Commercial Vegetable Recommendations: Onions
Michigan State University Extension Service
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Onions

Cooperative Extension Service • Michigan State University

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Production

The average yield of U.S. No. 1 pungent yellow onions in Michigan is 16.5 tons (660 50-lb bags) per acre. With irrigation and good cultural practices, it is possible to obtain marketable yields of 20 to 25 tons (800 to 1,000 50-lb bags) per acre. Green onions yield 8 to 10 tons (1,000 to 1,200 boxes) per acre.

Marketable yields from sets will normally be lower because of shorter growing period, less uniform growth, and a higher percentage of grade out. Yields of sweet onions from transplants are similar to yields from seeded onions. However, because of poor storability, marketable yield decreases rapidly after harvest.

Use

Virtually all Michigan onions are packed for fresh market, either soon after harvest or from storage.

Types and Cultivars

Onions may be classified in several different ways: by shape—flat, round, or globe; by color—red, yellow, or white; by pungency—sweet (Spanish) or pungent; and by bulbing response to day length—long, intermediate, or short day. Most onions grown in Michigan are of the pungent yellow globe type. Only long day cultivars should be grown from seed. Intermediate or short day cultivars can be grown successfully from transplants.

Days to maturity for onion cultivars are usually given in seed catalogs, but these are only rough estimates. Harvest maturity will depend on the date of planting, weather during the season, and location in the state. Normally, very early onions (90 to 110 days) that are seeded in April will be ready for harvest about the second week of August. Very late (100 to 120 days) pungent onions mature in mid- to late September. Medium to late Spanish cultivars developed primarily for the northwestern states usually do not mature in Michigan if grown from seed.

The following cultivars have performed well for several years in Michigan. There are many other excellent cultivars available.

Pungent yellow globe
Eskimo, Norstar, Progress
(very early—not for storage)
Capable, Bronze Reserve (early)
Sentinel, Spartan Banner 80
(mid-season)
Krummrey (late)

Red
Benny's Red (late)
Ruby (late)

Sweet (Spanish)
Sweet Sandwich (late)
Golden Treasure (late)

Green bunching
Japanese Bunching (70 days)
Tokyo Long White (70 days)
White Spear (70 days)

Climatic Requirements and Irrigation

Onion is a biennial plant, forming a bulb the year of planting seed, and a seed stalk the following year, after a period of cold temperature. However, onions can form seed stalks prematurely (called bolting) the year of seeding if they are subjected to cool temperatures after reaching the 5-leaf stage. Temperatures must be below 50°F for several days to induce bolting. The effect is cumulative, with more bolting occurring at lower temperatures and the longer cool temperatures persist. Some cultivars are more susceptible than others. Onions grown from sets and transplants are especially susceptible to bolting because they can be induced to bolt before planting. They also develop large plants quickly in the field, and are thus very sensitive to cool temperatures that often occur early in the season.

Onions are usually planted in April as soon as soils are dry enough to work. May 10 is normally the last day to seed full-season cultivars. If plant stands are reduced as a result of adverse weather conditions, onions can be reseeded as late as June 1, but plant short-season cultivars only. Plant onions early to obtain as much foliar growth as possible before bulbing occurs. Early planting generally results in larger onions and higher yields.

Onions initiate bulbing in response to daylength, so plant cultivars that are suited to our latitude. Onion seeds germinate at temperatures above 45°F, but optimum germination occurs at 75°F. Optimum foliar growth occurs at 65° to 68°F. Onion seedlings can tolerate light frosts (28°F) but may be killed by colder temperatures. Onions grow slowly in cold, wet soils.

Because of their limited root system, onions require a constant supply of moisture throughout the growing season. Deep muck soils with good moisture-holding capacity will often produce a good crop of onions without irrigation. However, to ensure maximum yields of high quality onions, supply 1 in. of water per week until bulbing occurs, and 1½ in. per week until tops begin to fall over. Dry weather after tops fall over will help onions mature and cure faster, resulting in better storability.

