

ASPARAGUS

PRODUCTION: The average yield in Michigan is 1,300 lb. per acre; a good yield is 2,000 lb. per acre.

USE: 80% of Michigan asparagus is processed and 20% is sold in the fresh market.

Varieties

"Washington" strains (Mary, Martha, Waltham) and "Viking" strains are recommended for use in Michigan. Although hybrids have been developed, none have been tested sufficiently for recommended use in Michigan. Good hybrids for Michigan are now being developed and tested.

Asparagus plants are dioecious, which means that there are both male and female plants in the same population. Male plants produce more spears and greater total yields, but the spears are smaller in diameter. Female plants produce fewer spears, but they are larger. Female plants also produce red berries containing seeds, which sprout and grow causing a major weed problem (volunteer asparagus). Therefore, male plants are preferred, but there is no way to separate male or female seed or crowns, so all commercial fields contain both. An objective of current research is to develop all-male hybrids, which should produce higher yields and eliminate the volunteer asparagus problem.

Climatic Requirements

Asparagus is a temperate, perennial crop that grows well in all parts of Michigan. However, spring frosts occurring after spears have emerged destroy these spears and delay subsequent spear development. Therefore, avoid planting asparagus in low-lying areas that are especially susceptible to frosts. Areas along the Great Lakes are especially well suited to asparagus production because of the modifying effects of the lakes.

Asparagus fern is killed by frost in the fall. Hard frosts during the winter on bare ground can injure crowns. Therefore, plant crowns at least 8 inches deep to gain some protection from the cold. Leave fern standing through the winter or chop it to 10 to 12 inches in the fall (in no-till fields) to catch and hold snow so that frost does not penetrate the soil deeply.

Soil Requirements

Asparagus grows well on any well-drained soil. Sands and sandy loams with good moisture-holding capacity are ideal. Although asparagus grows well on

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muck soil, there is more danger of damage from spring frost in low-lying areas. Good drainage is a primary requirement. Adjust the pH to 6.8 before planting, since asparagus does not tolerate acid soil very well. Asparagus fields tend to become more acid after repeated nitrogen applications. Asparagus does tolerate alkaline soils and high salt levels fairly well. Do not plant asparagus on steep slopes, since heavy rains may erode top soil and expose crowns. Erosion is a potentially serious problem during the year when crowns are planted and furrows are left partially open.

Crown Production

Site: Establish crown beds on land that has not had asparagus on it previously, to avoid *Fusarium* crown rot and other soil toxicity problems. The land should be free of perennial weeds and relatively free of annual weeds. Most loam, sandy loam, or muck soils are well drained, hold moisture well, and are soft enough for easy digging of the crowns. Avoid areas that dry out late in the spring, since crowns should be dug very early, before they begin to sprout.

Fertilizer requirements: Asparagus crowns require moderately high levels of N, P, and K for good growth. About 200 lb. each of P₂O₅ and K₂O should be available per acre. Before seeding, disc in 1,000 lb. of 10-20-20 per acre. When asparagus plants are 6 to 8 inches high, sidedress with 50 lb. N per acre (150 lb. ammonium nitrate).

Spacing and planting: Use sized seed, if available, to improve uniformity of plant size and emergence. Use a precision planter for accurate placement. Sow the seed 2 inches apart in the row, with 24 to 30 inches between rows. This spacing gives the plants plenty of room to develop and allows for easier harvest and separation the following spring. Sow the seed 1 to 1½ inches deep, in moist soil. Seeding may begin in mid-April and should be completed by May 15.

One lb. of seed will produce enough crowns for 1 acre. About 5 lb. of seed are needed for 1 acre of crown bed, and 1 acre of crown bed will produce enough crowns for 5 acres of production field.

Weed control in crown beds is essential to obtain large, vigorous crowns. Young asparagus plants are poor competitors and weed pressure will result in small crowns. Lorox and Amiben are registered in

Michigan for pre- and postemergence weed control in crown beds. See Extension Bulletin E-433, "Weed Control Guide for Vegetable Crops," for application instructions. Cultivation is also effective in controlling weeds. Be careful to keep cultivator shovels shallow, so you do not disturb the expanding asparagus storage roots.

Harvest crowns as early as possible the following spring, before buds begin to sprout. Crowns may be harvested after 2 years, resulting in larger crowns. However, 2-year-old crowns appear to suffer greater transplant shock, and there is no advantage in using them. Crowns are usually dug with a potato digger and either dumped directly onto trailers, or back onto the ground for hand loading.

