

Commercial Vegetable Recommendations

Asparagus

Bernard H. Zandstra
Department of Horticulture

John F. Kelly
Department of Horticulture

Mary Hausbeck
Department of Botany and Plant
Pathology

Edward J. Grafius
Department of Entomology

Hugh C. Price
Department of Horticultural
Science
Cornell University
Geneva, New York

FILE COPY
DO NOT REMOVE

Asparagus (*Asparagus officinalis*) is a perennial member of the lily (Liliaceae) family that has been cultivated in Europe and Asia for more than 2000 years. Asparagus is dioecious — that is, male and female flowers occur on separate plants. Currently about 25,000 acres of asparagus are planted in Michigan. Average yields are about 1,500 lb per acre in mature plantings. A vigorous field of an open-pollinated variety may produce more than 2,000 lb per acre. The new all-male hybrids may yield 4,000 lb or more per acre.

Varieties

Traditionally, commercial asparagus fields have been established with open-pollinated cultivars. Seed for these cultivars is collected from specified seed production blocks from which weak and abnormal plants have been removed. The seed is harvested mechanically when the fruit is fully mature, washed to remove all debris, and dried to 10 to 12% moisture.

Open-pollinated cultivars such as 'Mary Washington', 'Martha Washington' or 'Viking KB3' are dioecious (50% male and 50% female) and are being replaced rapidly by hybrids.

Recent advancements in tissue culture technology for asparagus have facilitated the development of clonal hybrids. Selected male and female parents are micropropagated and placed in seed production blocks that have one male plant for each four to five female plants. Honeybees transport pollen from the male to the female blossoms. The seed is harvested as described previously.

'Jersey Centennial' is a clonal hybrid that utilizes 'NJ 56' as the female parent and 'NJ 22' as the male. It is dioecious and produces spears with excellent size and quality. Under cool growing conditions, spears have very tight heads with purple coloration due to the accumulation of anthocyanin pigments. High temperatures during harvest cause heads to loosen similar to the open-pollinated cultivars. It is susceptible to *Fusarium* root and crown rot, but is very vigorous and appears to be able

to withstand this disease complex. Yields during years 3 to 6 are lower than those of other hybrids; however, in trials 'Jersey Centennial' increased in yield each year, and after 9 years of harvest its yield was among the top 10 percent of varieties tested.

All-male hybrids produce only male plants and thus produce no seeds. This is advantageous because the food that goes into fruit production in dioecious varieties is available for transport into the storage roots of all-male hybrids. Another advantage of these hybrids is that no problem with seedling asparagus occurs in established fields, because the plants produce no seed.

Currently, all-male hybrids are available from New Jersey, Germany and the Netherlands, but only the New Jersey all-male hybrids are recommended for Michigan. 'Jersey Giant' is the all-male hybrid that has been under evaluation for the longest time. In trials it has produced excellent yields through 10 years of harvest and retains tight heads except under very warm conditions. Similar to the other hybrids, it is not genetically resistant to *Fusarium* crown and root rot, but it is very vigorous and appears to be able to withstand pressure from this disease. Several other New Jersey all-male hybrids are under evaluation and may be recommended when seed becomes available. Hybrids also are being developed in Michigan. The seed of the new hybrids costs much more than that of open-pollinated varieties, and this cost is a major factor to consider when establishing new plantings.

Climatic Requirements

Asparagus is a temperate-zone, perennial crop that grows well in all parts of Michigan, although spring frosts occurring after spears have emerged destroy these spears and delay subsequent spear development. The early spears are generally

larger than later spears, so the loss of the early production can significantly reduce total yields. Therefore, avoid planting asparagus in low-lying areas that are especially susceptible to frosts. Areas near Lake Michigan are especially well suited to asparagus production because of the modifying effects of the lake, which delay spear emergence and reduce frost injury.

Asparagus fern is killed by frost in the fall. Deep freezes during the winter on bare ground can injure crowns. Therefore, plant crowns at least 8 inches deep to gain some protection from the cold. Shallower planting also will result in smaller spear size. Leave fern standing through the winter (preferred) 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 residual organic matter and good moisture-holding capacity are ideal. Although asparagus grows well on muck soil, there is more danger of damage from spring frost in low-lying areas.