Soil Requirements and Field Preparation

In Michigan, most onions are grown on muck soils. Good, deep muck soils are ideal for onion production because of their good water retention, high nitrogen content, ease of nutrient management, and ease of harvest. When onions are grown on sandy or marl mucks or mineral soils, more careful irrigation and fertilizer management is required.

Onions respond well to crop rotation. Because insects and diseases build up with continuous production of a single crop, yields and quality often decline. In addition, onions return very little organic matter to the soil, causing soils in continuous onion production to become hard and compact. Carrots, celery, and potatoes are common rotational crops for onions, but corn, sorghum-sudan, or rye should also be included in the rotation every 5 years to add large amounts of active organic matter to the soil.

If possible, plant a rye or barley cover crop in the fall on onion land. Plow 8 to 10 in. deep shortly before sowing onions to retain as much soil moisture as possible. If the cover crop grows too big, mow it before plowing. After plowing, use a roller to pack the soil to form a firm seedbed and sow seed immediately.

Seed Treatment Before Planting

Onion seed should be treated with thiram to control smut. Molybdenum deficiency (a potential problem) can usually be avoided by seed treatment. To treat seed, mix 4 oz. of sodium molybdate in 8 fl oz (½ pt) of water and stir until thoroughly dissolved. Pour the solution into 16 lb of onion seed in a rotating tumbler. Add 4 lb of thiram 50% WP and mix thoroughly. The seeds are then ready to plant.

Seed treated in this manner can be planted with a Planet Jr. seeder, but not with a precision seeder. If you use pelleted seed or a precision planter, add the thiram in the furrow on top of the seed.

Fertilizer Requirements

Maintain a pH of 5.3 to 6.5 on muck soil, and 6.2 to 6.8 on mineral soils. If the pH falls below these levels, add lime. Spots with very low pH often occur in shallow or sandy muck fields. Onions growing on these spots appear yellow and small compared to the rest of the field, because of reduced availability of phosphorus and potassium, and possible manganese toxicity. Sample these spots separately from the rest of the field when testing soil pH and apply lime as necessary to raise the pH.

Onions require high nutrient levels in the soil to attain maximum yields. Where onions will be grown on a regular schedule, it is wise to build up soil nutrient levels so that moderate amounts of fertilizer can be added each year. Maintain a phosphate (P_2O_5) level of 120 to 150 lb/acre and a potash (K_2O) level of 300 to 350 lb/acre. Add additional fertilizer on the basis of a complete soil test. Test soil every 2 years.

A 1,000 bag per acre crop of onions removes about 80 lb nitrogen (N), 50 lb P_2O_5, and 80 lb K_2O from the soil. To maintain sufficient nutrient levels in the soil, add approximately 150 lb N, 150 lb P_2O_5, and 260 lb K_2O per acre each year (more or less according to a soil test).

Fertilizer can be supplied through combinations of preplant broadcast, band application at seeding, and mid-June topdress applications. Do not apply N after July 15 because this may delay maturity. Possible fertilizer combinations for muck soil are:

- Broadcast and disc in 430 lb of 0-0-60 per acre (258 lb K_2O). Band 300 lb 18-46-0 per acre 3 in. below the seed at seeding (54 lb N and 138 lb P_2O_5). Topdress in mid- to late June with 200 lb of 45-0-0 or 265 lb of 34-0-0 per acre (90 lb N).
- Broadcast and disc in 500 lb of 12-24-24 and 250 lb of 0-0-60 per acre (60 lb N, 120 lb P_2O_5 and 270 lb K_2O). Topdress with 200 lb 45-0-0 or 265 lb 34-0-0 per acre (90 lb N).
- On mineral soils, apply 830 lb of 12-24-24 per acre (100 lb N, 200 lb P_2O_5, 200 lb K_2O) or the equivalent, before seeding and disc in. Topdress with 150 lb 34-0-0 (50 lb N) per acre in mid-June.
- For green bunching onions, apply and disc in 830 lb per acre 12-12-12 or the equivalent (100 lb N, 100 lb P_2O_5, 100 lb K_2O) on both muck and mineral soils. If subsequent crops of green onions are planted on the field the same year, reduce fertilizer rates for subsequent crops to 600 lb 12-12-12 per acre.

