GROWING ASPARAGUS IN MINNESOTA

Primary Author: Annie Klodd, University of Minnesota Extension Educator, Fruit & Vegetable Production

Contributing Authors: Natalie Hoidal, Carl Rosen, Vince Fritz, Cindy Tong, Bill Hutchison, Jeff Hahn, Theresa Keaveny, Chryseis Modderman and Jason Walker. Funding: MDA Specialty Crop Block Grant granted to Sustainable Farming Association.
Asparagus is a high-value perennial crop that lives over 15 years in Minnesota. Although commercial production in the United States is concentrated in California, Washington, and Michigan, our Minnesota climate and soils provide an excellent environment for growing asparagus, and the demand is higher than current in-state production. Asparagus is the earliest crop to market and growers market it via restaurants, farmers markets, community-supported agriculture (CSAs) and roadside stands. The cost to establish an asparagus field is substantial, so growers should have a robust management plan in place before planting.

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How asparagus grows

Asparagus spears emerge each spring from underground buds. After the harvest season ends in late June, additional spears are allowed to grow into ferns which photosynthesize and accumulate carbohydrates that the plant uses to keep growing the following year. The plants are dormant from December to April in Minnesota and many varieties are known to overwinter well in our climate.

Spear: The edible part of the asparagus plant is called the spear. Technically, spears are the newly emerged stems of the plant. Spears continually emerge from the underground buds on the crown of the plant for several weeks in the spring and summer.

Fern: Spears that are not harvested will keep growing and turn into “ferns.” This happens at the end of each harvest season and in newly planted asparagus stands that are not harvested. Ferns are an important part of asparagus production. They photosynthesize for several months following the spear harvest season, transporting energy to the crowns for storage over the winter. Healthier ferns give way to healthier plants and higher yields in subsequent years.

Crown: The crown is the belowground part of the asparagus plant that includes roots, rhizomes and buds. The spears grow off the buds during the growing season. During the dormant season (winter) the crowns store energy in the form of carbohydrates that allow the plant to keep growing from year to year. New asparagus fields are typically planted from small crowns rather than from seed.

Seeds: Female plants produce small black seeds that can become weedy volunteer asparagus. Open-pollinated varieties of asparagus contain both male and female plants. Hybrid varieties are mostly all-male plants, so using these minimizes the issue of re-seeding.
RECOMMENDED MINNESOTA ASPARAGUS VARIETIES

Most asparagus growers plant hybrid varieties for their superior yields, uniform spear size, disease resistance, and all-male plants. Open-pollinated varieties are also widely available, at a lower cost per crown than the hybrid varieties. However, yield of open-pollinated varieties is generally lower, and the size and quality of the spears is more variable.

Hybrid varieties for Minnesota: Millennium, Jersey Knight, Jersey Giant, Jersey Supreme

Open-pollinated varieties for Minnesota: Mary Washington, Martha Washington, Purple Passion

CHOOSING A PLANTING SITE FOR ASPARAGUS

Since asparagus is a long-lived perennial crop, proper site selection is important. While annual vegetable crops can be moved if the first planting site doesn’t work, asparagus cannot. The crop will be growing there for many years and cannot be easily relocated. Site requirements for asparagus include:

- Good soil drainage: planting in heavy or wet soil where water pools is not advised
- Full sunlight
- Medium textured soils (examples: silt loam, loam, sandy clay loam, sandy loam); avoid planting in heavy clay or very sandy soil.
- Access to irrigation, particularly in the planting year (especially important for sandy soils)
- Soil pH ideally between 6.5-7.0. Soils with a pH slightly above or below are not ideal, but can still be suitable for asparagus with liming or other amendments.

In addition to soil quality, the slope of the land also impacts soil water drainage. Therefore, planting asparagus on a slight slope is recommended especially when heavier soils are present. Avoid planting asparagus in heavy clay soil.

PLANTING A NEW ASPARAGUS FIELD

Following correct planting methods for asparagus is important for this long-lived perennial crop. Planting mistakes are costly because they can impact yield and crop health for years to come.

Step 1: Prepare the field a year before planting

Growers planning a new asparagus field should prepare the field in the year prior to planting. Waiting to prepare until the planting year only works if the grower already knows that the field is well suited for asparagus, and if nurseries still have crowns of the desired varieties available. Field preparation involves:

- Soil testing
- Measuring the field space
- Ordering crowns
- Amending soil pH and organic matter based on the soil test
- Reducing perennial weed population
- Planning the row spacing, row orientation, and number of crowns needed

Instructions for these steps are addressed throughout this guide.
Step 2: Schedule crown delivery

Crowns should be ordered 3-6 months before planting to ensure that preferred varieties are available. When placing the order, you will be asked to select a delivery date. Select a date close to when you anticipate planting, as the crowns must be refrigerated until planting. In Minnesota, asparagus is planted from early May to the first week of June.

