

Crop Profile for Spinach in Delaware

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Production Facts

- In 2002, 49,859 acres of spinach were harvested in the United States. Of this, 13,984 were grown for processing (1).
- The value of national production in 1996 and 1997 (the last year NASS reported figures) was \$48,029,000 and \$58,682,000, respectively (2).
- In 2002, 675 acres of spinach were planted and harvested in Delaware (3).
- The cash farm income to spinach producers in Delaware in the years 1995 to 1997 (the last year NASS reported figures) was \$1,260,000, \$253,000, and \$288,000 respectively (2).

Production Regions

Most spinach in the state is grown in Sussex County.

Cultural Practices

Spinach (*Spinacia oleracea*) is a crop that is grown in Delaware for fresh-market and processing use. It is a low-growing, fleshy-leafed annual that forms a heavy rosette of broad, crinkly, tender leaves. Spinach is classified as a very hardy cool-season crop. It grows best at a mean temperature of 50 to 60 degrees Fahrenheit. It does not germinate well in hot weather, and if planted in the late spring when hot weather is approaching, the plant will quickly throw up a flower stalk and go to seed after the development of only a few leaves.

Spinach for processing in Delaware can be planted for three different harvest periods—spring, fall, and overwinter spinach. Spinach for processing can be planted in narrow rows, ranging from 10 inches to 12 inches apart. This is often a function of the harvesting equipment and the width of the cutter on the harvester. It is usually planted in 6- to 8-row beds. Final stands should be 7 to 8 plants per foot, although 10 plants per foot is acceptable. Thinner populations will enhance control of foliar diseases because of better air circulation. The plants will also be thicker and blockier.

Spinach responds to lime. It is important to keep pH at 6.5 to 6.8. At a medium soil test level, 150 lbs./acre is required for both phosphorus and potassium.

While many nitrogen recommendations call for 125-150 lbs. of actual nitrogen, extensive grower experience indicates that as much as 200 lbs. is necessary for yield, color, and quality. This should be divided so that 1/2 is applied broadcast before planting, 1/4 spun on or sidedressed, and the remaining 1/4 applied in a final application that is either spun on or sidedressed. It is usually applied after each cutting.

Ammonium nitrate is the preferred nitrogen source because it does not drive down the pH as quickly as ammonium sulfate. To avoid burning foliage, it is critical to make topdressed applications when the spinach plants are dry. Good quality granules of ammonium nitrate should also be used to avoid burning of the foliage from dust that can concentrate right behind the opening of the fertilizer applicator.

Soil compaction is a major problem in spinach production. One cause is irrigation using large droplets and a high application rate. To avoid this situation it is advisable to use smaller droplet size with a lower application rate. Heavy equipment and multiple harvest in the spring and fall when the soil is wet are also causes of soil compaction. A number of practices can reduce the impacts of soil compaction. To minimize soil compaction:

1. Select well drained fields
2. Practice crop rotation, with summer cover crops, alfalfa and winter small grains
3. Use the lightest equipment that will do the job
4. Avoid field work when the soil is wet
5. Subsoil before and after spinach production, especially headland areas. Subsoil when soil is dry
6. Use on-land plows in combination with subsoiling
7. Use dual tires, large tread area, low tire pressures

Worker Activities and Timing (4)

Seeding – Spring: March 12 to April 20; Fall: August 10 to August 31; overwinter: October 1 to 15.

Cultivation/ weed control – Weed control is accomplished primarily through use of herbicides. Shallow cultivation may also be done (5).

Harvest – Spring: May 20 to June 7; Fall: September 25 to October 10; Overwinter: the next spring. Almost all spinach is harvested mechanically (5).

Insects

In the Mid-Atlantic Region, there are several insect pests known to attack spinach including seed corn maggot, spinach flea beetle, green peach aphid,

leafminers, beet armyworm, garden webworm and grasshoppers. All of these pests can attack both fresh market and processing spinach.

