD : no. 504)

Common name(s): Sclerotinia stem rot

Scientific name(s): *Sclerotinia sclerotiorum*

Aggravating factors:

- Poor air circulation. (e.g. near woods)
- Cool, wet weather (optimum temp. 40-59°)

How disease is spread:

- Sclerotia spread soilborne.
- High humidity in the canopy can increase the disease level if irrigated at flowering.

Comments:

- Fungus can survive in the soil for long periods and are highly resistant to most fungicides.

Control:

1. Do not rotate soybeans with garden, snap beans (*Phaseolus* spp), canola or sunflowers.
2. Thoroughly clean contaminated seed lots to screen out some of the sclerotinia.
3. Grow soybean cultivars that do not lodge readily.
4. Avoid planting soybeans in narrow rows.
5. Avoid irrigation at flowering.

(RPD : no. 504)

Common name(s): Stem canker

Scientific name(s): *Diaporthe phaseolorum* var. *caulivora*

Aggravating factors:

- Late July, early August.
- Warm, wet weather (optimum temp. 70°)

How disease is spread:

- Wind-borne and waterborne.
- Over seasons in soybean residue, in soil or in an infected seed.

Comments:

- The fungus is capable of remaining viable up to 14 months at temps. of 4-65°.

Loss range: 20-50%

Control:

1. Plant high-quality, certified seed that is disease-free (and will germinate more than 80-85% in a warm germination test or over 70% in a cold test).
2. Plant thoroughly cleaned seed.
3. Bury infected crop residue after harvest, where soil erosion is not a problem.
4. Where feasible, rotate soybeans for 1 or 2 years with corn, sorghum, small grains, alfalfa, or forage legumes.
5. Make a foliar application of a labeled fungicide.

6. Harvest as soon as the crop is mature.
 7. Maintain adequate potash based on a soil test.
- (RPD : no. 504)
-

Common name(s): Pod and stem blight and phomopsis decay

Scientific name(s): *Diaporthe phaseolorum var. sojae* and *Phomopsis longicolla*

Aggravating factors:

- Wet weather, when harvest is delayed.
- Cool weather (optimum temp. 59-68°).
- Insect injury.

How disease is spread:

- Seedborne.
- Over seasons in residue.

Comments:

- Seed infection is greater in densely populated fields, due to lodging of plants.
- Infected seeds produce low quality oil and flour.

Control:

1. Plant high-quality, certified seed that is disease-free (and will germinate more than 80-85% in a warm germination test or over 70% in a cold test).
 2. Plant thoroughly cleaned seed.
 3. Bury infected crop residue after harvest, where soil erosion is not a problem.
 4. Where feasible, rotate soybeans for 1 or 2 years with corn, sorghum, small grains, alfalfa, or forage legumes.
 5. Make a foliar application of a labeled fungicide.
 6. Harvest as soon as the crop is mature.
 7. Maintain adequate potash based on a soil test.
- (RPD : no. 504)
-

Common name(s): Soybean mosaic (SMV)

Scientific name(s): none

How disease is spread:

- Over seasons in seeds.
- Mechanically.

Comments:

- The incidence of seed transmission values from less than 1% to 30% or more.

Control:

1. Plant virus-free seed.
2. Do not plant seed produced in late season plantings.

3. In seed-producing fields, remove plants suspected of being virus-infected as soon as found.
4. Avoid handling or brushing up against infected plants whenever possible.

(RPD : no. 505)

Common name(s): Bean yellow mosaic (BYMV)

Scientific name(s): none

How disease is spread:

-Mechanically

Comments:

-Has a wide host range.

Control:

-Is not seed-transmitted, so no control is necessary.

(RPD : no. 505)

Common name(s): Bud blight (tobacco ringspot virus (TRSV) and soybean mosaic virus (SMV))

Scientific name(s): none

How disease is spread:

-Weeds are hosts of the virus, therefore spreading from weed to soybean.

Comments:

-Usually appears at the border of a field, advancing inward as the season progresses.

-The virus is spread from soybean to soybean by unknown vectors.

Loss range: 25-100%

Control:

1. Remove infected plants.

2. Grow 4, 6, or 8 rows of corn, forage sorghum, or other tall growing crop as a barrier between soybean, clover or alfalfa fields and between soybeans and non-cultivated areas.