Remove as much soil from the crowns as possible, separate, and sort them. Store the crowns in loose piles or in bulk boxes. Do not pack them tightly. Keep them cool (35 to 45°F) and dry, but do not let them become desiccated. Do not let them freeze. Crowns can be stored for up to 2 months under good conditions. Some sprouting will occur but this will not greatly reduce the vigor of the crowns.

Production

Site selection and preparation: Good establishment is important in long term profitability of asparagus. Any mortality of crowns the year of planting reduces the potential for maximum yields in future years. Any short cuts or cost-cutting operations in establishing production fields may result in poor stands and reduced vigor.

Choose a well-drained field with good air drainage that has not had asparagus planted on it before. This is important to avoid *Fusarium* crown rot.

The year prior to planting crowns, test the soil and apply lime to attain a pH of 6.8. Spread 15 to 20 tons of manure per acre, if available. Kill all perennial weeds present with Roundup. Then plant a cover crop, such as sudangrass or clover.

The fall before planting, chop and plow down the cover crop and plant winter wheat or rye. The spring of planting, spread P_2O_5 and K_2O over the cover crop and plow it down 12 inches.

Approximately 250 lb. each of P_2O_5 and K_2O per acre should be available in the soil at planting. Determine amounts to be added by a soil test. If soil test results are not available, apply 1,000 lb. of 5-20-20, or the equivalent, per acre over the cover crop and plow it down.

Planting: Plant as early in the spring as possible. Use large, disease-free, 1-year-old crowns. Check some crowns for *Fusarium* crown rot by cutting through the buds. Brown discoloration of the vascular system indicates probable *Fusarium* infection. If the crowns are infected with *Fusarium*, do not plant them.

Apply 70 lb. P_2O_5 per acre in the bottom of the furrows at time of planting crowns. Sidedress with 50 lb. N per acre when fern is 6 to 8 inches high.

Space crowns 1 ft. apart, center to center, in rows 4 to 5 ft. apart. This will require 9,000 to 11,000

crowns per acre. Separate crowns by size and plant the different sizes together. Smaller crowns develop more slowly, and the small plants may be cultivated over if planted with larger, more vigorous plants.

Make furrows with a middle-buster plow, which throws the soil in two directions. Furrows should be 8 to 10 inches deep from the level surface of the field. Shallower planting results in earlier production in the spring and smaller diameter spears. Earlier production often results in frozen spears, so it is not desirable.

Drop crowns by hand into the furrows. Buds should be pointing up, but perfect orientation of all roots is not necessary. Cover the crowns with 1 to 2 inches of soil the day of planting. As the fern grows, cultivate into the furrow, so that by the end of the summer the furrow is full. Be careful not to cover the fern.

Direct seeding in the bottom of furrows has not been very successful. It is difficult to get a good stand at the desired spacing. Furrows on a slope can easily be washed out or filled in by heavy rain. Transplanting of seedlings directly into production fields may become popular in the future, especially for establishment of cloned plants produced through tissue culture. However, the plants are very tender and can suffer from the same problems as direct seeded asparagus.

Fertilizer requirements: Since asparagus is a perennial, it does not require as much fertilizer as annual crops. A 2,000 lb. crop removes only 13 lb. N, 4 lb. P_2O_5 , and 9 lb. K_2O from an acre. After establishment, no additional P_2O_5 needs to be added to asparagus fields.

Each year, before working the soil, apply 50 lb. N per acre (100 lb. urea or 150 lb. ammonium nitrate). If the crop is being managed with no-tillage, use ammonium nitrate. Apply 60 lb. K_2O per acre every other year.

Tillage and maintenance each year: Asparagus can be managed under either of two systems: minimum tillage, or no-tillage. About 60% of Michigan asparagus is grown using no-till. Under no-tillage, asparagus fields are not normally cultivated. Herbicides are used to maintain weed control. With minimum tillage, fields are cultivated once each season, before asparagus begins to grow.

To use the no-tillage system, chop fern in the spring as low as possible with a rotary chopper; spread fertilizer; and apply herbicides. After the harvest season is complete, reapply preemergence herbicides. Every third or fourth year, level the field in the spring with a drag to remove ridges that build up above the rows.

With minimum tillage, work the fields lightly in the spring each year before asparagus begins to grow. Till as early as possible to a maximum of 2 to 3 inches using a rotovator or rolling field cultivator. Use a disc only if no other tillage equipment is available, and carefully maintain correct depth. Deep tillage can injure emerging spears and thus reduce early yields as well as open wounds for *Fusarium* infection. If a field cultivator is used, chop the fern before tillage, and

apply preemergence herbicides after tillage but before weeds emerge.