Copper (Cu) deficiency may be a problem on new muck soil. It seldom occurs on mineral soils. Symptoms in onions are wilting and death of leaf tips, and poor pigmentation of bulbs. If soil test levels of Cu are below 20 ppm, apply 3 lb of actual Cu per acre (12 lb copper sulfate) in the banded

fertilizer yearly until 40 lb actual Cu has been applied per acre. Onion seed should not contact Cu fertilizer. If Cu is broadcast instead of banded, increase the application rate to 10 lb actual Cu per acre per year.

Manganese (Mn) is deficient in most muck soils and many mineral soils in Michigan. Deficient onion plants are generally pale green, appearing to be deficient in N. The deficiency will be most obvious on muck soils with a pH above 6.0 and on mineral soils with a pH above 6.5.

To avoid the problem, apply 8 to 12 lb Mn per acre (30 to 45 lb manganese sulfate) in the banded fertilizer at seeding. Broadcast applications of Mn are not very effective. If fertilizer is not banded at seeding, apply 1 to 2 lb Mn (4 to 8 lb manganese sulfate) per acre in foliar sprays beginning in late June or early July. Reapply 1 or 2 times, waiting 10 days between applications. Include a surfactant in the solution.

Zinc (Zn) deficiency may occur in onions grown on new muck. The deficiency causes stunting, twisting, and bending of leaves and yellow striping of leaf tops.

On new muck, add 3 lb Zn (10 lb zinc sulfate or equivalent Zn EDTA) in the banded fertilizer per acre per year until a total of 25 lb Zn has been applied per acre. No more Zn should be needed after that, unless soil test levels fall below 2 ppm. If Zn deficiency occurs during the growing season, apply ½ to 1 lb Zn per acre (1½ to 3 lb zinc sulfate) as a foliar spray. Include a surfactant in the solution; apply the Zn in at least 30 gal of water per acre.

Molybdenum (Mo) deficiency may occur in onions grown on low-pH or high-iron muck soils. Symptoms appear as dying leaf tips and leaves wilting below the tip. The wilting and dying progresses down the leaves.

Seed treatment is the most effective method of application. If the deficiency occurs in a growing crop, apply 3 oz of sodium molybdate per acre in a foliar spray. Include a surfactant in the solution.

Spacing and Planting in the Field

Optimum yields of pungent yellow onion bulbs over 2 in. in diameter are obtained with plant populations of 225,000 to 250,000 plants per acre. This gives each plant 25 to 28 sq. in. of space. This population can be obtained by planting onions in 16-in. rows with 7 to 8 plants/ft of row. Wider or narrower row spacing that results in the same amount of space per plant can also be used: 20-in. rows with 9 to 10 plants/ft of row; or 32-in. rows with 14 to 16 plants/ft or row. A commonly used system is double rows 8 to 10 in. apart on 32- to 34-in. centers. The number of seeds in the double row should be the same as if it were a single row: 7 to 8 plants/ft in each row, for a total of 15 to 16 plants/ft in the double row. Row spacing is usually determined by the machinery available on the farm.

Pungent yellow onion populations of over 250,000 plants per acre may result in larger total yields, but the percentage of onions over 2 in. in diameter decreases. Populations less than 225,000 per acre will result in larger onions, but also lower total yields. Accurate spacing of pungent onions in the row is not as critical as the number of seeds/ft, because onions can move around to use available space in muck soil. On mineral soils, onions are embedded more firmly in the soil and tend to become misshapen or remain small rather than move when crowded. If this occurs, reduce seeding rate by about 25% in succeeding years.