3. Apply 2, 4-D or other herbicide to kill weeds in non-crop areas that adjoin soybean fields before plants emerge or in the fall after the field has been harvested.

(RPD : no. 505)

Common name(s): Soybean seed quality and fungicide seed treatment

Aggravating factors:

-Hot, humid weather.

-During prolonged wet periods from bloom to harvest and when harvest is delayed.

How disease is spread:

-Seedborne.

Comments:

-Proper seed treatment with a fungicide will increase the germination of poor quality seed.

Control:

1. Plant high-quality, certified seed.

A fungicide seed treatment is recommended when:

-Seed is grown for seed production.

-Planting at a reduced seeding rate.

-Germination is delayed because of unfavorable soil or weather conditions.

-Poor quality seed must be used and fungal infection is the reason for poor germination.

(RPD : no. 506)

Common name(s): Soybeans disease management program

Loss range: 5-15% annually (15 different diseases)

Summary:

1. Full season cultivars should be planted as early as possible. Soybean growth habit can affect disease development.
2. Plant high-quality seed. Disease is most damaging to poor quality seed, producing poor quality crop.
3. The use of seed-treatment fungicides to increase germination of poor quality seed is not recommended.
4. Crop rotation and clean tillage can be important practices in controlling diseases.
5. Planting high-quality seed in a warm (60° or more), moist, well-drained, and fertile seedbed at the proper depth and spacing will ensure high-yielding seedlings.
6. Adequate, balanced fertility can be important in reducing disease losses.
7. Scouting and monitoring soybeans is an important practice in long-term disease management.
8. Perform soil analysis.
9. Fungicide seed treatments will generally improve stands regardless of quality. Foliar sprays may increase yields 10-15%, increase seed quality, and reduce disease losses when such fields are planted to soybeans the next year.

(RPD : no. 507)

Weeds

Weeds will be present in every field every year. The severity of populations is determined by local field management conditions such as tillage, crop rotations, and herbicide use. The prevalence of specific weeds throughout the state is dependent upon soil type, rainfall and moisture, temperatures, and day-length for the region. Perennial weeds have become more of a problem as tillage has been reduced. Approximately fifty percent of all fields will report 3 or more weeds present during mid-season scouting⁸. Losses attributed to weeds in soybeans average from 3 to 5 percent annually⁹. The following table indicates the approximate level of severity as estimated by producers from a survey of pest density and severity.

Avg. Crop Loss and % Area Infested

Weed Name	% of Crop Area Infested	Avg. % Crop Loss
Barnyardgrass	30	0.1
Black nightshade	30	0.4
Canada thistle	7	
Common cocklebur	90	0.3
Common lambsquarters	90	0.6
Common milkweed	32	
Common ragweed	90	0.3
Crabgrass	60	0.2
Fall panicum	60	0.3
Giant foxtail	95	0.8
Giant ragweed	90	0.6
Hedge bindweed	3	
Hemp dogbane	37	
Jimsonweed	80	0.1
Johnsongrass	30	0.2
Pigweed spp.	90	0.6
Quackgrass	40	0.1
Smartweed	60	0.3
Shattercane	40	0.1
Tall morningglory	70	0.7

Velvetleaf	90	0.4
Wirestem muhly	10	0.1
Woolly cupgrass	5	
Yellow nutsedge	80	0.1

Herbicides applied to Illinois soybeans, 1997⁽⁴⁾

Active Ingredient	Acreage Treated (%)	Avg Rate (Lbs/acre)	Pounds Applied ('000)
Imazethapyr	47	0.06	184
Pendimethalin	31	1.15	3,760
Glyphosate	22	0.65	1,416
Trifluralin	16	0.95	1,556
Chlorimuron-ethyl	15	0.02	31
Imazaquin	15	0.08	112
Bentazon	14	0.72	931
Metribuzin	13	0.19	240
Sethoxydim	11	0.19	204
Acifluorfen	10	0.13	139
Thifensulfuron	10	0.002	2
2,4-D	9	0.40	350
Fomesafen	8	0.23	180
Clethodim	5	0.09	47
Fluazifop-P-butyl	4	0.05	19
Lactofen	4	0.10	40
Metolachlor	4	1.74	891
Clomazone	3	0.73	219
Fenoxypop	3	0.73	35
Flumetsulam	2	0.07	12
Flumiclorac Pentyl	2	0.04	6
Quizalofop-ethyl	1	0.05	7

