

Crop Profile for Peas in Wisconsin

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General Production Information

Wisconsin ranks third in the production of green peas for processing in the United States, following Minnesota and Washington state. Preliminary data from the National Agricultural Statistics Service for the 1998 growing season indicates that Wisconsin harvested 53,600 acres yielding over 92,000 tons. This represents 20% of the total amount harvested that year. Crop value was \$237 per ton for a total value of \$21.8 million. A small amount of peas are grown by market gardeners for fresh consumption however, this acreage is inconsequential when assessing pea production in the state.

Product Regions

Most of the peas grown in Wisconsin are grown in the central sands and the east-central part of the state in Fond du lac, Green Lake, Columbia, Calumet, and Dodge counties. Peas are also grown in Dane county.

Cultural Practices

Peas are a cool season, annual crop planted in rotation with other processing crops such as potatoes, sweet corn and snap beans. Peas are members of the legume family and as such, they provide a good source of protein and can utilize atmospheric nitrogen for growth and development.

Plant growth habit may be either determinate or indeterminate, the latter producing a vining plant that flowers indefinitely and is often used in fresh market production. Most processing pea varieties however have a determinate growth habit to assure a uniform crop that is ready for a once-over, destructive harvest.

Peas require a well-drained, sandy to loamy soil that warms quickly in the spring to facilitate early planting. Crop rotation is necessary to prevent the build-up of root rot pathogens that can cause serious yield loss problems if left untreated. Ideally, fields should be planted out of peas or other legumes for 7 years. Fields should have uniform fertility and have an adequate amount of organic matter to hold soil moisture and prevent drought. Phosphorus levels should be at least 50 ppm while potassium should be

between 120-180 ppm with levels around 160 ppm being optimum. Although peas require adequate moisture, too much or too little reduces yield. Inadequate drainage starves the root zone of oxygen so that normal root respiration cannot occur and nitrogen-fixing bacteria cannot function efficiently and root rot organisms become more destructive.

Peas do not compete well with weeds although some post emergence herbicide options exist. The best time to control weeds is before planting. Canada thistle is particularly troublesome because its flower buds are hard to remove from shelled peas and greatly reduce the pea grade. Eastern black and hairy nightshades also produces berries that can contaminate shelled peas particularly in crops harvested after July 4, making nightshade another serious weed. Mustard pods can also present an increased contamination risk. Fields should be chosen based on the absence of major weed problems.

Peas typically follow corn in a rotation. They are sometimes planted in a double crop system whereby snap beans, soybeans, or winter wheat are planted mid-season, after the peas have been harvested.

Seedbeds are tilled to a depth of 4-5 inches early in the season. It is important not to overwork the soil or crusting will result, causing germination problems. Pea/soybean drills are used to plant peas and the seeding rate depends on the cultivar and is usually determined by the processor. Early and light-vined varieties such as Alsweet should have at least 672,000 plants per acre (9 plants per foot in 7 inch rows). Later peas, including Perfection or Freezer varieties, need a minimum population of 450,000 plants per acre (6 plants per foot in 7 inch rows). Full stands of vigorous plants provide the needed competition against weeds. Most seed for commercial planting is treated with a fungicide to protect the seed and seedling from root rotting fungi. Nitrogen-fixing bacteria may be put in the planter box along with the seed to provide inoculum, particularly if peas haven't been planted in a particular field for more than 5 years.

Peas are harvested approximately 3 weeks after full bloom. The optimum harvest time is when the pods are filled and the peas are still soft and immature. Degree day accumulation is used to determine when peas are ready to harvest. Pea cultivars mature once 1100-1600 degree days using a base temperature of 40F have accumulated. A tenderometer is used to determine when the pea quality is optimum. All processing peas are harvested mechanically with a self-propelled combine that separate the peas from the vines.

Insect Pests

Pea Aphid (*Acyrtosiphon pisum*) is the most economically-important insect pest of peas not only because of the direct feeding damage that it causes but also because it is a vector of several virus diseases. The pea aphid is a small, green aphid approximately ¼ inch long and one-third as wide. Nymphs resemble adults except for their smaller size and lack of wings. Eyes are red and their legs and cornicles may be tipped with yellow.