Step 3: Fertilize and till the field

If the soil test indicates phosphorus or potassium deficiencies, the first fertilizer or compost application should be incorporated in the fall or spring before planting. More information is provided in the “Nutrient Management” section of this guide.

Step 4: Time to Plant - Dig furrows

On the planting day, begin by digging furrows (trenches) for the crowns. These will become the rows that the crowns are planted into. The general recommended between-row spacing is 4 feet. Rows can be spaced wider if needed to accommodate equipment. Rows should not be spaced closer than 3 feet, as the asparagus plants will widen as they mature, reducing walking space between rows.

Dig the furrows to between 8-10 inches deep. In heavy clay soils, the furrow depth may be reduced to 6 inches, and in sandy soils, the depth may be increased to no more than 12 inches. The soil that is displaced from the furrow should be pushed to either one or both sides, so that it can be back-filled into the furrow after planting and throughout the first growing season.

Some Minnesota growers use custom equipment to dig furrows, while most others use a single-bottom plow or a potato hilling disk. Hand shovels are efficient for very small plantings.

Depending on labor, equipment, and field size, a grower may choose to plant the crowns as the furrows are being dug, with one person digging and one to two people following behind the tractor with the crowns. Alternatively, all of the furrows may be dug before the first crowns are laid down. The disadvantage of this is drying of the soil, making it clumpy and harder to work with.

“We built a trencher out of a sub-soiler to make the trench and we use a three-point blade to fill it in.”

– Paul Schmidt, asparagus grower, Preston, Minn.
Step 5: Plant the crowns

To plant the crowns, place them “head-to-toe” (bud-to-root tip) in the furrow as shown in the photo at right. The recommended bud spacing is 12”. This spacing works well, because many crowns have roots between about 8-12” long. It is not necessary to spread out the roots around the bud of the crown. Some older growing guides recommend this practice, which is often referred to as an “octopus formation,” but it is time-consuming, and research does not support the claim that it leads to improved plant health or vigor. Fertilizer can be added to the furrows at planting, according to guidance in the “Nutrient Management” section.

Step 6: Cover the crowns with soil

Immediately after laying the crowns in the furrows, cover them by back-filling the furrow with 2-3 inches of soil. Prolonging the time between planting and covering can cause the roots of the crowns to dry out. Therefore, it is important to cover the crowns with soil very soon after planting. It is also best if the soil used to back-fill still has good moisture, and to irrigate after planting.

After Planting

After planting, there should still be plenty of soil along the sides of the furrows, which will be used later in the season to continue back-filling the furrows as the ferns grow.

Small, narrow spears will start to emerge from the soil within 2-3 weeks of planting, depending on precipitation, temperature and amount of soil cover. Once the spears are sturdy and several inches tall, 3-4 more inches of soil can be back-filled into the furrow (see illustration below). Use caution with this step, as large clods of dry soil can break the brittle spears.

By August, all of the displaced soil should be placed back into the furrow so the soil is level (see photo at right).
Asparagus requires adequate nutrients and water to produce a strong yield each year. This section discusses fertilizer application, use of compost and manure, micronutrients, and irrigation for asparagus in Minnesota. Asparagus produces best in well-drained, medium-textured soils but will grow in a range of soil conditions. It will not tolerate extreme acid soil conditions and grows best at a pH of 6.5-7.0.

The objective during the first three years after planting is to encourage maximum fern growth so that plants build extensive storage root systems. Providing sufficient nutrients to the crowns aids in strong fern and root system development. After the first three years, the goal is to maintain the health and productivity of the stand, remembering that nutrients are removed from the system each year with the harvest of spears.

**Soil Fertility Requirements – New Plantings**

**Soil testing**

During field preparation the year before planting, take a 12” deep soil sample to determine how much phosphorus (P), potassium (K), as well as other nutrients to add. The test results will also reveal whether the soil pH must be amended with lime or sulfur in order to achieve the ideal pH range of 6.5-7.0.

Because amendments like lime and sulfur gradually alter the soil pH over several months, it is important that the soil test be done a year prior to planting, to allow time to apply and incorporate the amendments and for pH conversion to occur. Growers who have already been farming the field, have tested the soil recently, and know the soil pH to be in the proper range may be able to skip this step.

**Amending the Soil in Preparation for Planting**

Use the results of the soil test to determine how much, and what type of, amendment to add to the soil. Whether using fertilizer, manure, or compost, each amendment has a certain concentration of each nutrient. In order to determine how much amendment to apply, know the following:

1) Current P and K concentrations and organic matter (%OM) from the soil test

2) Recommended soil nutrient applications for asparagus in Tables 1-3 on next page for new and established plantings

3) Nutrient concentrations in the amendment (actual or approximate). With compost or manure, you also need to know the moisture content in order to know the available nutrient content (pounds of N/ton, P2O5/ton). For more information, see Managing Fertility in an Organic System and Nutrient Management for Commercial Fruit and Vegetable Crops in Minnesota.
Nitrogen, (N): Use Table 1, along with your soil test report, to determine how much actual nitrogen (lb/A) to apply. Then, determine how much amendment to apply based on the concentration of N in the amendment.