Within the past few years, chloramben, dinoseb, and oxyfluorfen have lost product registrations for weed control in soybeans. While actual losses of registrations have been few, restrictions placed on many herbicides have increased. Alachlor, paraquat, and isoxaflutole are all restricted-use pesticides. They may be purchased and applied only by or under the direction of certified, licensed applicators. Groundwater advisories have been added to many labels to prevent mixing, loading, and application in areas of high risk for runoff or leaching. It is likely that additional restrictions will be imposed on individual products, to limit not only water contamination, but also drift, wildlife exposure, and residues in foods.

A number of new products have been registered for weed control for soybeans. These products expand the spectrum of weeds controlled and the window for applications. Unfortunately, many of these new products have the ALS inhibition mode of action and, as mentioned above, significantly increase the potential for development of resistant weeds.

Herbicide Rates, MOA, REI, PHI, and Primary Targets

Trade name	Component ingredients		Product rate		Unit	MOA*	REI	PHI	Primary
	active a	active b	Low	Hi					
Authority STS	sulfentrazone		6.8	6.8	oz prod	c/a	12		BL/Grass
Axiom 68DF	FOE5043	metribuzin	7	13	oz prod	s	12		Grass
Canopy	chlorimuron	metribuzin	4	7	oz prod	a/P	12	60	BL
CanopyXL Authority BL	chlorimuron	sulfentrazone	5.1	7.9	oz prod	a/c	12		BL/Grass
Command 3ME	clomazone		2	2.7	pt	b	12	65	Grass
Dual II Mag	metolachlor		1	2	pt	s	12	30	Grass
FirstRate	cloransulam		.6	.8	oz prod	a	12	65	Grass
Frontier	dimethenamid		1	2	pt	s	12	40	Grass

Lorox	linuron		.8	3	# prod	P	24		BL
Sencor/ Lexone	metribuzin		.3	.7	# prod	P	12	60	BL
Prowl	pendimethalin		1.5	3.6	pt	m	12		Grass
Pursuit	imazethapyr		4	4	fl oz	a	12	85	BL/Grass
Python	flumetsulam		1	1.3	oz prod	a	12	85	BL
Scepter 70DG	imazaquin		2.8	2.8	oz prod	a	12	90	BL
Sonalan	ethalfluralin		1.5	3	pt	m	12	90	Grass
Trifluralin	trifluralin		1	2	pt	m	12	90	Grass
Assure II/ Matador	quizalofop		7	9	fl oz	l	12	80	Grass
Basagran	bentazon		1	2	pt	p	12	30	BL
Blazer	acifluorfen		0.5	1.5	pt	c	48	50	BL
Classic/ Skirmish	chlorimuron		0.5	0.75	oz prod	a	12	60	BL
Cobra	lactofen		4	12	fl oz	c	12	45	BL
FirstRate	cloransulam		0.3	0.3	oz prod	a	12	65	Grass
Flexstar	fomesafen		1	1.3	pt	c	24	preblo	BL
Fusilade	fluazifop		6	6	fl oz	l	12	preblo	Grass
Fusion	fenoxaprop	fluazifop	6	10	fl oz	l	24	preblo	Grass
Galaxy	acifluorfen	bentazon	2	3	pt	c/p	48	50	BL
Liberty	glufosinate		16	28	fl oz	r	4	12	BL/Grass
Pinnacle	thifensulfuron		0.25	0.25	oz prod	a	12	60	BL
Poast Plus/ Prestige	sethoxydim		1.5	1.5	pt	l	12	75	Grass
Pursuit 2S	imazethapyr		4	4	fl oz	a	12	85	BL
Raptor	imazamox		4	5	fl oz	a	4	85	BL
Reflex	fomseafen		1	1.5	pt	c	24	preblo	BL
Resource	flumaclorac		4	12	fl oz	c	12	60	BL

Roundup Ultra	glyphosate		1.5	3	pt	r	4	14	BL/Grass
Scepter 70DG	imazaquin		1.4	1.4	oz prod	a	12	90	BL
Select	clethodim		4	6	fl oz	l	12	60	Grass
Stellar	flumaclorac	lactofen	5	7	fl oz	c	12	60	BL
Storm	acifluorfen	bentazon	1.5	1.5	pt	c/p	48	50	BL
Synchrony	chlorimuron	thifensulfuron	0.5	0.5	oz prod	a	12	60	BL

*Mode of Action codes: a=ALS inhibition, c=contact action, r=amino acid synthesis, l=meristem (lipid) inhibition, p=photosynthetic inhibitor (non-mobile in plant), s=shoot inhibition, b=bleaching herbicide, P=photosynthetic inhibitor (mobile in plant), m=mitosis inhibitor.