Seed Corn Maggot

This insect can be a problem in overwintered-, spring-, and fall-planted spinach. In the spring crop, it is primarily a problem during cool, wet growing seasons. Only a few maggots per seed or plant can significantly reduce stands. Maggots overwinter as puparium in the soil with flies emerging as early as late February. Eggs are laid in freshly plowed fields as well as at the base of overwintered spinach plants. Outbreaks are favored by planting into freshly plowed ground that is high in organic matter; freshly manured fields; and/or heavy crop residues (e.g. small grain covers) where tillage is delayed and/or surface residue is visible after tillage operations.

Monitoring: 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 Available

Cultural: The use of cultural management practices before planting is critical 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: No seed treatments are available for seed corn maggot control in spinach. Diazinon is labeled as a broadcast application before planting for cutworms and wireworms but does not have seed corn maggot on the label.

Spinach Flea Beetle

This insect eats small holes in spinach leaves resulting in reduced market value. Unlike other flea beetles, larvae can also cause leaf-feeding damage by skeletonizing the undersides of the leaves. When disturbed, larvae and adults drop to the ground and play dead.

Monitoring: Monitor newly emerged plants two to three times per week for adults and larval damage including pitting or irregularly shaped holes. Pay particular attention to outside rows. Although no thresholds are available, spot treatment of outside rows may be needed if damage increases at each sampling date.

Controls:

Biological: None

Cultural: None

Chemical:

- Sevin 80S - 0.67 - 1.25 lb/acre; One application per season.

Green Peach Aphid

This insect is known to infest a wide variety of crops, including spinach. Adults overwinter on cultivated greens and weeds. Eggs overwinter on fruit trees such as peach, plum, and cherries. In the Mid-Atlantic region, multiple generations occur throughout the season with peak populations occurring in May through June and again in mid-September through October. Aphids remove sap from the undersides of the leaves, resulting in curled leaves and stunted plants. In addition to damaging plants, they can vector viruses, including lettuce and spinach mosaic. Aphids as well as beneficial insects can be considered contamination problems in spinach grown for processing, resulting in rejection of an entire crop.

Monitoring: Begin sampling for aphids in the spring by checking the undersurface of leaves on 5 to 10 plants in 10 locations throughout the field. Apply treatments if you find one aphid per plant on seedling plants or 4-10 aphids per plant on established plants. When making a treatment decision, take into consideration beneficial insects such as ladybeetles, syrphid fly larvae, and lacewings.

Controls:

Biological: Although biological controls may eventually help to reduce populations, they often do not occur soon enough to prevent contamination problems in a fresh market or processing crop. Diseased or parasitized aphids will turn brown and remain stuck to leaves, resulting in potential quality problems.

Cultural: None

Chemical:

- Admire Pro--4.4-10.5 fl oz 4.6F/A
- imidacloprid (Admire; generics available)--10-24 fl oz 2FS/A
- Assail--2-4 oz 30SG/A
- Fulfill--2.75 oz 50 W/A
- imidacloprid (foliar-Provado; generics available)--3.75 fl oz 1.6FS/A

- Venom--5-6 oz(soil); 1-3 oz(foliar) 70SG

Spinach and Vegetable Leafminers

These insects emerge from April through May depositing eggs on the undersides of leaves. Initially, larvae produce light-colored, irregularly winding mines. As the maggots increase in size, the mine widens at one end to form an irregular blotch. Severe infestations cause the foliage to turn brown or white. Infested spinach becomes unmarketable. Four to five generations can occur each year; however, the first generation causes the most damage.

Monitoring: As soon as plants emerge, fields should be sampled on a weekly basis for the presence of mines and larvae. Randomly examine 10 plants in 10 locations for larval damage. Treatment is recommended if 50% of the plants have eggs or mines or you find 1 or more mines per leaf. As you approach harvest, the treatment threshold increases to 4% of leaves with mines.