The soil test report gives a %OM reading but does not list an N reading. This is because nitrogen is very mobile and the concentration in a small area of soil can change rapidly. Therefore, %OM is used to determine N requirements. According to Table 1, a new field with low organic matter such as 1.5% should receive 120 lb/acre of N over the course of the first season. Established plantings require less as the root systems become more established and more internal nutrient recycling occurs.

*Low %OM: less than 3.1%. Medium %OM: 3.1-4.5%. High %OM: over 4.6%.

**Phosphorus (P) and Potassium (K):**

Phosphorus levels of 30 ppm or over are adequate for asparagus and no further additions are necessary. Table 2 shows phosphate (P$_2$O$_5$) recommendations for asparagus based on the test report. For example, a new field with 25 ppm P on the soil test should receive 100 lb/A of P$_2$O$_5$ in the form of fertilizer or organic amendment. An established field with the same test report should receive 25 lb/A.

Follow the same procedure for potassium using Table 3. For example, a field with a soil report reading of 101-150 ppm K should receive 100 lb/A of potash (K$_2$O) before planting, or 25 lb/A for an established field.

Using manure and compost in asparagus: For asparagus, %OM less than 3.1% is considered low, 3.1-4.5% is medium, and anything over 4.6% is high. Building up organic matter in soils is a long term process that can include cover crops, green manures, animal manures, and compost addition. While organic matter can be added in any of these forms prior to planting, it will not be sufficient as a long term solution as it will break down over time. To maintain organic matter, additional organic amendments may be needed over time. Various types of organic amendments can be used in an asparagus bed, including composted manure.

Raw manure can be incorporated prior to planting, but adding raw manure directly to the crowns at planting is not advised. A high-ammonium manure from poultry or swine, or one with a high salt content, can burn the crowns if placed directly on top of them. A manure with less ammonium and more organic matter, from dairy or composted manure, is less likely to cause damage. To reduce risk, incorporate manure into the soil prior to planting or incorporate it lightly to the backfilled soil rather than placing it directly onto the crowns.
Additional recommendations for using manure in asparagus include:

1. Send the manure to be tested for N, P, K and salinity.

2. Right rate is important. Make sure the manure rate matches up with asparagus nutrient recommendations, taking into account what nutrients are already in the soil. More manure is not always better.

3. Incorporate the manure after broadcasting. If using manure at or before planting, some soil separation between the roots and manure is good. Rake in the manure before planting the roots, or backfill some soil onto the crowns before laying manure.

4. In mature plantings, never apply manure in the spring prior to spear emergence. Topdress and incorporate it after harvest ends and before fern growth.

5. If composted manure is used, the same recommendations apply.

For more information, see Nutrient Management in an Organic System: https://conservancy.umn.edu/handle/11299/197961

### How and When to Add Soil Amendments in the Planting Year

Prior to planting, nutrients should be incorporated with tillage or cultivation to help ensure even distribution.

In the fall or spring prior to planting, broadcast and incorporate most of the recommended phosphorus and all of the potassium by tilling 8-12 inches deep with a chisel plow or rototiller. Compost and manure can be added at this time as well.

On the day of planting, form the furrows and apply an additional 25-30 lb/A of phosphate (P\textsubscript{2}O\textsubscript{5}) into the trench right before placing the crowns. If using compost, this rate of actual phosphate still applies. Read the concentration of phosphate on the fertilizer label or get a manure/compost analysis to determine how much product to apply.

If the phosphorus levels on the soil test report are rated “high,” omit the fall or spring broadcast application and only do the trench application.

A small amount of compost may also be added at planting. Since 2-3 inches of soil are pushed over the crowns to cover them immediately after planting, a portion of this cover can consist of compost.

After planting, apply approximately 1/3 to ½ of the total recommended rate for nitrogen via broadcast of a nitrogen-containing fertilizer. Any remaining N should be side-dressed later in the season when the trenches are backfilled.

In the first and second years after planting, soil amendments can be incorporated with shallow cultivation before spears emerge in the early spring. The recommended rate of N at this time is 40-60 lb/A. The P and K rates will depend on the soil test. A very wet spring may prohibit entering the field to fertilize prior to spear emergence, and delaying cultivation can damage the spears. As the soil warms up, add 30-40 lbs. N/acre if needed based on the soil OM%.