Approximately 3 to 3½ lb of seed are needed per acre of pungent yellow onions. To determine exactly how much seed you will need, check the number of seeds per pound and the germination rate of the seed. Then divide the desired plant population by the number of live seeds per lb. This equals the minimum amount of seed required per acre. Because some plants do not develop bulbs, plant about 15% more seed than required. For example, if there are 100,000 onion seeds per lb and the seed has a 90% germination rate, each pound of seed will produce about 90,000 plants. The desired plant population for pungent yellow onions, 250,000, divided by the number of live seeds per lb, 90,000, equals 2.78 lb of seed. An additional 15% (0.42 lb) equals 3.20 lb or roughly 3¼ lb of seed per acre.

A seeder used for sowing onions must be adjustable to be able to plant different populations. The seeder must also be able to apply insecticide and fungicide in the furrow with the seed. Plant onion seed in moist soil about ½ in. deep. If the soil is dry and wind erosion may be a problem, plant seeds 1 in. deep.

Wind breaks will help reduce blowing of soil and blasting of small plants. Rye or barley strips planted at the time of onion seeding should be no more than 50 ft apart to be effective. Remove the wind break strips when onions are 5 to 6 in. high, either with herbicides or with a cultivator. A rough soil surface will also help reduce wind injury.

Dry onions can also be grown from sets. Approximately 25 bushels (800 lb) of sets ⅞ in. or less in diameter are needed to plant 1 acre. Set onions can be planted at the same populations as seeded onions. Fertilization practices are the same as for seeded onions. Set onions usually mature 2 to 3 weeks earlier than seeded onions. They should be sold soon after harvest and should not be stored.

Spanish onions, or Spanish-pungent hybrids, mature late in the season when grown from seed

in Michigan. They have the genetic ability to produce large bulbs and large yields at populations of about 125,000 plants/acre. Accurate spacing is necessary to obtain maximum yields of large bulbs. Higher populations result in smaller bulbs; lower populations result in delayed maturity.

Spanish onions can also be grown from transplants. Short day (Group 1) cultivars will produce large, early onions if grown from transplants that are at least 8 to 10 weeks old at transplanting. They begin to bulb about one month earlier than long day (Group 3) onions in Michigan, because of the difference in day length requirement for bulbing, and are ready for market much earlier. Approximately 120,000 to 140,000 plants are needed to plant 1 acre. Plant the seedlings 3 to 4 in. apart in rows 15 to 24 in. apart, either with a transplanter or by hand.

Plants are usually obtained from the southern U.S., but can be grown in the greenhouse. To have plants ready to plant in early April, sow seed in mid-January. Good plants are ⅛ to ¼ in. in diameter at the base and 4 to 5 in. tall. Remove the tops of longer leaves to facilitate transplanting and to reduce dehydration of the plants in the field after transplanting.

When plants arrive in boxes from the south, they should be planted immediately. If they have to be stored more than 2 days, open the boxes and remove some plants to allow good air circulation through the boxes. Keep them cool (40° to 50°F) but do not refrigerate below 40°F. They should remain good for about 2 weeks. Do not plant seedlings that have become soft and rotten. If the leaves are dry but bulbs are still intact, they will probably grow.

Seed Storage

Onion seed loses its viability rapidly. Check each lot of seed for germination before planting to determine seeding rate. This is especially important for seed more than 1 year old.

Onion seed can be stored successfully with little loss of viability for 2 to 3 years if kept at 50% or lower relative humidity and 32°F. If packed in airtight containers, seed will last up to 10 years. If seed is left over at the end of the planting season, place it in airtight containers or plastic bags, seal tightly, and store it in a cool (below 50°F), dry place.

Preharvest

Long-storage onions may be treated with maleic hydrazide (MH) in the field to reduce sprouting and extend the storage season. Maleic hydrazide will not extend storability of poor storing cultivars. Apply MH when onions are fully mature and leaves are still green, but necks are soft and about 50% of the tops have fallen over. This usually occurs about 2 weeks before harvest. Application of MH before onions are mature results in soft, spongy bulbs. Applications after most leaves have turned brown will not improve storage. Apply 2 lb active ingredient MH in 30 gal water per acre when the temperature is below 80°F.