For more information on herbicide modes of action see: <http://ext.agn.uiuc.edu/CropProfiles/herbMOA.htm>

Weed Resistance

Weed resistance to herbicides is now recognized as a major threat to soybean production. Weed species resistant to herbicides in the upper Midwest now include common lambsquarters, giant foxtails, kochia, and redroot pigweed. The herbicides that have resulted in the development of resistant weeds include the triazines, sethoxydim, and the imidazolinone and sulfonyleurea chemistries. The potential for resistance development seems greatest for herbicides with systemic modes of action and long half-life. The likelihood of resistance also increases if the herbicide is used at high rates or repeatedly in the same field.

The use of imidazolinone and sulfonyleurea herbicides, which have the ALS inhibition mode of action, has raised concerns about the development of new resistant weeds. These herbicides have been well received by farmers and their use continues to expand on both corn and soybean crops. Because of a broad-spectrum of weed control and their use on both corn and soybeans in rotation, the potential for development of resistance to this compound class is high. If herbicides with alternative modes of action are not available the risk rises significantly. After populations of resistant weeds develop, only expensive or environmentally unsound remedies may remain.

Velvetleaf (*Abutilon theophrasti*)

Velvetleaf is most damaging in the Northern and Central parts of the state. Velvetleaf is a serious competitor for moisture in drought conditions. Cultivation can somewhat control velvetleaf when used in the early season.

Foxtail spp. (*Setaria spp.*)

The three species of foxtails in Illinois are giant foxtail (*Setaria faberi*), green foxtail (*S. viridis*) and yellow foxtail (*S. glauca*). Giant foxtail is the most competitive of the three species. Foxtails are considered the most important weeds species in Illinois. One plant may produce several heads with 500-1000 seeds per head that can germinate in one to several years after production. These plants are adapted to most Illinois conditions, tend to grow in clumps that compete with crops and make cultivation and plowing difficult. All foxtails most serious in reduced and no-till fields.

Common Milkweed (*Asclepias syriaca L.*)

This perennial weed reproduces by seeds and adventitious buds that sprout from underground roots. Seedlings produce vegetative buds 18-21 days after germination, and seeds may remain viable for up to three days. Seeds may germinate from as deep as 2 inches in the soil, and undisturbed fields or fields with reduced tillage and moist soils are favored. Problems with common milkweed has been increasing due to the decrease in tillage and row cultivation.

Hemp dogbane (*Apocynum cannabinum*)

This perennial weed is capable of regrowth within six weeks of emergence. The underground root system may extend laterally 20 feet per year and downward as far as 14 feet. The northwest quarter of the state is usually most severely infested with dogbane. Tillage can reduce dogbane infestations, but is ineffective once populations are established.

Common Lambsquarters (*Chenopodium album*)

Common lambsquarters produce numerous small seeds with germinate after an overwintering process. Optimal temperature for germination is 70F, but can germinate between 40 to 94, which suggests early germination capabilities. Survival is favored by rains which dilute or leach herbicides from the soil surface.

Yellow nutsedge (*Cyperus esculentus*)

Yellow nutsedge causes the most severe perennial weed infestations and is quite serious across Illinois. It reproduces from tubers as the seed does not survive overwintering, and tubers can adapt to almost any soil type and conditions. Tubers germinate at up to 12 inches of soil and remains viable for up to three years in soil. Severe infestations can occur in various parts of the state.

Smartweeds (*Polygonum spp.*)

This summer annual grows best on wet soils and is widely distributed across Illinois. Smartweed emerges early in the spring and can be a severe problem if tillage is delayed to wet soils, as seedbed preparation may result in transplanting larger plants rather than destroying them.