### Table 3: Potassium recommendations for asparagus

<table>
<thead>
<tr>
<th>Potassium (K) soil test</th>
<th>Amount of Potash (K\textsubscript{2}O) to apply (lb/A)</th>
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<td>200+</td>
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Soil Fertility Requirements – Established Plantings

Once the plants are established, the primary objective is to maintain plant vigor. This does not necessarily require annual fertilization. Asparagus has a very fleshy root system which is capable of storing a large quantity of nutrients. The roots can store an estimated 150 lbs. N/acre, 37 lbs. P/acre and 170 lbs. K/acre.

The plant can use these stored nutrients, in part, for the development of spears in the early spring. The actual amount of nutrients removed by a 2.5 ton/acre harvest is 23 lbs. N/A, 3 lbs. P/A and 20 lbs. K/A. Therefore, it may not be necessary to apply fertilizer every year. This decision should be made based on crop vigor, yield, and soil testing. Good record keeping is important.

Generally, it is not necessary to apply fertilizer for an asparagus crop until after harvest. In fact, delaying fertilization until after harvest can reduce early weed growth. For sandy coarse-textured soils, however, 20-25 lbs. N/A in the spring may be beneficial for spear development. Tables 1, 2 and 3 present fertilizer recommendations for established plantings. This fertilizer should be top-dressed after harvest to encourage the ferns to grow.

Secondary Macro- and Micronutrients

The response of asparagus to applications of secondary macronutrients (Ca, Mg, S) and micronutrients (B, Cu, Fe, Zn, Mn, Mo, Cl, Ni) is not well documented in Minnesota. In general, asparagus does not respond strongly to micronutrients, so micronutrient application should not be a focus of an asparagus nutrient management plan. While many soils in Minnesota are high in calcium, most soils low in calcium (Ca) and magnesium (Mg) are acidic and should be limed with dolomitic lime prior to planting. Sulfur may be limiting on sandy soils with low organic matter. Nutrient ranges for healthy mature asparagus ferns are presented in Table 4. Suspected nutrient deficiencies should be confirmed with soil tests and/or tissue analysis.

Irrigation

Adequate soil moisture is necessary for fern development, spear development the following year, establishment of new crowns, and spear quality and yield. Asparagus plants use 0.10 to 0.20 inches of soil water per day during the period of fern growth. Asparagus roots can penetrate up to 10 feet to obtain soil water if not restricted, but their greatest water uptake occurs from the top 6 to 24 inches of the soil. Maintaining adequate soil moisture in this zone, especially during the fern stage, should be the goal of an irrigation program.

Soil moisture during fern growth should not be allowed to deplete more than 50 to 60 percent of the soil’s water holding capacity in the active rooting zone or go beyond a soil tension of 70 centibars before another irrigation. Asparagus plants do not generally show visual signs of wilting when moisture-stressed, so extra care must be exercised to ensure there is adequate soil moisture throughout the growing season.

However, not all asparagus fields need to be irrigated. In fact, most asparagus producers in Minnesota only water the crowns in the first year in order to promote establishment. Irrigation is most needed during drought, or in sandy and shallow soils in central Minnesota. In most years, growers feel that the soil moisture on their fields remains adequate during the season.

Irrigation is a balance. Infrequent, moderate soaking of the soil is preferred over frequent, light irrigation which can lead to foliar disease development. On the other hand, over irrigation may cause some of the applied nitrogen to leach below the plant’s root zone and possibly into the groundwater.
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MANAGING WEEDS IN ASPARAGUS

Because asparagus is a perennial crop that grows from April to November, weed management is one of the most significant production challenges. The aisles between the rows can be managed with a variety of methods and tools, but managing weeds within the asparagus row requires more precision. A good weed management program minimizes weed competition without harming crop growth, and targets aggressive perennial weeds like Canada thistle and quack grass that thrive in Minnesota asparagus beds.

Non-Chemical Weed Management in Asparagus

Cultivation: While cultivation serves a purpose in asparagus, many growers find opportunities to reduce cultivation to maintain soil health, and do not cultivate every year. Cultivation is most often used between the rows, to uproot small weeds. However, it can also be used cautiously before or after the harvest season during very tight time intervals. Some asparagus producers cultivate the rows in the early spring, after snow-melt but before spear emergence. If the final spear harvest is cut below the soil surface, in-row cultivation may also be possible immediately following the last harvest. At both timings (early spring and after last harvest), the cultivation must be very shallow, less than 3 inches, and should be done before new spears start emerging. This is challenging and is not always possible. If the spears have started to emerge, cultivation may hit the spears and damage them, reducing yield and introducing disease. After harvest, cultivation can damage emerging ferns if they are not all cut below the surface.

Shallow cultivation will not reliably control thistles or other weeds with taproots and rhizomes, or large, established annual weeds.

Cover crops: Rather than cultivating between the rows, many asparagus growers avoid cultivation and grow no-till asparagus. This can improve soil health by greatly reducing soil disturbance. No-till asparagus growers can either plant cover crops in the aisles between the rows, or allow the natural vegetation to grow. Beyond weed control, cover crops can provide additional benefits including soil health improvements, reducing compaction, and keeping walkways clean. They can also make harvest easier during rainy conditions that would otherwise make the soil muddy and difficult to walk on. Usually, these are perennial cover crop mixes such as fescues, perennial ryegrass, and clover. Perennial cover crops and natural ground covers should be mowed periodically to reduce weed seed production.