Harvest, Curing, and Storage

If onions are slow to mature, the process can be speeded up by rolling the tops down with a light roller that does not dislodge or damage the onions, and/or by undercutting the bulbs with a cultivator. They are usually ready for harvest 5 to 7 days after undercutting. After a majority of the leaves are dry, lift and top the onions by hand or by machine. Leave 1 to 2 in. of neck on the onions to ensure a tight seal after drying. Obtaining tight necks is not usually a problem unless onions are harvested very green, and then sufficient neck is essential for successful drying and storage.

Spanish onions grown from transplants are usually topped by hand because of their soft, tender skins. Spanish onions are very susceptible to sunburn, which is caused by direct exposure to sunlight after harvest. Several layers of the onion flesh dry out and collapse on the side of the bulb exposed to the sun. Spanish onions should not be exposed to direct sunlight for more than 1 to 2 hours after harvest. If they are pulled to hasten drying, cover the bulbs with leaves, or remove tops immediately and dry in the shade.

After topping, onions can be placed in small crates or bulk-boxes, or harvested into bulk trucks and placed directly into storage. Whichever system is used, sufficient curing of the bulbs after harvest is essential to minimize disease development in storage, to develop thick, tight, outer scales, and to maintain good skin color. Onions can be cured outside or in storage. For air curing, place onions in boxes, cover with plastic to keep them dry, and leave them outside for 2 to 3 weeks. The best curing occurs at temperatures of 75° to 80°F and relative humidity of 60% to 70%.

Onions harvested in bulk are usually cured in storage. Use an externally-vented heat source to maintain a drying temperature of 85° to 90°F. Do not use an open-flame heater (such as a contractor's heater) because it adds 1 gal of water to the air for every gal of fuel burned. Force the warm air through the onion pile for at least 4 to 5 days, or until necks of onion bulbs are tight. Air volume should be 1.5 cu ft/minute for each cu ft of stored onions. Do not pile onions more than 12 ft deep in bulk.

After curing, gradually decrease the storage temperature. Do not reduce the temperature in storage below that of outside temperatures, because a few warm days will cause sweating, discoloration, and decay of bulbs. Air flow can be reduced to 0.75 cu ft/minute/cu ft of onions. By late October,

onion temperatures should be at about 45°F and by late November they should be 32° to 35°F and at a relative humidity of 60% to 70%. To maintain uniform temperature within the onion pile and to remove moisture from upper layers, run fans 2 to 4 hours per day, 1 to 2 days per week, on cool, dry days.

For more information on onion storage, see Extension Bulletin E-1409, *Temperature and Humidity Guides to Curing and Storing Onions.*

Grading and Packing

Michigan storage onions are normally packed in 3, 10, or 50 lb bags for fresh market. The onions are normally packed to meet U.S. No. 1 grade standards for medium size storage onions: mature; fairly firm; fairly well shaped; free from decay, sunscald, doubles, bottlenecks, seedstems, splits, sunburn, sprouts, frost damage, peeling, cracked fleshy scales, dirt, and insect and disease damage. Diameter should be a minimum of 1½ in. and 40% of a lot must be 2 in. in diameter or larger. Individual packages in a lot may have as few as 15% onions over 2 in., but the entire lot must average 40% over 2 in.

Large onions are normally worth more than small onions. To maximize returns, grow larger onions and pack bulbs 2 in. or larger only.

Physiological Disorders

Tipburn often appears in mid- to late summer on otherwise healthy onions. The upper 1 to 2 in. of mature leaves turn yellow and then brown, but the rest of the leaves remain green. A field may turn from bright green to yellow and brown in one week's time, even with control of foliar diseases.

Tipburn appears to be caused by a combination of factors, including incipient maturity, dry conditions, thrip damage, nutrient deficiency, and secondary effects of diseases such as botrytis leaf blight and pink root. If a significant percentage of foliar tissue dies, yields may be reduced. Good cultural practice, disease control, and timely irrigation will help avoid tipburn.

Insects

Consult Extension Bulletin E-972, *Lettuce and Onion Pests*, for pictures of insect pests and life history information. See Extension Bulletin E-312, *Control of Insects, Diseases, and Nematodes on Commercial Vegetables*, for current pest control recommendations.