Controls:

Biological: None

Cultural: None

Chemical:

- Entrust--2.0-3.0 oz 80W/A
- permethrin--4-8 fl oz 3.2EC/A
- SpinTor--6-10 fl oz 2SC/A
- Trigard--0.167 lb 75WSP (one packet)/A
- Venom--5-6 oz(soil); 1-3 oz(foliar) 70SG/A

Beet Armyworm

This insect is a migratory pest arriving in the Mid-Atlantic region in mid-July and is generally a problem in fall plantings. Female moths lay their eggs in the hearts of the plants, with larvae feeding on the buds and terminal growth of the plants. In spinach, webbing may be produced on the leaf surface but should not be confused with garden webworm, which generally feeds in the heart of the plant. Feeding damage generally peaks in late August to early September.

Monitoring: Fields should be sampled twice a week to determine the number of larvae per plant. Randomly sample 10 plants in 10 locations throughout a field. A treatment is recommended on seedling plants if you find one larva per 10 plants. On established plants, the treatment threshold is one larvae per 2 plants.

Controls:

Biological: None

Cultural: None

Chemical:

- Confirm--8 fl oz 2F/A
- Entrust--1.2-2.5 oz 80W/A
- Intrepid--4-8 fl oz 2F/A (early season) 8-10 fl oz 2F/A (late season)
- Lannate-- 3 pt LV/A **Note.** Continuous use of Lannate may result in leafminer outbreaks. Do not apply Lannate when minimum daily temperature is 32oF (0oC) or lower. DO NOT apply to spinach seedlings less than 3 inches in diameter
- Larvin--24-30 oz 3.2F/A
- Proclaim--2.4-4.8 oz 5SG/A
- SpinTor--4-8 fl oz 2SC/A

Garden Webworm

Overwintering moths begin laying eggs in fall planted spinach soon after plant emergence in mid-August. Larvae immediately move into the growing point ("heart") of the plants resulting in stunted plants and distorted plant growth. As their name implies, webworms quickly produce silk often tying all of the "heart" leaves together.

Monitoring: Examine 10 plants in 10 locations and look for infested leaves and buds on small plants. Treatment should be applied when 5% of the plants are infested with small larvae. Controls must be applied before larvae are found deep in the growing point and before significant amounts of webbing are produced.

Controls:

Biological: None

Cultural: None

Chemical:

Sprays must be applied before webbing occurs.

- *Bacillus thuringiensis*
- Confirm--8 fl oz 2E/A
- Intrepid--4-8 fl oz 2F/A (early season) 8-10 fl oz 2F/A (late season)

Grasshoppers

Grasshoppers are primarily a problem with processing spinach grown in the fall. Although grasshoppers do not cause feeding damage on the leaves, they are a major contamination problem during harvest of fall spinach. Grasshoppers are a major problem especially when spinach is harvested at night or in cold weather (which it usually is) because the grasshoppers hold on and won't shake off. In the fall, spinach is often the only green crop left and it can get full of grasshoppers in a bad year. Movement from surrounding grassy areas and soybeans can result in high population levels.

Monitoring: No precise sampling methods or treatment thresholds have been developed for grasshoppers in spinach. In fall planted spinach, fields should be watched within a month from harvest for movement of grasshoppers into the main field. Early controls can help to reduce the problem at harvest. In addition, treatment around field edges to reduce movement into the main field has helped reduce the problem. Unfortunately, even with the use of these methods contamination problems often still occur.

Controls:

Biological: None

Cultural: None

Chemicals: Sevin is the only material labeled for grasshopper control in spinach; however, it has a 14-day wait until harvest. Since the problem occurs right before harvest, the use of Sevin is not a practical control option.

Table. Spinach insecticides REI, PHI, % of crop treated.