Giant Ragweed (*Ambrosia trifida*)

Wet weather favors giant ragweed, and this summer annual may be a severe problem in isolated fields. The seeds of giant ragweed may remain viable in the soil for several years. Small seedlings can be controlled with row cultivation and tillage.

Common Cocklebur (*Xanthium pennsylvanicum*)

Cocklebur seeds are spread by attaching to animal fur or tillage or harvesting equipment. Cocklebur is a serious competitor for moisture. Cultivation and tillage will help control cocklebur.

Pigweeds (*Amaranthus spp.*)

Pigweeds are prolific seed producers, and one female can produce over 100,000 seeds in one growing season. The seeds of this plant may remain viable for years. Pigweeds are a problem in no-till systems because undisturbed soils favor germination of the minuscule seeds, and the debris keeps the field moist and allows for extended germination. Other favorable germination locations are where excess nitrogen is available, and where no soil applied herbicides have been used. Localized populations of some biotypes of pigweed have shown triazine or acetolactate synthase (ALS)-inhibitor resistance.

Canada thistle (*Cirsium arvense*)

Canada thistle is a perennial weed with a vigorous, rhizomatous root system. Propagation is by rootstock and seeds; only female plants produce seed. Canada thistle is listed as a noxious weed in Illinois, and is most severe in the northern counties of Illinois. Preplant tillage and row cultivation can control small seedlings but are less effective in controlling plants arising from rootstocks.

Morningglories (*Ipomoea spp.*)

Tall morningglory and ivyleaf morningglory are the two major annual morningglory species found on Illinois soils. The seeds of these summer annuals may survive for several years in soil. Infestations are most common in moist soils along river bottomland, but these plants can be found most anywhere in the state. Annual morningglories adapt to crops by vining about the crop, so shading by the canopy is not particularly successful in reducing growth. Newly emerged seedlings can be controlled by tillage and cultivation, but this may result in conditions that favor emergence by weeds deeper in the soil profile. After vines begin to twine about the stems of the crop, cultivation may not be as effective.

Eastern Black Nightshade (*Solanum ptycanthum*)

This summer annual can produce thousands of berries; each berry contains up to 50 seeds. While nightshade is generally not considered a serious pest in Illinois, severe infestations in individual fields do occur. Tillage and row cultivation are effective for early, newly emerged seedlings. The weed is particularly damaging to soybeans because the sticky juice of the berries can plug harvesting equipment and result in dockage at the elevator.

Quackgrass (*Elytrigia repens*)

Quackgrass is a cool season perennial that reproduces by rhizomes, and to a lesser amount by seeds. New plants sprout at axillary buds, and rhizomes may remain viable for years. Quackgrass is most often a problem in the northern part of the state. Tillage can be an effective control.

Common Ragweed (*Ambrosia artemisiifolia*)

Common ragweed is a summer annual that is favored by moist soils and can be a serious problem in individual fields. Control of common ragweed with tillage or row cultivation is effective in controlling

small seedlings.

Jimsonweed (*Datura stramonium*)

Jimsonweed produces several hundred hard-coated seeds per plant which may remain viable in the soil for years. This summer annual grows best under warm temperatures and moist soils. Jimsonweed infestations harm soybean crops via competition for water, especially in dry years. The shade of its leaves in shorter crops increases yield loss due to decreased nutrient uptake. Jimsonweed also contains the alkaloids, atropine, hyoscyamine, and hyoscyne, which are toxic. Even small amounts of jimsonweed can cause harvest problems.

Barnyardgrass (*Echinochloa crusgalli*)

This summer annual germinates from 0 to 5 inches deep in the soil. The seeds remain viable for several years, and plants may emerge throughout the summer. Barnyardgrass is most troublesome in low, moist, warm areas.

Crabgrass spp. (*Digitaria spp.*)

A warm season grass most often troublesome in the southern and southeastern part of the state. The plants generate stolons and may result in a severe infestation from a single plant. May be most severe during the late part of the growing season after herbicides have degraded or and holes remain in the canopy. Tillage and row cultivation also helps with control.

Johnsongrass (*Sorghum halepense*)

Johnsongrass is a perennial noxious weed in Illinois and produces prolifically via rootstock and seeds. Rhizomes overwinter; both rhizomes and seeds sprout in the spring. Seeds may survive for several years before germination.