The pea aphid overwinters as eggs on plant tissue of alfalfa, clover, leguminous weeds, and other leguminous plants. The following spring, the eggs hatch into wingless females which give rise to the next generation of aphids without engaging in sexual reproduction. In late May or June when the first cutting of alfalfa takes place, winged adults migrate into pea fields. As the season progresses and peas no longer provide adequate food supplies for aphid populations, winged forms again appear and migrate back to alfalfa. Late in the season male aphids are produced and sexual reproduction occurs. Black eggs are laid on the stems and leaves of alfalfa plants for overwintering.

Feeding injury caused by the pea aphid results when the aphid ruptures cells in the leaves, stems, blossoms and pods of the plant in an effort to remove plant sap. Wilting, stunting and chlorosis are commonly associated with aphid feeding particularly when populations are high. In addition to the direct injury caused by feeding activity, the pea aphid is a vector of several virus diseases of peas. Also, aphids excrete a sticky substance called honeydew. Sooty molds or other fungi which grow on honeydew-covered plant parts may lead to harvesting problems and also may make the foliage inedible to livestock.

Insect Contaminants of Peas

There are dozens of insect species that are potential contaminants of processed peas; however the six species listed below are the most common. Although they do not pose a threat in terms of direct yield loss, contamination by any one of these insects poses a serious quality issue and can result in a processor rejecting the crop from an entire field.

Cabbage Looper (*Trichoplusia ni*) The cabbage looper is a potential contaminant in late-season peas. Adults are greyish-brown moths with a wing span of 1½ ". The caterpillar (larva) is up to 1½ " long, with a greenish body that tapers at the head end. Cabbage loopers don't overwinter in large numbers in Wisconsin, but migrate in from southern states in mid-July through September. Pupae overwintering in the southern US give rise to the first generation adults in spring. Once these migrants reach Wisconsin, they mate and lay eggs singly on the lower leaf surfaces in July. Larvae mature through 5 successively larger instars over the next 4-5 weeks before pupating. Adults emerge in 10-14 days, and mate and lay eggs which give rise to the second generation.

Alfalfa Looper (*Autographa californica*) The alfalfa looper caterpillars may range in color from light to dark green, and may reach 1¼" in length. They pose a risk of contamination throughout the entire growing season. Adult moths are silvery-grey with a darker fringe along the wing edges. The alfalfa looper overwinters as an adult moth which emerges when temperatures warm to 40F in the spring. After mating, females lay from 500-1500 small, white eggs on wild crucifers. The eggs hatch within a week, and larvae are active for two weeks before pupating and giving rise to the next generation of adults.

Celery Looper (*Anagrapha falcifera*) Celery loopers are late season contaminants in peas. This is another moth with greyish-brown forewings and a patch of rust-colored scales outlined by silver. Larvae resemble that of the previous two pests ranging in color from light to dark green. At maturity, larvae are

1¼" long. The celery looper overwinters as pupae in the soil. When springtime temperatures reach 50-55 F, adult moths emerge and seek out host plants on which to lay their eggs. There are three generations per year in Wisconsin.

Alfalfa Caterpillar (*Plathypena scabra*) The adult alfalfa caterpillar is a sulfur-yellow butterfly with distinct black markings along the margins of both the fore- and hind-wings. Larvae are dark brown, becoming green once they begin to feed. At maturity the larvae are 1½ " long. The alfalfa caterpillar overwinters as pupae on alfalfa plants. In the spring, adults emerge, mate and lay between 200-500 eggs single on the lower leaf surface of alfalfa leaves. The larvae complete their development within two weeks of egg hatch at which time they enter the pupal stage without spinning a cocoon. There are two generations per year.

Imported Cabbageworm (*Pieris papae*) The adult imported cabbageworm is a white butterfly with a 2 inch wingspan. Bullet-shaped, yellow-orange eggs are laid on the leaves of host plants. Newly hatched larvae are yellow in color but become green once they begin to feed. Larvae have 5 pair of abdominal prolegs. The pupa is grey-brown with 2 angular projections at the head end. The imported cabbageworm overwinters as pupae. Adult butterflies emerge in late April or early May. The first generation eggs are laid on the leaves of cruciferous weeds. These eggs hatch in about one week, and in another 2 weeks, the larvae have completed development and pupate yielding the second generation adults one to two weeks later.