Insecticide	REI (hours)	PHI (days)	% of spinach treated
acetamiprid (Assail)	12	7	0%
<i>Bacillus thuringiensis</i>	4	0	5%
tebufenozide (Confirm)	4	7	10%
pymetrozine (Fulfill)	12	0	5%
imidacloprid (Admire/Provado)	12	21/ 7	20%- Provado 0% - Admire
methoxyfenozide (Intrepid)	12	1	30%
methomyl	48	7	5%

(Lannate)			
thiodicarb (Larvin)	48	14	<2%
permethrin	12	1	10%
emamectin (Proclaim)	48	14	< 2%
carbaryl (Sevin)	12	14	<2%
spinosad (SpinTor; Entrust)	4	1	30% - Spintor <1% - Entrust
cyromazine (Trigard)	12	7	<1%
dinotefuran (Venom (soil/foliar)	12	21/ 7	0% - new label in 2006

Diseases

Seed Treatment

Use seed treated with Maxim 4FS (0.08-0.16 fl oz/100 lb. seed) for Rhizoctonia and Fusarium control and Apron XL LS (0.16-0.64 fl oz./100 lb. seed) for Pythium control.

White Rust

White rust is the most common and economically damaging disease in Delaware spinach. Losses are due primarily to reduction in quality and increased costs resulting from increased sorting time, and rejection of loads when the level of white rust is too high. Processing spinach has specific threshold levels of disease, when a load exceeds the threshold the entire load will be rejected.

Crop rotation is used on most of the spinach acreage in the U.S.; however, rotation alone is not adequate to control white rust. Recently cultivars that have moderate levels of resistance to white rust, and with fair agronomic characteristics, have been developed. A cultivar with moderate resistance to white rust (Vancouver) is now grown on 30% of processing acreage in region, and other moderately resistant cultivars are currently in University trials. In addition, fungicide applications are necessary on moderately resistant cultivars to limit the incidence of white rust lesions that reduce leaf quality. Despite widespread crop rotation and limited use of host resistance, fungicide usage is very high on spinach in order to control white rust. Azoxystrobin (Quadris), copper, mfenoxam (Ultra Flourish) and fosetyl-aluminum (Aliette) are used to control foliar diseases on U.S. acreage. Despite high fungicide usage, losses due to white rust persist due to lack of information on pathogen detection, prediction and timing of initial fungicide applications. In addition, copper fungicides and acibenzolar-S-methyl have caused phytotoxicity in some environments.

White rust appears as a small yellowish spot on the upper surface of the

leaves. As these lesions develop, glassy white pustules form which eventually release spores. Tissue next to pustules may turn brown. An entire leaf may become infected and die. Ideal conditions for disease spread are cool nights with heavy dew alternating with warm, dry, sunny days. This disease is the most troublesome for processing spinach in the region. It is the most abundant in the spring and fall crops. Twenty-five to seventy-five per-cent of acreage is treated. Fall spinach is almost always treated. Spring spinach is usually treated. Moderately resistant cultivars are available, however the leaf type is not as desirable as the leaf type of the sensitive cultivars.

Threshold

Random sample weekly 10 plants in 10 locations looking for white blister-like pustules on underside of leaves. Threshold is “presence” within the area.

Chemical Control:

The use of mefenoxam at planting for damping-off control will provide early season control. Beginning 2 to 3 weeks after emergence (prior to symptom development), apply the following on a 7- to 10-day schedule (do not use if temperature is 90oF [32.2oC] or above).

- Actigard--0.75 oz 50WG/A
- azoxystrobin (Quadris--6.2-15.4 fl oz 2.08F/A or Amistar--2- 5 oz 80WDG/A.
- Cabrio—8-12 oz 20EG/A
- Aliette--3 lb 80WDG/A
- Fixed copper
- Ridomil Gold Copper--2.5 lb 70WP/A (14-day schedule)

FRAC group 11 fungicides, Quadris, Amistar and Cabrio should not be applied more than twice before switching to a fungicide with a different mode of action.