Wirestem muhly (*Muhlenbergia frondosa*)

This perennial grass reproduces from rhizomes; it tillers profusely and flowers in August and September. The northwest quarter of the state is most often infested with wirestem muhly.

Fall Panicum (*Panicum dichotomiflorum*)

Fall panicum is a summer annual that grows best in warm, wet, fertile soils. The plant tillers profusely and in late August and September the tillers open and scatter hard-coated seeds. These seeds may remain viable for years, and fall panicum is most often a problem in reduced or no-till fields whose undisturbed soils are favorable for germination.

Herbicides

Although the weed species present in each field do affect herbicide selection, other less obvious factors also have significant impact. For instance, no-till and conservation tillage practices are more prevalent in areas where rolling terrain and abundant rainfall prevails. Where no-till and conservation tillage

practices are used there is a greater reliance on persistent herbicides that have burndown characteristics and do not need mechanical incorporation.

Farm size also may affect herbicide selection. In Illinois, large open spaces encourage the amalgamation of farmland, the use of large farm equipment, and a higher percentage of farm operation by non-owners (70% of farms in Illinois are operated by someone other than the owner). As a result, operators strive for weed-free fields, with the intent of maintaining their lease by exceeding the expectations of the landlord. In addition, open spaces, straight rows, and numerous access roads put each field on public display. Weeds are hard to hide when you look down between the rows for nearly one-half mile. As a result, the expectations for weed-free fields tend to be high, and farmers are inclined to spend more for weed control.

Because their fields are on public display, operators are also less tolerant of crop injury. A stunted or injured crop is an embarrassment to the farmer, and farmers make concerted efforts to avoid cosmetic injury even though yield effects may be minimal. In addition, large fields exacerbate concerns about drift injury. For example, a farmer with an 80-acre corn field would not want to risk injuring his neighbor's adjacent soybeans by applying 2,4-D or dicamba to his corn. Where fields are smaller and farther apart the concern about drift injury is greatly reduced. Another factor having a significant impact on herbicide selection is regional preferences for specific products. Farmers' perceptions of new products often arise from performance complaints and crop injury claims from other local producers. Unfavorable weather in an area in the first or second year after product introduction can greatly reduce herbicide efficacy and slow the acceptance of the product to a near standstill. Concerns about crop injury and carryover injury are also factors that affect product preference. Carryover injury on corn from imazaquin and clomazone in 1989, and the resultant poor acceptance of the products thereafter, are prime examples of how dry, cool and windy weather can affect the acceptance of new products.

Regional product preferences are also based on the manufacturer's marketing and promotional efforts. Newly introduced products that carry guarantees capture market shares quickly. Products that carry more complete guarantees tend to be favored. The availability of marketing and sales personnel for a specific product or set of products also greatly affects a farmer's choice.

Exposure to herbicides

Little is known about actual exposure of applicators to soybean herbicides. Of the citations reviewed, none detailed either a survey of current safety practices or actual exposure to workers who mix, load or apply herbicides with modern self-propelled equipment such as is found on large farms in the Midwest. Most citations pertained to pesticide residues in food or as environmental contaminants.

Approximately 45% of all herbicides are applied by custom applicators with sophisticated equipment bearing air filtration systems. The remaining applications are applied by farmers with a wide range of equipment types. Larger pieces of equipment, such as those used to apply and incorporate preemergence

herbicides, typically have a cab and air filtration system. However, for postemergence and spot applications, smaller vehicles that have exposed operators may be used. The frequency with which small vehicles are used is unknown. Other factors affecting operator exposure include: distance between the spray boom and the operator, prevailing weather conditions, protective clothing worn by applicators, and the prevalence of vapors and dispersed spray droplets. To date these factors have not been quantified.

Applications of granular or dry formulations of herbicides are used on about 300,000 acres of soybeans annually. Although the number of dry formulations available has increased in recent years, most new dry formulations are water-dispersible granules that have reduced dust inhalation risk. Dry formulation packaging has also reduced container disposal problems.

Exposure of either farmers or custom applicators during mixing and loading has not been well researched. We can speculate that the increase in use of pesticides that are available in highly concentrated dry formulations has great potential for reducing such exposure.

In 1997, 11,136,000 pounds of herbicide were applied to the soybean crop, and of the 10,000,000 acres planted in Illinois, 98% of them received at least one herbicide application. The average rate of herbicide use was 1.1 lb per acre.

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