“We feel cover crops have built a resiliency into the soil that matches the plant’s resiliency. No erosion, good tilth.”

– Paul Schmidt, asparagus grower, Preston, Minn., shown with wife, Karen.
The challenge with perennial cover crops is that they can spread into the rows, potentially competing with the asparagus plants and crop and reducing yield. Cover crop roots compete with the asparagus crowns for soil resources including water, nutrients, and space, and thus may decrease spear yield especially when resources are limited. A cultivator with sweeps may be used to cut into the edges between the aisles and rows, to prevent cover crops from spreading into rows.

Annual cover crops may also be used between rows. This may be a helpful option for newly planted fields since they are quicker to establish, but there is limited research available on the use of annual cover crops in asparagus. Organic growers may also choose to use annual cover crops to prevent spread into the asparagus rows. As your stand matures, the rows of asparagus will start to widen into the aisles. Growers may use annual between-row cover crops for the first couple of years to keep weed competition low, and as spears start to fill in the spaces between rows, they may transition away from cover crops.

Flaming: Flame weeder, also called propane weeder, emit heat from propane-powered torches to kill weeds. Despite the name, this tool kills weeds by heating them, not by burning them directly with the flame. Flame weeder come in many different shapes and sizes, from individual torches on a backpack model to pull-behind implements for tractors. Flaming can be used carefully within the rows, during stand establishment, or in the aisles. Like cultivation, flaming is most effective on small, annual broadleaf weeds. Grasses tend to have concealed growth points that are protected from heat, and while flaming will kill the above-ground tissues of perennials, it does not reach the below-ground storage tissues.

Hand-removal: At times, hand-weeding is the best option for large annual and perennial weeds and for removing weeds in the rows during the harvest season. In the absence of herbicides, hand removal is the most effective option for managing Canada thistle and quack grass in asparagus stands. Mowing and cultivation are not sufficient for eliminating thistles in the rows, as it takes repeated passes throughout the season to control thistles with these methods. Flaming has been found ineffective on thistles and quack grass; it does not impact the belowground rhizomes (spreading roots) that these plants use for reproduction.

Mulching: While not a commonly used practice, the aisles between the rows can be mulched using wood chips, straw, or landscape fabric in order to smother weeds between rows.

Going No-Till in Asparagus

Minimizing soil disturbance is one of the Sustainable Farming Association’s Five Soil Health Principles.

Previous research in New York suggests that no-till asparagus can have higher yields, denser root systems, and better crown, fern, and bud growth than fields tilled in the spring. Going no-till helps build soil health, makes harvest easier by reducing muddy field conditions, reduces erosion, supports ground-nesting bees, and eliminates the risk of injuring spears and crowns during cultivation.

Asparagus lends itself well to going no-till or minimal-till, allowing growers to build their soil health. Since asparagus is a perennial crop, the soil is not disturbed by planting after the establishment year. While some growers cultivate before or after harvest to incorporate nutrients, this step may be bypassed if the soil already has sufficient levels of nutrients. Interrow cultivation can be avoided with the use of a perennial cover crop or natural ground cover that is mowed regularly to reduce weed seed production.

Here are 5 tips for growing no-till or minimal-till asparagus:

• Plant a thick perennial cover crop mix between the rows to compete with weeds.
• Forego spring and post-harvest cultivation whenever possible.
• Use soil testing to track soil nutrient content in your field. Only incorporate fertilizer if the soil test indicates a deficiency.
• Mow, flame, or hand-pull weeds in and between the rows rather than cultivating.
• Prepare the soil with organic matter, fertilizer and pH amendments prior to planting, to reduce the need to incorporate amendments later on.
Using Herbicides in Asparagus

A number of herbicides are available for use on asparagus. The most effective product and rate will vary depending on the type of asparagus beds (newly planted crowns vs. established beds) and the time in the season. The herbicide program should produce long-term weed control, be safe to use on the asparagus fern, and follow state and federal pesticide regulations. As outlined below, new and established asparagus present different sets of requirements.

Herbicide Types and Application Timings

There are several reasons why some growers choose to use herbicides (either synthetic or organic) in asparagus. First, many Minnesota asparagus growers are also growing strawberries, and therefore are too busy in late June to spend time on weed management after asparagus harvest. One to two well-timed applications containing both pre- and post-emergent herbicides can reduce the amount of time spent on weed management. It also reduces soil disturbance by reducing the need for cultivation. Herbicides can be applied in the following timeframes:

- Before planting crowns (new stands)
- Early spring before spears emerge
- During harvest after cutting all emerged spears
- After final harvest but before ferns grow
- To ferns after the harvest season

Refer to the Midwest Vegetable Production Guide for Commercial Growers for herbicides labeled for use in asparagus. This guide is updated annually.