Leaf Spots

Leaf spots are primary pests. Cercospora leaf spot and Cladosporium have been encountered on overwintered spinach as minor problems but Cladosporium can be a primary pest in some circumstances. Anthracnose is probably the major leaf spotting disease-afflicting spinach. Initial symptoms are small, water-soaked areas on both old and young leaves. These areas develop into yellow or necrotic lesions. The older lesions are tan and appear papery. Eventually lesions may coalesce causing the leaf to be wilted. Anthracnose is also a secondary infection often infecting leaves with other diseases, especially white rust. Wet conditions, dense plantings, poor air circulation, and low soil fertility favor the disease. The disease is favored by long periods of 90-100% relative humidity, night time leaf wetting & temperature of 77-86oF. Controls should be applied when the disease is first noticed.

Threshold

Random sample weekly 10 plants in 10 locations. Threshold is “presence” or

favorable weather conditions.

Chemical Control

- azoxystrobin (Quadris--6.2-15.4 fl oz 2.08F/A)
- Amistar--2-5 oz 80WDG/A)
- Cabrio--12-16 oz 20EG/A

FRAC group 11 fungicides, Quadris, Amistar and Cabrio should not be applied more than twice before switching to a fungicide with a different mode of action.

Damping off

Seedling damping off, a primary pest of spinach, is caused by soil-borne fungi and is the most serious in the fall planted crop. After germination, the seedling becomes infected, withers and dies.

Chemical Control

Apply the following preplant incorporated or as a soil surface spray after planting:

- mefenoxam--1-2 pt Ridomil Gold 4E/A
- 2-4 pt Ultra Flourish 2E/A

Downy mildew (blue mold)

Downy mildew is not common in Delaware, possibly due to the use of fungicides and resistant cultivars. Predominant cultivars grown have resistance to several races of *Peronospora farinose*. The varieties Seven R, Vancouver, Melody, Tyee, Olympia, Samish, Vienna, Marathon, and Kent have some resistance to specific races of downy mildew. Because new races could occur, this disease has the potential to result in significant yield loss. Fungicides used for white rust management, such as mefenoxam Ridomil, copper and axoxystrobin have some efficacy on downy mildew. Ninety per-cent of spinach acreage is treated with Ridomil Gold or Ultra Flourish.

Downy mildew is the most troublesome in cool, wet weather (temperatures of 2 to 25 degrees C), which are frequently the conditions experienced in this region in fall, winter and spring. Under ideal conditions the disease can spread rapidly and significant yield loss can result. Lesions occur primarily on the undersurface of leaves and when sporangia develop they have a bluish hue, giving rise to the name blue mold. There are several races of the disease, which makes it more difficult for selecting disease resistance varieties.

Threshold

Begin scouting weekly after emergence. Random sample 10 plants in 10 locations. Threshold is "presence." Downy mildew is not a problem when temperatures exceed 90oF.

Cultural Control

Rotate away from spinach for at least 2 years. Use resistant varieties where

possible. Do not plant spring crop near overwintered fields.

Chemical Control

The use of mefenoxam at planting for damping-off control will provide early season control. Beginning 2 to 3 weeks after emergence (prior to symptom development), apply the following on a 7- to 10-day schedule (do not use if temperature is 90oF [32.2oC] or above). Fungicides containing copper may cause some phytotoxicity.

- Actigard--0.75 oz 50WG/A
- azoxystrobin (Quadris--6.2-15.4 fl oz 2.08F/A or Amistar--4 oz 80WDG/A.
- Cabrio--12-16 oz 20EG/A
- Aliette--3 lb 80WDG/A
- Fixed copper
- Ridomil Gold Copper--2.5 lb 70WP/A (14-day schedule)

FRAC group 11 fungicides, Quadris, Amistar and Cabrio should not be applied more than twice before switching to a fungicide with a different mode of action.