Adjust the pH to 6.8 before planting. Asparagus does not thrive on soils with pH below 6.0, although it can tolerate pH down to 5.0. Soil pH below 6.0, however, favors *Fusarium* crown rot. Asparagus fields tend to become more acid after repeated nitrogen applications, so excessive nitrogen applications should be avoided. Asparagus tolerates alkaline soils (up to pH 7.5 is acceptable) and high salt levels fairly well.

Do not plant asparagus on steep slopes where heavy rains may erode topsoil and expose crowns. Erosion is a potentially serious problem during the planting year, when furrows are left partially open.

Crown Production

Crowns most frequently are raised by growers who specialize in that operation. If you purchase crowns, it is important to buy from an established grower with a reputation for disease-free, vigorous and true-to-type plants.

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 friable enough for easy digging of the crowns. Avoid areas that dry late in the spring. 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, disk in 1,000 lb of 10-20-20 (or the equivalent, depending on soil test) 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 1 1/2 inches deep in moist soil. Plant the seed between mid-April and mid-May.

One pound 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: Good weed control is essential for successful crown production. Weeds reduce the vigor of young plants

and may reduce stands. Roots and rhizomes of perennial weeds may contaminate crowns and allow the weeds to become established in production fields. (Weed control recommendations are contained in North Central Regional publication 330, "Weed Control Guide for Vegetable Crops.")

Insect control: Most of the pests that attack mature fields can also be a problem in crown nurseries. See bulletin E-959 for pictures and descriptions of insect pests.

Harvest: Crowns should be harvested as early as possible the following spring, before buds begin to sprout. Crowns may be harvested after 2 years, but these 2-year-old crowns appear to suffer greater transplant shock, so there is no advantage in using them. Weak crowns have been shown to yield less than plants established from vigorous crowns. Often 2-year-old crowns are weak crowns grown an additional year to obtain additional size.

Crowns usually are 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, and 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 freeze or become desiccated. Crowns can be stored for up to 2 months under good conditions. Some sprouting will occur, but this will not reduce the vigor of the crowns significantly.

Production

Site selection and preparation: Good establishment is important for long-term profitability of asparagus. Any mortality of crowns in the planting year reduces the potential for maximum yields in future years. Any shortcuts 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 before planting crowns, test the soil and apply lime as needed to attain a pH of 6.8. Spread 15 to 20 tons of manure per acre, if available. Kill all perennial weeds present with a registered herbicide. 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 P₂O₅ and K₂O over the cover crop and plow it down 12 inches.

Approximately 250 lb each of P₂O₅ and K₂O 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. It is important to get P down to the area below the crowns before planting, because it is difficult to get this immobile element into that area after planting.

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 (water- and nutrient-conducting) system indicates probable *Fusarium* infection. Do not plant infected crowns or lots with a high percentage of infected crowns. Apply up to 70 lb P₂O₅ (depending on soil test) per acre in the bottom of the furrows at the 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 each size group together. Do not plant very small crowns (less than 1/2 inch in diameter).

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 smaller diameter spears and earlier production in the spring, which often results in frozen spears.

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 be washed out or filled in easily 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. The plants are very tender, however, and can suffer from the same problems as direct-seeded asparagus.

Fertilizer requirements: Because 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 P₂O₅, and 9 lb K₂O from an acre. After establishment, no additional P₂O₅ needs to be added to asparagus fields.

Annual applications of nitrogen (N) should be split between pre- and postharvest. The total amount of actual N should not exceed 75 lb per acre. There is no yield response at increased rates and runoff of leached nitrogen could potentially contribute to groundwater contamination. Use ammonium nitrate (33-0-0) or other nitrate forms as a N source because their nitrogen is readily available and non-volatile. Do not use anhydrous ammonia on asparagus — injection causes root injury.

Potassium should be applied as recommended by a soil test. Take soil samples at least every 3 years on established asparagus fields. If a soil test is not available, apply 60 lb K₂O per acre every other year. Potassium (0-0-60) should be broadcast pre- or postharvest and allowed to leach into the root zone.

Annual tillage and maintenance:

Asparagus should be managed with a no-tillage system. Under no-tillage, asparagus fields normally are not cultivated. Herbicides are used to maintain weed control.

With 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, reapply preemergence herbicides, if needed. Every third or fourth year, level the field in the spring with a drag to remove the ridges that build up above the rows.

The most critical aspect of no-tillage asparagus is control of perennial weeds, including volunteer asparagus. Once perennial weeds become established in an asparagus field, they build up and spread quickly. Use herbicides as needed to keep them under control.