Armyworm (*Pseudaletia unipunctata*) These sand-colored moths have a wing span of 1½ " with definitive white dots in the center of each forewing, and dark markings on the hind wings. The brownish-green larvae are hairless, and about 2 inches long when fully grown. Pupae are dark brown and approximately ¾" in length. The armyworm moths usually appear in late April and early May. After mating, clusters of greenish-white eggs are laid. Larvae emerge 7-10 days after the eggs are laid and feed for 3-4 weeks. The full-grown larvae pupate for an additional two weeks and emerge as adults. There are three generations per season, with each generation lasting 5-6 weeks.

Colorado Potato Beetles (*Leptinotarsa decemlineata*) have become an increasing contamination concern in Wisconsin pea production in recent years. Colorado potato beetles overwinter as adults in the soil, often at field margins. Adults become active in the spring. Females will lay up to 500 bright yellow eggs in clusters of 15-25 on the lower leaf surfaces before dying. Eggs hatch in 4-9 days and larvae begin feeding immediately. After passing through four instars over the course of 2-3 weeks, larvae return to the soil to pupate. Within 10-14 days, adult beetles emerge. There are 1-2 generations per year in northern states and 3-5 generations in the south.

Brown Stink Bug (*Euschistus servus*) is another new contaminant in peas. Their size is approximately that of the shelled peas. Adult stink bugs are shield-shaped and brown in color. Immatures are called nymphs and resemble the adults except for their smaller size and lack of wings. Brightly-colored, barrel-shaped eggs are laid in clusters on the lower leaf surface.

Chemical Controls for Insect Pests in IPM and Resistance Management Programs

- **Dimethoate** (Cygon EC, Dimethoate EC) is used to control pea aphids at a rate of 0.16 lb a.i./A, and can be used up until the day of harvest. Only one application of dimethoate is made per season and 5-40% of the pea acreage is treated with this insecticide depending on whether temperature and rainfall conditions favor pest outbreaks. Dimethoate is a critical pesticide in the production of peas in Wisconsin. There are currently no alternative pesticides, other than Asana, available for use in controlling aphids in peas. Restricting aphidicides to a single pesticide class will increase the rate at which pesticide resistance develops.
- **Esfenvalerate** (Asana XL) is a restricted-use pesticide that effectively controls pea aphids and several of the caterpillar contaminants including alfalfa caterpillars, armyworms, cutworms, and loopers. It is used at a rate of 0.03-0.05 lb a.i./A for the caterpillar contaminants, and at a rate of 0.015-0.025 lb a.i./A for aphids up to three days before harvest. Six percent of the pea acreage in Wisconsin was treated with esfenvalerate in 1996.
- **Methomyl** (Lannate L) is a restricted-use pesticide labeled for control of pea aphids, alfalfa caterpillars, armyworms, and loopers. To control alfalfa caterpillars, it is used at a rate of 0.23-0.9 lb a.i./A. For aphid, armyworm, and looper control, methomyl is applied at a rate of 0.45-0.9 lb a.i./A. There is a 1 day pre-harvest interval. Methomyl hasn't been used in Wisconsin pea production since Asana was labeled.

Diseases

Aphanomyces Root Rot (*Aphanomyces euteiches* f. sp. *pisi*) is the most important pea disease in Wisconsin. Annual yield losses of 10% have been observed and in some fields, 100% loss may be realized. The disease not only destroys individual vines, but also reduces the quality of shelled peas by making them irregular in size, variable in harvesting maturity, and lacking in sugar content. Fields infested with *Aphanomyces* may remain unsuitable for planting susceptible crops for up to 10 years.

Aphanomyces root rot is a soil-borne fungus capable of infecting pea plants at all stages of growth. The fungus produces such a large number of spores that it can be readily disseminated over large areas through movement of water and in contaminated soil carried from one field to another by farm implements and machinery. Warm temperatures (72-82F) and high soil moisture favor disease development and symptom expression.