Root disease complex

Root disease complex is of secondary importance in spinach, but when it occurs, it causes 100% yield loss. Several diseases combine to create root problems, including Pythium, Rhizoctonia, Phytophthora, and Fusarium. These soil-borne fungal pathogens typically persist in fields for years and infect susceptible plants when conditions are optimal. Rhizoctonia can cause an eyespot symptom on leaf petioles resulting in loss of entire leaves. The growing points may not be harmed and plants can recover and produce some yield. Fusarium wilt in Delaware can cause considerable damage. Crop rotation, planting fields with good drainage and using resistant varieties whenever possible are probably the best ways to manage these diseases.

Cucumber Mosaic Virus

Cucumber mosaic virus (CMV) is a minor disease in spinach. Extension Specialists in Delaware report one grower with a problem on Vancouver in 2003. Aphids which vector the virus must be controlled. Using resistant varieties is the only control for CMV.

Damping Off

Apply the following preplant incorporated or as a soil surface spray after planting: mefenoxam--1-2 pt Ridomil Gold 4E/A or 2-4 pt Ultra Flourish 2E/A

Nematodes (Root Knot and Lesion)

Nematodes are not usually a major problem in spinach, but can sometimes be severe. They are controlled by soil sampling and survey in advance. They are primarily a fall crop issue and a rotation issue (their damage is worse behind specific crops).

Table. Fungicides: REI, PHI, and % crop treated

Fungicide	REI (hours)	PHI (days)	% of spinach treated
Actigard	12	7	
Aliette	12/ 24	3	<2%
Amistar	4	0	
Cabrio	12	0	
coppers, fixed	24	0	25%
Quadris	4	0	
Ridomil Gold	12	21	
Ridomil Gold Copper	48	21	<1%
Ultra Flourish	12	21	90%

Weeds

Common weeds in Delaware spinach are Canada thistle, morningglory, common milkweed, hemp dogbane, pigweed, ragweed, lambsquarters, common cockbur, chickweed, henbit, field pansy, annual bluegrass, volunteer small grains, redstem filaree, wild geraniums, and wild mustard.

Preplant Incorporated

Cycloate--2.5-3 lb/A. Apply 3 to 4 pints per acre Ro-Neet. Apply before seeding and incorporate into soil 2 to 4 inches with disk. Delay of planting for 7 to 10 days may help reduce potential injury. 90% of acreage is treated.

Preemergence

S-metolachlor--0.32-0.63 lb/A. A Special Local-Needs Label 24(c) has been approved for the use of Dual Magnum 7.62E to control weeds in spinach in Delaware. The use of this product is legal ONLY if a waiver of liability provided by the local growers association has been signed by the grower, all fees have been paid, and a label has been provided by the association. Apply 0.33 to 0.67 pints per acre Dual Magnum 7.62E to control annual grasses, galinsoga, and certain other broadleaf weeds. Use as a surface-applied preemergence spray. DO NOT preplant incorporate Dual Magnum. Use the lower rate on fields with coarse-textured soils low in organic matter. Use the higher rates on fields with fine-textured soil and those with high organic matter. Apply Dual Magnum to spinach accurately with a well calibrated sprayer. The margin of crop safety for Dual Magnum on spinach is narrow; rates higher than recommended for the soil type may result in crop injury. 95% of acreage is treated.

Postemergence

Clethodim--0.094-0.125 lb/A. Apply 6 to 8 fluid ounces per acre Select 2EC with oil concentrate to be 1 percent of the spray solution (1 gallon per 100 gallons of spray solution) or 12 to 16 fluid ounces of Selectmax 0.97EC with nonionic surfactant to be 0.25% of the spray solution (1 quart per 100 gallons of spray solution) postemergence to control many annual and certain perennial grasses,

including annual bluegrass. Select 2EC will not consistently control goosegrass. The use of oil concentrate with Select 2EC may increase the risk of crop injury when hot or humid conditions prevail. To reduce the risk of crop injury, omit additives or switch to nonionic surfactant when grasses are small and soil moisture is adequate. Control may be reduced if grasses are large or if hot, dry weather or drought conditions occur. For best results, treat annual grasses when they are actively growing and before tillers are present. Repeated applications may be needed to control certain perennial grasses. Yellow nutsedge, wild onion, or broadleaf weeds will not be controlled. Do not tank-mix with or apply within 2 to 3 days of any other pesticide unless labeled as the risk of crop injury may be increased, or reduced control of grasses may result. Observe a minimum preharvest interval of 14 days. 20% of acreage is treated.