Preventing Herbicide Injury

Herbicide injury, either from drift from neighboring fields or mismanaged in-field application can damage spears and stunt asparagus production. Common causes of herbicide injury include exceeding labeled rates, using the wrong nozzle type or sprayer pressure, failing to calibrate the sprayer, and spraying during weather conditions or crop stage not permitted by the label.

Herbicide damage in one year can decrease yield the following year by injuring the ferns and crowns. If herbicide damage is severe (i.e. if it killed a significant portion of the ferns), the grower should consider reducing the harvest period the following year in order to allow the stand to recover. Monitor the rate of spear emergence the following spring to determine if this is necessary.

References on asparagus herbicide injury:
- http://herbicidesymptoms.ipm.ucanr.edu/?selectedAI=141

New Crown Plantings

Good weed management is critical for establishing high yielding, healthy new asparagus beds. The newly planted crowns have very small root systems, so just a few weeds around each plant can impact fern growth and subsequent yields. We strongly encourage growers to keep their new stands as weed-free as reasonably possible.

As described previously, most new asparagus production fields are established by planting one-year-old nursery grown asparagus crowns into deep furrows. Since the first new shoots take several weeks to emerge and grow to a size that can be safely cultivated, weeds in the furrow may become large and not controllable by cultivation.
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ASPARAGUS INSECT PESTS

Asparagus grown in Minnesota has fewer insect pests compared to many other vegetable crops. However, there are three types of insect pests to monitor and manage if needed.

Asparagus Beetles

The asparagus beetle (black head, red prothorax, black and red wing covered usually with six whitish spots) is the most common insect that attacks asparagus. Adult beetles overwinter on the previous year’s ferns, and under debris along field edges.

Adult asparagus beetles emerge in the spring around the time of spear emergence, feed on the spears, ferns and flower buds, and lay eggs on the plants. The eggs are rather distinctive and easy to observe as they are black in color, usually sticking out at a 90-degree angle from the spear and ferns (see photo). These eggs hatch in approximately one week and the fleshy, dark gray larvae then move to the foliage on which they feed. The larval stage lasts two to three weeks, after which the larvae drop to the ground, burrow into the soil, and pupate (cocoon stage). Two or three generations are produced during the growing season in Minnesota.

Larval feeding on the spears causes the spears to grow in a “shepherd’s crook,” rendering them unmarketable (see photo). This happens because the side of the spear that is damaged by the beetles’ feeding grows slower than the side that is undamaged. The appearance of eggs on the spears is also considered unmarketable. Additionally, larvae feeding on newly planted ferns can cause extensive defoliation and should be closely monitored.

The spotted asparagus beetle (orange with black spots) also may be present. Its life cycle is similar to that of the asparagus beetle, except that the larvae largely feed on the developing berries.

Consequently, spotted asparagus beetles cause relatively minor damage to the spears or fern.
Managing Asparagus Beetles

Monitoring: Research at the University of Minnesota found that common asparagus beetles are much more active and easy to detect during the afternoon hours on sunny days. Therefore, to accurately estimate the percentage of plants infested, it is critical to do beetle sampling during the afternoon (e.g., anytime between 12-6pm). Sampling for beetles early in the morning, on most days, will typically underestimate the actual infestation level.

Cultural Control and Prevention: Since asparagus beetles overwinter in the dead ferns from the previous season, removing the ferns in late fall rather than waiting until spring will help minimize asparagus beetle populations in the field. However, the short growing season in Minnesota often means that the ferns are not yet fully dormant when our region receives the first snowfall of the fall/winter. It is important to wait to remove the ferns until they are fully dormant (color change from green to brown), but it would be difficult or impossible to remove the ferns with snow on the ground.

Therefore, depending on the situation, growers may be forced to wait until the spring to remove the ferns. When this is the case, growers should completely remove them from the field and burn them as soon as possible in the spring, rather than leaving them in the field. Some growers will even burn the ferns in-field instead of mowing and removing them. This decision will depend on the practicality of removing them, the individual’s comfort with field burning, and city or county ordinances around burning. No matter what method each farm uses to destroy the dead ferns, this step is important for managing asparagus beetles.

Asparagus beetles can also overwinter in residues like straw, leaves, cover crops, and other dead plant matter. While cover crops play helpful roles in asparagus production, which we describe later in this guide, growers should also be aware that cover crop detritus will also serve as an overwintering site for asparagus beetles. If populations become severe, individual growers may try scaling back on cover crop production to evaluate whether asparagus beetles are reduced as a result.

Additionally, promoting plant vigor and harvesting spears regularly and thoroughly will help reduce the number of beetles that hatch in the spring.