Infection usually occurs at the time of crop emergence. Initial symptoms appear as long, soft, water-soaked areas on the surface of the lower stem and roots. As the disease progresses, these discolored areas become light tan and spread over the entire root system. Plants that are infected while very young

are stunted and weakened. Pods on infected plants may have only one or two peas and these are inclined to be large and irregularly shaped. Peas of this type are usually poor in quality. In severe cases, infected plants wilt, turn yellow, shrivel and die prematurely.

Ascochyta Leaf Spot (*Ascochyta pisi* Lib.) Is an occasional, economically-important disease of late-season peas grown in Wisconsin. Symptoms appear as small, purple spots with distinct margins on leaves, stems and pods that later become black in color. Pod lesions may be somewhat sunken and reduce the quality of the pea seed within.

The fungus overwinters in infected plant debris and is spread by rain or irrigation water. Consequently, wet weather favors disease outbreaks.

Control can be achieved through the practice of a 3-4 year rotation out of peas and the incorporation of infected debris immediately after the crop has been harvested. Disease-free seed is another important means of preventing infection.

Fusarium Wilt (*Fusarium oxysporum* f. sp. *pisi*) is a destructive disease of peas that attacks plants of all ages and reduces yields by killing the plants before they mature.

The fungus overwinters as resting spores in the upper soil layers where it can survive indefinitely. In the spring, the fungus invades the root system of developing pea plants. It may be carried on seed to other fields. The fungus does not appear to be sensitive to soil moisture levels or alkalinity, although the incidence of wilt is slightly greater where the soil is moderate in moisture content.

Plants can become infected at any stage of development from the youngest seedlings to mature vines. The first signs of disease are pale leaflets and downward curling of stipules and leaflets. Leaves of infected plants wilt, beginning with the lower leaves and progressing upward. The entire plant eventually wilts, and the stem shrivels. Pod formation is usually reduced, and seeds rarely develop in affected pods.

Rhizoctonia Seedling Blight (*Rhizoctonia solani*) is an occasional disease of peas and is generally considered to be of minor importance. The fungus can live indefinitely in the soil and is disseminated by any means that moves infested soil from one area to another. Infection occurs directly through intact plant tissue. As seedlings age, they become less susceptible to attack. Disease development is temperature dependent and is most severe when soil surface temperatures are between 75-85 F. Because sandy soils warm up relatively rapidly, *Rhizoctonia* seedling blight is often more serious on these soils.

The browning of stems and death of very young pea seedlings is the most common above-ground symptom. Up to ½ inch of the terminal shoot is affected just as it emerges through the soil and before the leaves expand. Often one or two auxiliary shoots arise from the seed within a few days after the first shoot dies back. These auxiliary shoots also may become infected or they may produce a normal, but late plant.

Powdery Mildew (*Erysiphe polygoni*) is a late season disease of peas that is rarely economically important in Wisconsin's pea crop. Early symptoms include discolored spots on the upper leaf surface that later become powdery in appearance as they enlarge. Small, oval, black fruiting bodies may be seen in older lesions. Dry weather favors disease development. Drought stress also accelerates disease development by stressing the host plant.

The pathogen that causes powdery mildew is seed-borne and therefore, the use of disease-free seed is recommended to prevent infection. Sulfur fungicides are useful in protecting healthy foliage in infected fields.

Downy Mildew (*Peronospora pisi*) is a common and troublesome pea disease where peas are grown under cool, moist conditions. In most of the pea-growing areas of the US, the disease is present during the early part of the growing season but is seldom of economic importance.

Downy mildew develops when night temperatures are relatively low and fogs or prolonged periods of dew are prevalent. The symptoms of downy mildew first appear on the lower leaf surface as fluffy, white to grey patches of the fungus. These patches often turn darker with age. On the upper side of the foliage there are yellow to brown areas with indistinct margins. The disease may appear on the pods without foliar infection. Young pods are particularly susceptible. Several yellow-brown diseased areas of indefinite size and shape are apparent in pod infections. On the inside of the pod, opposite the outer diseased area, there may be a white, felt-like growth of the pod endocarp. Peas developing near these areas remain small and may have brown, sunken spots.