If weeds or thin spears interfere with harvesting during the season, chop the field with a rotary chopper after a clean harvest. When harvest is complete, chop the field close to the ground and reapply preemergence herbicides.

Harvest and Postharvest

When to harvest: Do not harvest any spears from newly planted asparagus the year of planting, or the following year (second year). Harvest the field for about 2 weeks the third year. Harvest for about 6 weeks the fourth and subsequent years, or until a majority of spears are under $\frac{3}{8}$ inch in diameter—whichever comes first.

Harvest usually begins about the first week of May in southern Michigan, and 1 to 2 weeks later in mid and northern counties. Regardless of when harvest begins, it should not extend beyond July 1.

A well-established asparagus field should be productive for 20 years or longer. Some fields remain in production for 50 years or more. However, fields infected with *Fusarium* rots often become unprofitable after only 10 to 12 years.

How to harvest: Most Michigan asparagus is snapped by hand, by people either walking over fields, or riding on "picking aids."

Snap asparagus spears off just above the ground when they are 7 to 9 inches high. If the asparagus is to be sold for fresh market, the spears should be oriented with heads in the same direction in picking containers. Processing asparagus does not have to be oriented.

Mechanical harvesting of asparagus has not been widely adopted, since most mechanical harvesters have been non-selective, cutting tall and short spears at the same time, resulting in reduced yields.

Asparagus grows very rapidly when temperatures are above 80°F. The growth rate sometimes approaches 1 inch per hour. Therefore, during warm weather, asparagus should be harvested every day. When temperatures remain below 70°F, it may be possible to harvest every 2 to 3 days without loss of quality. Spears should always be harvested before bracts open and heads begin to branch out. Hot weather may cause bracts to open when spears are only a few inches above the ground.

Grading: The Michigan asparagus industry has established the following grade standards for processing asparagus: *Select grade:* maximum length of 7½ inches; spears must be $\frac{1}{4}$ inch or greater in diameter 4 inches below the tip; any white butts, undersize or overlength spears, beetle eggs on spears, or trash in the asparagus are cull material and may result in rejection of a lot.

Although official grade standards for fresh market asparagus have not been established, the following rules are proposed: *Fancy grade:* spears must be a minimum of $\frac{3}{8}$ inch in diameter; for oriented spear

packs, minimum length is 7 inches; for loose spear pack, maximum length is 9½ inches. The asparagus must be all green, fresh, not badly misshapen, free from decay and free from damage caused by spreading tips, dirt, disease, insects or mechanical damage. *Select grade:* does not meet one or more of the grade requirements for fancy grade asparagus.

Handling asparagus for fresh market: To maintain asparagus freshness, cool it as soon as possible after harvest. Hydrocooling is preferred. The half-cooling time for packed asparagus is about 2½ minutes, so about 5 minutes in a hydrocooler at 32°F will lower temperature to about 40°F.

Store asparagus at 32 to 36°F at 95% relative humidity. Under those conditions, quality will be maintained for 2 to 3 weeks. Do not set cut ends of spears in water. This can lead to opening of the tips and soft rot of the butt ends.

Handling asparagus for processing: Asparagus for processing is usually dumped into bulk boxes in the field and hauled to a receiving station or processing plant at the end of the day or when harvest for the day is complete. While waiting for shipping or processing, place asparagus in cold storage, or at least in the shade. Asparagus should never be left in the sun or the tips will open, and spears will wilt and become fibrous.

Weed Control

Perennial weeds are the greatest weed problems in asparagus, because it is a perennial crop. Some of the more common perennial weeds in asparagus are quackgrass, swamp smartweed, milkweeds, bindweed, horsenettle, yellow nutsedge, and Canada thistle. Perennial weeds should be killed with Roundup the year before crop establishment. Two or more applications may be needed to clean the field since various weeds emerge at different times of the year. After establishment of the crop, spot treat any emerging perennials with Roundup after the harvest season, avoiding contact with crop plants. Since tillage tends to break up and spread perennials, weedy fields should be managed with no-tillage.

Volunteer asparagus is a serious weed pest in asparagus. It grows from seed dropped from mature fern the previous fall. Once established, it is very difficult to control. No-till management is probably the best means of control, since the seeds are not buried and usually do not germinate on the soil surface. The young seedlings are easily cultivated out within a month of emergence. A field cultivator will root out plants 1 to 2 years old. Older plants can be killed in the fern stage with a spot treatment of Roundup; avoid spraying the crop plants.