Erosion control in asparagus with small grain cover crops: Asparagus fields on sloping, sandy soils are very susceptible to wind and water erosion. You can reduce erosion significantly by interplanting asparagus with a small grain cover crop in the row middles. The small grain may be planted after asparagus harvest and allowed to grow all summer, or planted in the fall to provide protection over the winter.

Oats usually are planted in the summer and allowed to grow until they are killed by frost. The plant residue should provide sufficient cover to protect the soil over the winter. Winter rye or barley may be planted in September and then killed in the spring with a registered herbicide before asparagus emerges. When a grass herbi-

cide becomes registered for use on asparagus, the cover crop may be left to grow until the asparagus emerges, to provide even longer-term erosion control.

Small grains are sensitive to several pre-emergence herbicides used on asparagus, so it is necessary to coordinate the choice of cover crop and the herbicide program.

Harvest and Postharvest

When to harvest: Do not harvest any spears in the planting year or the 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 3/8 inch in diameter. Older varieties should not be harvested more than 24 times. New varieties may tolerate more harvests — data are still being gathered on these. It is important to leave enough unharvested buds to give an abundance of fern growth. This number varies with the vigor of the crown. Usually spear size begins to decline when this bud number is getting too low. A few crowns can be dug, as the last harvest approaches, to count living buds.

Harvest usually begins about the first week of May in southern Michigan and 1 to 2 weeks later in middle 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 asparagus is snapped off by people walking or riding on picking aids. Asparagus for fresh market should be placed in the picking containers with all spears oriented in the same direction. This is not necessary with asparagus for processing.

Asparagus for processing is harvested by grasping the spears and bending them until they break off. Grasping the spears near the tip produces a high quality, fiber-free product (with a reduced yield) and also leaves long stubs in the field that may interfere with subsequent harvests.

Asparagus for fresh market should be snapped near the ground to obtain longer, more uniform spears. The spears should be at least 8 inches long to allow for trimming of the butts in the packing line.

Mechanical harvesting of asparagus has not been adopted widely because most mechanical harvesters have been non-selective, cutting tall and short spears at the same time and thus reducing 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. Always harvest spears 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 standard for **processing asparagus**:

—**Select grade:** maximum length of 7 1/2 inches; spears must be 5/16 inch or greater in diameter 5 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. This grading scale may change, depending on the needs of the asparagus industry.

Although official federal grade standards for **fresh market asparagus** have not been established, the following rules are proposed:

—**Fancy grade:** spears must be a minimum of 3/8 inch in diameter; for oriented

spear packs, minimum length is 7 inches; for loose spear pack, maximum length is 9 1/2 inches. The asparagus must be all green, fresh, not badly misshapen, free from decay and free from defects 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: Cool spears as soon as possible after harvest to maintain quality. Warm asparagus continues to mature and will lose water and develop fiber and open tips. It also continues to respire rapidly, giving off heat that hastens deterioration. Hydrocooling is the preferred method of cooling. The half-cooling time for packed asparagus is about 2 1/2 minutes, so about 5 minutes in a hydrocooler at 32°F will lower the temperature from 60°F 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 usually is dumped into bulk boxes in the field and hauled to a receiving station or processing plant at the end of the day's harvest. While waiting for shipping or processing, place asparagus in cold storage or, at least, in the shade. Asparagus never should be left in the sun — the tips will open, and spears will wilt and become fibrous.

Weed Control

Because asparagus is a perennial crop, perennial weeds are the most troublesome. Some of the common perennial weeds in asparagus are quackgrass, swamp smartweed, milkweed, bindweed, horsenettle, yellow nutsedge, and Canada

thistle. Perennial weeds should be killed with a registered herbicide the year before crop establishment. Because various weeds emerge at different times of the year, two or more applications may be needed to clean the field. After establishment of the crop, spot treat any emerging perennials with a registered herbicide after the harvest season, avoiding contact with crop plants.

Volunteer asparagus is a serious weed pest in asparagus. It grows from seeds 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. Because the seeds are not buried, most of them do not germinate on the soil surface. Kill volunteer asparagus after the harvest season with a registered systemic herbicide.

Annual weeds usually can be controlled by applications of registered pre- and postemergence herbicides. Apply a long-residual preemergence herbicide in the spring before asparagus emerges. If needed, reapply a preemergence herbicide after harvest is complete for the year. The spectrum of weeds controlled varies with the herbicide, so it is wise to rotate herbicides each year. (See North Central Regional publication 330, "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. Early in the season, insecticides can be applied in a narrow band over the spears to reduce costs.