Mosaic virus disease outbreaks in peas can result in economic loss, but this is usually not the case. The pea mosaic viruses survive between crops in weeds and ornamental plants. In the spring, pea and potato aphids (*Acyrtosiphon pisum* & *Macrosiphon euphorbiae*) acquire the viruses as they feed on these infected plants. As the winged aphids migrate, the viruses are spread to the peas. Symptom expression usually occurs 10-13 days following inoculation. In years with mild winters and dry springs, aphids can survive in larger numbers and the likelihood of virus infection is increased.

Bean yellow mosaic virus is characterized by a yellow mottling on the stipules and leaves between the veins. Patches of normal green tissue of various sizes are scattered irregularly over the surfaces of both leaves and stipules. Plants become stunted if they are infected when young. The upper leaves and stipules become wrinkled and twisted or otherwise malformed. Pods may be fewer and smaller than normal. Severity of symptoms depends on the pea cultivar and environment.

Pea enation mosaic causes blister-like outgrowths from the lower leaf surface and pods. Scattered chlorotic areas may be apparent on the foliage. As the chlorosis progresses, a translucent 'window' may appear. Infected pods are severely deformed.

Red clover vein mosaic virus infections result in extremely stunted plants with veins cleared and a

proliferation of axillary buds. The most conspicuous symptom is the brown to purple streaks that develop on pea stems. Barren pods may develop brown or purple spots.

Pea streak virus infection can kill seedlings of most pea cultivars. Plants infected later in the season exhibit leaf and stem spots and streaks that yellow the vascular system. Pod symptoms include spots and sunken lesions.

Chemical Controls for Diseases in IPM and Resistance Management Programs:

- **Captan** or **Thiram** are used as a seed treatment to control seed rot and damping-off. It is applied to the seed before planting. Virtually all of the pea seed planted in Wisconsin is treated with a fungicide prior to planting.
- **Sulfur** is labeled for control of powdery mildew on peas at a rate of 8-10 lb wettable sulfur in 100 gallons of water. It should not be applied when plants are wet or when temperatures are above 85F. Sulfur is rarely used to treat Wisconsin's pea crop.

Alternative Pest Management Strategies:

Three non-chemical weed management practices that are beneficial in peas are high plant populations, early planting dates, and crop rotation. At the high planting rates, peas have better competitive abilities against weeds. When peas have emergence problems and populations are low, they are more susceptible to weed competition. Early planting can aid weed suppression by having the peas, a cool season crop, emerge prior to some of the weeds. This improves the pea's competitive ability against weeds. Crop rotation with perennials like alfalfa or winter annuals like winter wheat can help reduce weed density during the year peas are grown. Cultivation is not a weed control option in peas because the peas are drilled in narrow rows. Killing weeds with tillage immediately prior to planting is important to prevent weeds from emerging before the peas. Weeds that emerge before the peas are much more competitive than late emerging peas. The competitive ability of peas with different leaf types against weeds is being evaluated.

Rotation of pea crops with non legume crops is essential to control such soil borne diseases as common root rot and Fusarium wilt. Other diseases such as Ascochyta leaf blight and anthracnose are easily controlled if peas are rotated with non legume crops such as small grains, corn or non legume vegetable crops. Use of a 3-5 year rotation will be helpful in the long term health of a field.

Prior to planting a field to peas, a soil sample representative of the field should be evaluated for root rot potential. You might consult UW Extension Publication A3242 for details on collecting and storing soil samples. Establishing the risk of root rot before planting helps growers to avoid the high risk fields and more profitably grow peas in fields at low risk from common root rot.

Pea breeders are investing time and money in the development of cultivars with resistance to key pea

diseases. It is possible to purchase cultivars with resistance to some virus and fungal pathogens. While resistance to root rot has been particularly elusive, breeders continue work toward the goal of developing improved levels of resistance to common root rot.

Critical Pest Control Issues

Broadleaf weed control, especially eastern black nightshade and Canada thistle control, is not as good as desired because the available herbicides often injure peas. Despite such shortcomings in controlling certain weeds, there are no major crises in weed management in peas as long as the current herbicide registrations are maintained.

Developing improved resistance to common root rot is the highest priority for the pea industry. There are few fungicides registered for use on peas other than captan and thiram. Loss of either or both of these materials through FQPA enforcement would have an enormous impact on the pea industry in Wisconsin.