Onion maggot *(Delia antiqua)* is the most serious insect pest of onions in Michigan. The ¼ in. long, brownish-grey adults emerge in the spring and lay eggs on the bases of seedlings and on volunteer onions. When the eggs hatch, the larvae burrow into the roots. Forty percent or more of the crop may be destroyed by the first generation of maggots. Summer adults, which emerge from the soil in July, cause much less damage than the spring generation because they prefer previously damaged plants for egg laying. Egg survival during very hot summers is generally poor because they are killed by temperatures above 120°F, which often occur at the surface of black, muck soils. Damage caused by summer-emerging adults appears as elongated holes or scars in the outer scales of bulbs.

Third generation adults emerge in late August and September and usually begin laying eggs after harvest. Cull onions from grading and bulbs left in the field are hosts for the maggots. The maggots overwinter as pupae in the soil and emerge as adults the following spring.

All seeded dry bulb onions should be treated with a soil insecticide. Granular insecticide should be applied in the seed furrow with the seed before the furrow is closed. Transplanted onions should be drenched with a soil insecticide after transplanting.

Insecticide resistance is a major problem in control of onion maggot. Onion maggots develop resistance to insecticides faster than most other insects because they feed only on onions and must resist insecticides to survive. Their high reproductive rate and the heavy use of chemicals for their control also increase the rate of resistance development. Exposure to foliar sprays aimed at adult flies or other pests increases the maggots' resistance to the soil-applied insecticides.

To minimize resistance problems, onion maggot control should be as diversified as possible. Foliar sprays for control of other pests should be kept to a minimum in order to reduce buildup of resistance and encourage natural enemies. Plow fields in the fall to bury onions left in the field after harvest. Bury onion trash from grading in land fills. When possible, reduce fungicide sprays through onion disease forecasting programs to increase the incidence of fungal disease in the maggot flies.

Thrips *(Thrips tabaci)* are very small ($^{1}/_{16}$ in.) cream or brown insects that migrate into onion fields in early to mid-July. They damage onions by chewing through the epidermis of the leaves and sucking the sap. Heavily infested onions turn brown at the leaf tips and plant development slows. Heavy infestations can reduce yields. Thrips multiply quickly during hot, dry weather.

Thrips are found between leaves deep inside the plant. It is difficult to control them once they are well established because they are hidden between leaves, and insecticides do not penetrate into the plants well. Check onions regularly for thrips, especially during warm, dry weather, and apply insecticides as needed. For best results, apply insecticides in at least 60 gal of water per acre at 100 psi pres-

sure to obtain good penetration into the plants. Check onions after heavy rains because rain appears to be a major thrip mortality factor, and additional sprays may be unnecessary.

Most insecticides are toxic to thrips. Long-residual insecticides are more effective than those that dissipate quickly. Two or three applications may be necessary to obtain complete control. Consult insecticide labels for application intervals.

Nematodes

Northern root-knot, root-lesion, onion bloat, and stubby-root nematodes are found in Michigan onion fields and can reduce yields. If nematode problems are suspected, have soil and root tissue tested for nematodes. (See Extension Bulletin E-800, *Nematode Detection.*) If nematodes are present in numbers above an action threshold, an appropriate nematode management procedure will be recommended.

Diseases

Smut *(Urocystis colchici)* is a soilborne fungus that causes black streaks in the outer bulb scales and leaves of young plants. Leaves often twist and turn yellow. The black streaks in bulbs and leaves are filled with black, dusty spores. Infected young plants usually die, but some infected plants survive to develop moderate size bulbs. Yields and quality are greatly reduced by smut infection. The fungus overwinters in the soil. Virtually all Michigan onion fields are infected with smut.

All onion seed should be treated with a fungicide, preferably thiram 50% WP, before seeding or as it is sown. Crop rotation will help reduce infection levels.