Chemical Management: OMNI-approved and synthetic insecticides are available for control of asparagus beetles. They should be applied if at least one of the following criteria (action thresholds) is reached:

- 1 out of 10 plants (10%) have adult beetles
- 50-75% of the plants have asparagus beetle larvae
- 2% of spears have dark, oval-shaped eggs

Organic insecticide options for asparagus beetles include Entrust (spinosad) and neem oil. However, Entrust cannot be used on spears intended for harvest, because it has a 60 day pre-harvest interval.

Several synthetic insecticide options can be used for asparagus beetles on spears and ferns. Products with long pre-harvest intervals cannot be used on harvestable spears. For updated information on insecticides labelled for asparagus, see the online, annually revised, Midwest Vegetable Production Guide (BU-7094-S).
**Asparagus Aphid**  

European asparagus aphid (*Brachycorynella asparagi*) populations are only high in some years in the upper Midwest. However, in the rare years when large populations do appear, it can cause severe economic loss.

The aphid was first reported in southern and central Minnesota in 1982. The asparagus aphid is a minute (about 0.06 inch long), blue-green sucking insect that usually feeds on asparagus fern.

The aphid feeds only on the fern, but can still be quite destructive. While feeding on the ferns, the asparagus aphid injects a toxin that damages the health of the plant. The toxin gets transported down the plant, from the ferns into the dormant buds underground. The toxin causes the buds to elongate into new shoots prematurely, producing a "witch's broom," or a dwarfed, very bushy, short plant with silver, blue-green color. Under severe insect pressure, all the buds on the crown may "break," causing the plant to have none left over for the following season, essentially terminating the plant’s life.

This damage results in decreased yield and sometimes plant death the following spring. Because of the damaging nature of this toxin, the action threshold for this insect is low; only a few aphids per plant can cause substantial damage. Younger plants, including those 1-2 years after transplanting, are most susceptible to damage.

**Managing Asparagus Aphid**

Like asparagus beetles, asparagus aphids also overwinter on the ferns. However, it is the eggs that overwinter rather than the adults. Because they rely on these ferns as their sole host, fern removal is also important for managing this pest.

Several naturally occurring biological controls usually prevent this aphid from reaching the damaging levels typically observed in the western production areas of California and Washington state. The adults and larvae of several lady beetle species, other insect predators, a parasitic wasp (specific to aphids) and fungi (triggered by warm, humid conditions) all help to reduce aphid infestations.

**Insecticide options:** When populations are increasing rapidly and biological control does not appear to be effective, chemical control may be used. Researchers on the west coast, where asparagus aphid is a common pest, have spent decades developing best management practices for controlling it. Dimethoate, Cythion 5E, Di-Syston, and Fulfill are effective as foliar applications. In a controlled study by Michigan State University, Fulfill was found to be the most effective of these options. Sevin® is not recommended for aphid control (See Sources below).

Organic insecticide options include insecticidal oils and PyGanic. However, the efficacy of these products is less thoroughly documented, and they may not be as effective as the synthetic options listed above.

**Biological control:** Lady beetles and parasitic wasps (*Diaeretiella rapae*) have been found to decrease populations in certain cases. However, very high aphid population levels are difficult to manage with biocontrol alone. For information, visit “European Asparagus Aphid” in the Sources list below.
**Cutworms**

Several species of cutworms successfully overwinter each year in Minnesota. Cutworms, which feed on a number of vegetable crops, cut off asparagus spears and ferns near the base of the plant. They are active starting in April and continue feeding all season, but are most destructive in the early season when plants are smaller. Therefore, they do impact actively growing spears, and must be monitored closely early in the spring season. In addition, some species feed primarily at dusk or during evening hours; therefore, sampling near dusk can be beneficial.

If a cutworm feeds on the base of a spear but does not completely sever it, the spear will grow crooked as the undamaged side grows faster than the damaged side. This damage can be mistaken with asparagus beetle damage.

**Managing cutworms on asparagus:** Control is warranted if one or more cutworms per 10 crowns are found. Pesticides can be used as a foliar spray.

Spinosad baits may be used for cutworm control on ferns, but are not labeled for use on spears.

As with other pest species, consult the Midwest Vegetable Production Guide (BU-7094-S), which is revised annually by Extension Specialists in many Midwest states.

**Note on pesticide use:** With all organic and synthetic insecticides, be careful to observe all label instructions such as pre-harvest interval, re-entry interval, application rates, and personal protective equipment. Insecticide labels can change frequently; the label is the final authority for current pesticide use rates and limitations. Rotate pesticide modes of action to reduce the risk of resistance developing. Resistance can and does occur with both organic and synthetic pesticides.