Outlook for New Registrations

Bifenthrin (Capture 2EC) was registered for use on peas in 1999 and have been very effective in controlling aphids and the insects that pose a contamination risk in peas.

Capture will likely reduce the use of esfenvalerate in the future.

The efficacy and crop tolerance of imazamox (Raptor) is currently being evaluated in peas. Imazamox is a postemergence herbicide that controls many annual broadleaf and grass weeds, including eastern black nightshade and has crop tolerance similar to or better than Pursuit.

At the present there appear to be no useful new chemical materials close to registration for control of pea diseases. With the exception of common root rot and virus diseases, most of the common pea diseases can be controlled with careful attention to crop rotation and careful selection of well drained productive fields.

Weeds

Broadleaf Weeds

Common lambsquarters (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*), velvetleaf

(*Abutilon theophrasti*), and common ragweed (*Ambrosia artemisiifolia*) are annual broadleaf weeds that are commonly found in pea fields. All of these weeds are very competitive with peas because they grow taller than the peas and can significantly reduce yields. During this growth, they compete for light, nutrients and water. Without control, moderate densities of any of these weeds will greatly reduce pea yields. Common lambsquarters and redroot pigweed are highly prolific and produce tens of thousands of seed per plant. Velvetleaf and common ragweed are as prolific, but still produce many thousands of seeds per plant. Early planted peas are often harvested before these weeds produce mature seed. However, a percentage of seed from these broadleaf weeds will remain dormant in the soil from previous crops so that infestations continue for many years before the seed bank can be reduced. Some velvetleaf seeds may remain viable in the soil for a few decades and the seed longevity of the other broadleaf weeds can also exceed ten years. As a result, it is impractical to try to eradicate these weeds and control is required annually. Common lambsquarters, velvetleaf, and common ragweed tend to germinate earlier in the spring than redroot pigweed and the peak emergence of these weeds typically occurs by mid-June. However, a percentage of these weeds will still emerge throughout the growing season. Common lambsquarters and redroot pigweed are controlled by pendimethalin (Prowl) and trifluralin (Treflan) the most frequently used herbicides in peas, but these herbicides do not control common ragweed and velvetleaf adequately and would require control by another herbicide.

Eastern black nightshade (*Solanum ptycanthum*) and hairy nightshade are common annual broadleaf weeds that causes a special problem in peas at harvest. Nightshades are not as competitive as the other broadleaf weeds because of their short stature. However, nightshades produce green berries, which turn black as they ripen. These berries are similar in size to the peas and can be harvested along with the crop. These berries are contaminants and the harvested crop can be docked because of the lower quality. Eastern black nightshade is common on most of Wisconsin's fields. In the central region of Wisconsin on coarse-textured soils (the central-sands), hairy nightshade is more frequent than eastern black nightshade, but created the same management problems. Early maturing and early planted peas may be harvested before nightshade berries are produced, but it is very important to control nightshade in other fields.

Canada thistle (*Cirsium arvense*) is a perennial broadleaf weed that is another potential contaminant in peas. The plant produces flower buds that are a similar size as peas and can be harvested along with the peas. Peas contaminated with thistle buds have a lower quality and are docked. Canada thistle will also compete with peas and reduce pea yields. However, Canada thistle plants may grow in patches, which makes it easier to spot treat for control. Herbicides used to suppress the production of thistle buds will not provide long term control of Canada thistle's perennial root system.

Annual Grasses

Annual grass weeds are very competitive with peas, especially at higher densities. Of these grasses, foxtails (*Setaria* spp.) are commonly found in Wisconsin pea production. Annual grasses can be controlled either by several soil-applied or postemergence herbicides. However, foxtails are prolific seed producers and the seed persists for many years in the seed bank. Consequently, annual grass weeds will

be present in each year's production of peas.