Annual weeds can usually be controlled by applications of pre- and postemergence herbicides. Apply a long residual preemergence herbicide in the spring before asparagus emerges. Reapply a preemergence herbicide after harvest is complete for the year. Since the spectrum of weeds controlled varies with herbi-

cide, it is wise to rotate herbicides each year. Recommended preemergence herbicides registered for asparagus include Karmex, Princep, Devrinol, Sencor, and Lexone.

Lorox is registered in Michigan for postemergence control of most annual broadleaved weeds in asparagus. Spray when weeds are less than 2 inches high. 2,4-D is also registered for postemergence broadleaf control.

See Extension Bulletin E-433, "Weed Control Guide for Vegetable Crops," for complete weed control recommendations.

Insects and Diseases

Detailed information on disease, insect, and weed pests of asparagus is available in Extension Bulletin E-959, "Common Asparagus Pests." See Extension Bulletin E-312, "Control of Insects, Diseases, and Nematodes on Commercial Vegetables," for current pest control recommendations.

Cutworms attack asparagus during the harvest season. Injured spears may be damaged at the growing tip, stopping spear growth, or damaged on the side, causing crooked spears. Check fields for larvae in the fall and note damage during harvest. Fall applications of granular insecticides will control cutworm species that overwinter as larvae. Spring foliar applications of insecticides will control species that overwinter as eggs or larvae.

Common and spotted asparagus beetles lay eggs and feed on spears or fern. Larvae of common asparagus beetles also cause severe feeding damage. Larvae of spotted asparagus beetles feed on the berries. Beetle eggs on spears are a serious contaminant of processing asparagus. Therefore, to maintain a quality product, beetles must be controlled if they appear during the harvest season. They should be controlled later in the season to maintain vigorous fern growth.

Plant bugs, especially the tarnished plant bug, attack new growth, particularly during late July and August. Injection of toxic saliva causes tissue collapse and tip die-back within a few days. Fern loss can be severe and growers should check fields when flushes of new fern growth appear.

European asparagus aphids are present in most Michigan asparagus fields, but do not appear to cause economic damage.

Rust (*Puccinia asparagi*) is a common disease that attacks asparagus fern, causing dark red to black pustules on the leaves and stems. Heavy infestations occur during wet summers and can reduce plant vigor and contribute to general asparagus decline. Fungicides give fair to good control of rust, depending on

the year and the number of applications. Since all registered fungicides are preventive rather than curative, optimum rust control is attained by beginning applications at the first sign of rust pustules and continuing until about September 10, at 10 day intervals.

Purple spot (*Stemphylium vesicarium*) has become a disease of concern in recent years. Small (1 to 2mm) elliptical, purplish spots appear on spears during harvest and on fern later in the season. Lesions that appear later in the season are tan with a dark brown border. These lesions may become quite large (up to 1 x 3 cm) and variable in size. Banding of needles by this pathogen causes needle drop and can result in severe defoliation. Chemicals have been ineffective in controlling purple spot.

Crown rot (*Fusarium oxysporum* f. sp. *asparagi* and *Fusarium moniliforme*) is the major cause of asparagus decline. Most of the fields in Michigan are infested to a greater or lesser degree. The organism is carried on asparagus seed and crowns, and lives in the soil for many years. Infected plant beds appear to be a source of inoculum for many fields.

Crowns infected with crown rot have a reddish-brown discoloration in the vascular tissues of the rhizome, shoots, and storage roots. The storage roots of infected mature crowns become hollow and rotten. Fern of infected plants first turns yellow during the summer, then turns brown as the plants slowly die back. Production from infected plants decreases, with fewer and smaller spears.

Chemical treatment has been ineffective in controlling crown rot. No known treatments will overcome heavy infestation in the field. Old asparagus fields should not be replanted to asparagus. Nitrogen application, irrigation, and insect and weed control will reduce stress and give the asparagus more of a competitive edge, and may result in longer productivity. The best control is avoidance, by purchasing disease-free crowns and planting them into new ground.

More information on asparagus production may be obtained from the following publications, available from County Cooperative Extension Offices or the MSU Bulletin Office, P.O. Box 231, East Lansing, MI 48823-0231.

E-312 Control of insects, diseases, and nematodes on commercial vegetables

E-433 Weed control guide for vegetable crops

E-550 Fertilizer recommendations for vegetable and field crops in Michigan

E-959 Common asparagus pests

E-1327 Costs of asparagus production in western Michigan

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Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

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O-14796