Cutworms attack asparagus during the

harvest season. Damage at the growing tip stops spear growth; damage on the side causes crooked spears. Check fields for larvae in the fall and note damage during harvest. Fall applications of registered granular insecticides will control cutworm species that overwinter as larvae. Spring foliar applications of registered insecticides will control species that overwinter as eggs or larvae.

Common asparagus beetles (dark blue and brown with white spots) lay eggs and feed on spears or fern. Beetle eggs on spears are a serious contaminant of asparagus. Therefore, to maintain a quality product, you must control beetles if they appear during the harvest season. Larvae (gray "slugs") may also have to be controlled later in the season to protect fern from defoliation.

Spotted asparagus beetles (orange with black spots) are not major pests. Adults do some feeding on spears and lay eggs on the fern. Larvae feed only on the asparagus berries.

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 dieback within a few days. Fern loss can be severe. Growers should check fields when flushes of new fern growth appear.

Asparagus aphids are often present in Michigan asparagus fields but usually do not cause economic damage. Natural enemies — including lady beetles, tiny wasps and fungal disease — help to control aphids. Harvest of spears and removal of volunteer asparagus plants in May and June eliminate food for aphids and will help control them. Young fields that are not harvested may have more aphid problems.

Rust (*Puccinia asparagi*) is a common disease that attacks asparagus fern, causing dark red to black pustules on the leaves

and stems. The black pustules overwinter on old stems or stubble and germinate in the spring. Heavy infestations occur during wet summers and can reduce plant vigor and contribute to general asparagus decline. Planting wide rows in the direction of prevailing winds may facilitate air circulation and allow plants to dry off quickly. Registered fungicides give fair to good control of rust.

Purple spot (*Stemphylium vesicarium*) has become a disease of concern in recent years. This fungus overwinters on plant debris and is a problem in reduced tillage systems. Small (1 to 2 mm), elliptical, purplish spots appear on spears during harvest. Later in the season, tan lesions (up to 1 x 3 cm) with dark brown borders occur on the fern. Banding and girdling of needles by this pathogen causes needle drop and can result in severe defoliation. Fungicides are being evaluated for efficacy against this pathogen.

Crown rot (*Fusarium oxysporum f. sp. asparagi* and *Fusarium moniliforme*) is a major cause of asparagus decline. Most of the fields in Michigan are infested to some degree. The organism is carried on asparagus seeds and crowns, and it lives in the soil for many years. Infected plant beds appear to be a source of inoculum for many fields. Seeds can be sterilized by soaking in 20% laundry bleach (plus 3 drops of Tween 20 per 250 ml--about 1/2 pint) for 30 minutes followed by soaking in benomyl/acetone (25,000 µg/ml, about 0.2 oz/half pint) for 24 hours.

Crowns infected with crown rot have a reddish brown discoloration in the vascular tissues of the rhizome, shoots and stor-

age roots. The storage roots of infected mature crowns become hollow and rotten. Fern of infected plants first turns yellow during the summer, then brown as the plants slowly die back. Production from infected plants decreases as they produce 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. Proper fertilization, irrigation, and control of insects, weeds, rust and purple spot will reduce stress and give the asparagus more of a competitive edge, and may extend productivity. The best control is avoidance through purchasing disease-free crowns and planting them into new ground.

More information on asparagus production may be obtained from the following publications which are available from the Cooperative Extension Service:

- E-312 Control of Insects, Diseases and Nematodes on Commercial Vegetables.
- E-550a Fertilizer Recommendations for Vegetable Crops in Michigan.
- E-959 Common Asparagus Pests.
- E-1327 Costs of Asparagus Production in Western Michigan.
- NCR-330 North Central Weed Control Guide for Vegetable Crops.



MSU is an affirmative-action equal-opportunity institution. Cooperative Extension Service programs and materials are open to all without regard to race, color, national origin, sex, handicap, age or religion.

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. Gail Imig, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

This information is for educational purposes only. Reference to commercial products or trade names does not imply endorsement by the Cooperative Extension Service or bias against those not mentioned. This bulletin becomes public property upon publication and may be reprinted verbatim with credit to MSU. Reprinting cannot be used to endorse or advertise a commercial product or company.