Botrytis leaf blight *(Botrytis squamosa)* is a disease that causes small white spots on leaves that are surrounded by light green or yellow halos. The spots are often confused with herbicide injury, which does not have the halo around the spots. The spots may expand to cover large portions of leaves, which turn yellow and die within a week. Rainy weather causes more leaf blighting.

Spray onions with a foliar fungicide on a 7- to 10-day schedule to control blight. *Bravo 500* (chlorothalonil) is especially effective. Do not use *Bravo 500* on Spanish onions because of possible crop injury.

Downy mildew *(Peronospora destructor)* is a major foliar disease in Michigan onions. Lesions ¼ to ½ in. in diameter appear about midseason on mature leaves. A white- to purple-colored mold develops on otherwise healthy-looking leaves as the fungus forms the spores that spread the disease. The mold is obvious in early morning when plants are wet with dew, but often dries up during the heat of the day. Infected leaves dry up quickly and die after spores have formed. The disease is most prevalent during cool, wet weather.

To avoid downy mildew, spray onions with a foliar fungicide on a 7- to 10-day schedule as soon as foliar symptoms appear. *Ridomil MZ-58* (metalaxyl plus EBDC) is very effective against downy mildew.

A blight forecasting instrument has been developed at Michigan State University that predicts, on the basis of weather, the probability of downy mildew and Botrytis leaf blight infection and the need to spray. In a normal year, applying fungicides according to predictor recommendations can save a grower several sprays and reduce production costs.

Purple blotch *(Alternaria porri)*, a fungus, is present in some Michigan fields. It is often confused with downy mildew because the symptoms are quite similar.

Symptoms appear as small, water-soaked spots on leaves, which expand and turn brown and dark purple. The spots are covered with a brown mold in early morning. Affected leaves die and break off.

Purple blotch can be controlled by applications of foliar fungicides. *Rovral* (iprodione) is especially effective.

Fusarium basal rot *(Fusarium oxysporum* f. sp. *cepa)* is a problem in some fields in Michigan. The fungus lives in the soil for many years. It enters the bulbs at the base through root tips or injuries caused by other organisms. Plants infected early in the season turn yellow and wilt. Later-infected bulbs may appear normal and firm at harvest but inner scales rot at the base of the bulb. The rot tends to be firm and dry. The disease progresses in storage. The outer scales of infected bulbs often appear slightly darker brown than normal.

Fusarium basal rot may be more severe in poorly drained fields. There is no chemical control. Resistant cultivars are available and should be used in infested fields. Where possible, grow other crops on badly infested fields.

White rot *(Sclerotium cepivorum)* has appeared in a few fields in Michigan. It is a greater problem in other northern states and Canada, and there is potential for more problems in Michigan.

The disease first appears as yellowing and wilting of the leaves. The bulbs become soft and rotten, and can be pulled from the soil easily because roots have rotted. A white mold develops on the bulbs, and black sclerotia form in the mold and on the bulbs. The sclerotia appear to be grains of black soil but can be identified under a microscope.

The fungus is specific to members of the onion family, and persists in the soil for a long time. It appears to be worse in poorly drained fields. Plant breeders are

working on resistant cultivars but none are commercially available yet. Therefore, the only current solution to white rot is to grow other crops in badly infested fields.

Pink root *(Pyrenochaeta terrestris)* is a soil-borne fungus that is present in virtually all Michigan onion fields, but causes most damage during hot, dry years because of high soil temperatures and water stress. Roots turn bright pink and die, and new roots form throughout the season. Infected plants have about 50% of the root system of healthy plants, and water and nutrient uptake is subsequently reduced. Yields and bulb size may be reduced. Infected plants also appear to be more susceptible to other diseases, such as Fusarium basal rot and white rot. Southern transplants are often infested with pink root, leading to severe disease in the field.

Spartan Banner and Downing Yellow Globe have some resistance to pink root. Heavily infested fields should be managed carefully with special attention given to irrigation, drainage, and fertilization to obtain maximum yields. The disease does not have an adverse effect on the quality of harvested bulbs because it is confined to the roots during the growing season.