Chemical Controls for Weeds in IPM and Resistance Management Programs:

Broadleaf Herbicides:

- **Bentazon** (Basagran) is an important herbicide used in Wisconsin pea production. It provides excellent postemergence control of velvetleaf and wild mustard and provides partial control of Eastern black nightshade, common lambsquarters, and redroot pigweed when applied to very small seedlings. Basagran is applied at a rate of 1.5-2.0 pt/A when the broadleaf weeds are small and actively growing and after peas have 3 pair of leaves. Twenty-six percent of the pea crop in Wisconsin is treated with bentazon in 1998.
- **MCPA** (MCPA) is applied postemergence and controls most annual broadleaf weeds and inhibits Canada thistle bud formation. However, it is weak on Eastern black nightshade and smartweed. MCPA is applied at a rate of 0.25-0.75 pt/A no later than three nodes before pea flowering. It is important not to use MCPA when temperatures exceed 80 F to prevent burning of plants. About 10% of the Wisconsin pea crop is treated with MCPA.
- **MCPB** (Thistrol) is applied post emergence and controls many annual broadleaf weeds, and suppresses Canada thistle bud formation. It is not effective in controlling smartweed, mustards, and Eastern black nightshade. Thistrol should be applied at a rate of 2-4 pt/A, and should not be applied if soils are waterlogged or during drought. In 1998, 19% of the pea crop in Wisconsin was treated with MCPB.

Grass Herbicides:

- **Quizalofop** (Assure II) provides postemergence control of annual and perennial grasses but does not control broadleaf weeds. To avoid antagonizing Assure II's activity, broadleaf herbicides should be applied either 7 days before, or 24 hours after applications of Assure II. It should be applied at a rate of 6-12 oz/A with 1% crop oil concentrate or 0.25% nonionic surfactant. Approximately 2% of the pea crop in Wisconsin is treated with quizalofop.
- **Sethoxydim** (Poast) provides postemergence control of annual and perennial grasses but does not control broadleaf weeds or sedges. Poast should be applied at a rate of 0.5-1.0 pt/A plus 2 pt/A of crop oil concentrate. The higher rate can be used to control foxtails, fall panicum, barnyardgrass, and woolly cupgrass when they are less than 8 inches tall and actively growing. Sethoxydim was used to treat about 8% of the pea crop in Wisconsin.

Broadleaf and Grass Herbicides - Soil-Applied:

- **Clomazone** (Command 4EC) is an important herbicide that controls annual grasses and many broadleaf weeds but is weak on pigweeds and Eastern black nightshade. Command should be applied at a rate of 1 pt/A as a pre-plant incorporated treatment to mineral soils only. In 1998, less than 1% of the Wisconsin pea crop was treated with clomazone.
- **Glyphosate** (Roundup Ultra) provides excellent control of actively growing quackgrass, good control of Canada thistle and other perennial weeds. Roundup Ultra should be applied pre-plow before planting peas at a rate of 1-3 qt/A. Target weeds shouldn't be tilled or mowed for several months before treatment. Less than 5% of the pea crop in Wisconsin is treated with glyphosate.
- **Imazethapyr** (Pursuit DG) controls several annual broadleaf weeds and some annual grasses. It can stunt peas if cool and/or wet weather follows treatment. Pursuit is applied as a preplant treatment within 7 days of planting at a rate of 1.08 oz/A, or as a postemergence application when weeds are less than 2 inches tall. In Wisconsin in 1998, 20% of the pea crop was treated with imazethapyr.
- **Metolachlor** (Dual II) provides good to excellent control of foxtails, and other annual grasses, good control of Eastern black nightshade and pigweed, and partial control of nutsedge. It does not control most other broadleaf weeds. Dual II is applied as a pre-emergence herbicide at a rate of 1.5-3.0 pt/A to mineral soils only. Metolachlor was used on 5% of the pea crop in Wisconsin in 1996.
- **Pendimethalin** (Prowl) controls annual grasses, lambsquarters, and pigweed, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and Eastern black nightshade. Prowl should be applied as a preplant incorporated treatment at a rate of 1.2-3.6 pt/A. Twenty-four percent of the Wisconsin pea crop was treated with pendimethalin.
- **Trifluralin** (Treflan MTF) is used for control of annual grasses, lambsquarters, and pigweed, but it is weak on wild mustard, smartweed, common ragweed, velvetleaf, and Eastern black nightshade. Treflan MTF is used as a preplant incorporated treatment at a rate of 1.0-1.5 pt/A. Trifluralin also helps to suppress *Aphanomyces* root rot. Twenty-seven percent of the pea crop in Wisconsin is treated with trifluralin.

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