Clopyralid—0.047-0.188 lb/A. Apply 2 to 8 fluid ounces of Stinger 3A per acre in a single application to control certain annual and perennial broadleaf weeds. Stinger controls weeds in the Composite and Legume plant families. Common annuals controlled include galinsoga, ragweed species, common cocklebur, groundsel, pineappleweed, clover, and vetch. Perennials controlled include Canada thistle, goldenrod species, aster species, and mugwort (wild chrysanthemum). Stinger is very effective on small seedling annual and emerging perennial weeds less than 2 to 4 inches tall, but is less effective and takes longer to work when weeds are larger. Use 2 to 4 fluid ounces to control annual weeds less than 2 inches tall. Increase the rate to 4 to 8 fluid ounces to control larger annual weeds. Apply the maximum rate of 8 fluid ounces to suppress or control perennial weeds. Spray additives are not needed or required by the label, and are not recommended. Application of higher recommended rates, 0.094 to 0.188 lb/A (4 to 8 fluid ounces), may cause a crop response that appears as a more upright leaf development. Yield and maturity are not affected. Observe a minimum preharvest interval (PHI) of 21 days. Stinger is a postemergence herbicide with residual soil activity. Observe follow crop restrictions or injury may occur from herbicide carryover. 10% of acreage is treated.

Phenmedipham--0.33-0.67 lb/A. Apply 2 to 4 pints per acre Spin-aid 1.3E. For use on spinach for processing only. Controls seedling broadleaf weeds. Only chickweed less than three inches long or tall can be controlled consistently. Scout fields regularly and reapply if weeds germinate after the initial application, but do NOT exceed 6 pints per acre per year and maintain a 40-day preharvest interval. Apply only during the fall months to spinach with a minimum of four to six true leaves. Apply in a spray volume of 10 to 18 gallons of water per acre. The use of an 8002 flat fan nozzle or a comparable nozzle is suggested. See label for application restrictions, mixing instructions, and weather restrictions to prevent crop injury or herbicide failure. 75% of acreage is treated.

Sethoxydim--0.2-0.3 lb/A. Apply 1 to 1.5 pints per acre Poast 1.5EC with oil concentrate to be 1 percent of the spray solution (1 gallon per 100 gallons of

spray solution) postemergence to control annual grasses and certain perennial grasses. Choose Poast 1.5EC to control large crabgrass. The use of oil concentrate may increase the risk of crop injury when hot or humid conditions prevail. To reduce the risk of crop injury, omit additives or switch to nonionic surfactant when grasses are small and soil moisture is adequate. Control may be reduced if grasses are large or if hot, dry weather or drought conditions occur. For best results, treat annual grasses when they are actively growing and before tillers are present. Repeated applications may be needed to control certain perennial grasses. Annual bluegrass, yellow nutsedge, wild onion, or broadleaf weeds will not be controlled. Do not tank-mix with or apply within 2 to 3 days of any other pesticide unless labeled, as the risk of crop injury may be increased, or reduced control of grasses may result. Observe a minimum preharvest interval of 15 days and apply no more than 3 pints per acre in one season. 5% of acreage is treated.

Postharvest

Paraquat--0.6 lb/A. A Special Local-Needs 24(c) label has been approved for the use of Gramoxone Inteon 2SC for postharvest desiccation of the crop in Delaware. Apply 2.4 pints per acre Gramoxone Inteon 2SC as a broadcast spray after the last harvest. Add nonionic surfactant according to the labeled instructions. Less than 2% of the acreage is treated.

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