Botrytis neck rot *(Botrytis allii)* is a common disease of bulbs in storage. The organism enters the bulbs through the neck during the growing season or after harvest. The scales at the base of the neck collapse and become soft; a whitish-grey mold with black sclerotia appears on the fleshy scales under the dry outer scales. The bulbs gradually soften and the inner flesh appears cooked or frozen. Soft rot may set in and the bulbs become smelly, soft, and rotten. To avoid Botrytis neck rot, control foliar diseases throughout the season. Harvest onions when they are mature and necks are well dried. Leave 1 to 2 in. of neck on the onions and cure well before storage. Do not store onions harvested from wet areas. Avoid bruising bulbs during harvest.

Bacterial soft rot *(Erwinia carotovora* and *Pseudomonas spp.)* enters bulbs through the neck during the growing season. It often begins in leaves infected with other organisms and moves down individual scales into the bulbs. The problem is especially severe during rainy weather. If dry weather returns, disease progression may be slowed and bulbs may appear normal. The infected scales may dry up. However, the rot normally progresses eventually, especially in storage, causing soft, foul-smelling bulbs.

Some cultivars appear to be more susceptible than others. Spanish onions developed for the dry areas of the western United States are especially susceptible when grown in humid areas like Michigan. To avoid the problem, control foliar diseases with fungicides and do not plant cultivars that are known to be susceptible. There is no chemical treatment available to stop the bacteria once it is established in the plants.

Aster yellows is caused by a mycoplasma carried by the aster leafhopper *(Macrosteles fascifrons)*. It is primarily a disease of lettuce, celery, and carrots, but also infects onion. The disease causes soft, small bulbs and long, yellow-green leaves. The bulbs do not dry well during curing and often sprout in storage because they have not become dormant. Under extreme disease conditions, infection may approach 5% to 10%. The main problem caused by the disease is poor drying of onion bulbs in storage, which may cause subsequent rots.

Because the disease is transmitted from infected weed and crop hosts by leafhoppers, it can only be controlled by reducing the presence of host plants near onions and controlling the leafhoppers in most crops. It is of little value to spray onions to control aster leafhoppers.

Weeds

Weed control is a major expense and concern in onion production. Onions are very poor competitors, and weed pressure any time before bulb formation will reduce yields. Weeds later in the season keep onions from drying quickly and interfere with harvesting.

A good weed control program consists of pre- and post-emergence herbicide applications. With a good herbicide program, cultivation is usually unnecessary. Once or twice a season it may be necessary to pull out large weeds that have escaped herbicide applications. For current weed control recommendations, see Extension Bulletin E-433, *Weed Control Guide for Vegetable Crops.*

Pesticide Information

Pesticides must be registered with the U.S. Environmental Protection Agency (EPA) and the Michigan Department of Agriculture before they can be used legally in Michigan. Purchase only pesticides that are labeled for the crop to be treated and the pest to be controlled. Remember that the pesticide label is a legal document on pesticide use, and all instructions and limitations on it must be followed closely. The use of a pesticide in a manner not consistent with the label can lead to injury of crops, humans, animals, and the environment, and can lead to civil fines and/or condemnation of the crop.

Additional Information

More information on onion production is available in the follow-

ing bulletins, available from county Cooperative Extension Service offices, or from the MSU Bulletin Office, P.O. Box 6640, East Lansing, Michigan 48823-6640. Some bulletins are for sale only, so check for availability and prices.

E-312 *Control of Insects, Diseases, and Nematodes on Commercial Vegetables*
E-433 *Weed Control Guide for Vegetable Crops*
E-486 *Secondary and Micronutrients for Vegetables and Field Crops*
E-550 *Fertilizer Recommendations for Vegetable and Field Crops in Michigan*
E-675 *Vegetable Varieties for Commercial Growers*
E-800 *Nematode Detection*
E-972 *Lettuce and Onion Insect Pests*
E-1409 *Temperature and Humidity Guides to Curing and Storing Onions*
E-1721 *Diseases of Onions*
E-1751 *Identifying Diseases of Vegetables*

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