**Sources**

- Asparagus beetles: https://extension.umn.edu/yard-and-garden-insects/asparagus-beetles

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**ASPARAGUS DISEASE MANAGEMENT**

There are five key diseases to look out for in asparagus stands in Minnesota. Several of them impact the asparagus ferns in particular, and reduced fern health leads to yield losses in subsequent years. Cultural and preventative techniques should be utilized prior to reactive management such as fungicide use. Therefore, asparagus growers should also be aware of the diseases that infect asparagus, and proactively manage their stands in ways that prevent diseases from occurring.

If disease breakouts do occur, management does not end with the harvest season. Growers must scout asparagus stands as the ferns grow, monitoring for diseases and managing infections accordingly.
Asparagus Rust

Asparagus Rust is caused by the fungus *Puccinia asparagi*. Lesions on the ferns that can become quite large, reducing fern growth and subsequent stand productivity.

**Symptoms:** Small, uneven, cream-colored “scab”-like lesions on the stems of ferns, orange-colored stripes on the stems with more advanced infections, and early senescence (dieback) of the ferns. Asparagus rust does not cause symptoms on the spears.

**Conditions:** It is more common in newly planted fields that are not harvested. This is because the act of harvesting spears removes the fungal spores that form on them in the early spring (basidiospores and aeciospores). These early spores are necessary for subsequent fern infections to occur. When they are removed via spear harvest, it is unlikely that the orange “rusty” fern infection will form.

**Management:** In Minnesota, asparagus rust can often be controlled organically without the use of fungicides. Regular harvest of all spears will greatly reduce the risk of asparagus rust forming on the ferns, and this is often sufficient for mature stands. In non-harvested stands, or in cases where new and mature stands will regularly be in close proximity, the use of newer varieties with better disease resistance can help reduce, but not eliminate, risk of infection.

If rust is found on the ferns, removing infected ferns before the spring helps slow the spread of the disease the next season by interrupting the disease cycle. In severe cases, specific fungicides active on asparagus rust can be applied. Fungicides effective on asparagus rust are listed in the Midwest Vegetable Production Guide for Commercial Growers, which is updated annually.

**Resources for asparagus rust:**
- https://ag.umass.edu/vegetable/fact-sheets/asparagus-rust
- http://entoweb.okstate.edu/ddd/diseases/asparagusrust.htm
- http://www.plantmanagementnetwork.org/pub/php/review/asparagus/

Purple Spot

Purple Spot is caused by the fungus *Stemphylium vesicatorium*. Severe infection can cause the ferns to senesce early and eventually decrease yield and productivity of the infected plants. While it can infect spears, this is not considered the main impact of purple spot.

**Symptoms:** Small purple, ovalur spots on the spears and ferns, early senescence of ferns.

**Conditions:** Previous studies of no-till asparagus have suggested that purple spot may be more common in no-till stands because the fungi remain in detritus left in the field. Cool, wet weather and blowing sand contribute to purple spot infection on spears and ferns. Blowing sand is abrasive to the spears, creating disease entry points.
Management: Because the fungal spores survive on dead ferns over the winter, remove the previous year’s dead ferns from the field or burn them in the field to decrease infection of the next year’s spears. In fields with sandier soil, consider using cover crops and wind breaks to reduce wind-blown sand. Chlorothalonil fungicides have been found effective on purple spot. For a complete, updated list of fungicide recommendations, refer to the Midwest Vegetable Production Guide for Commercial Growers.

Resources for purple spot:
- plantmanagementnetwork.org/pub/php/review/asparagus/
- https://apps.extension.umn.edu/garden/diagnose/plant/vegetable/asparagus/spearspots.html
- http://www.plantmanagementnetwork.org/pub/php/review/asparagus/

Cercospora Leaf Spot (Cercospora blight)

Cercospora leaf spot is caused by the fungus Cercospora asparagi. Like other diseases, fern damage from Cercospora causes yield loss the following year by reducing fern growth and speeding up senescence. Repeated infection in multiple years can reduce the lifespan of an asparagus stand.

Symptoms: The symptoms start on the lower parts of the ferns and spread upward. Symptoms include browning of the ferns, oval lesions with tan or gray center and reddish brown border, and yellowing over entire ferns in advanced cases.

Conditions: Cercospora spreads and infects ferns from June to August, and is stimulated by warm, humid weather. Therefore, Cercospora risk increases as the fern canopies grow large and create humid environments. Risk also increases with frequent rainfall during hot periods, and when excessive irrigation is used.

Management: Minimize the amount of time the fern canopy is wet:

- If irrigation is necessary, irrigate in the mid-morning so that the ferns can dry quickly.

“The first year of asparagus growth made the space between rows look bare and it seemed to need something other than just weeds growing between the row of asparagus … I thought I would try planting some ground cover. So, I bought discounted wave petunias (end of season), and other ground-hugging flowers. It made the area look better and pop with color. When I was weeding it was fun to see the flowers cover areas up and have less weeds. Who can not smile looking at all that beautiful color of flowers!”

— Noreen Thomas, asparagus grower, Moorhead, Minn.
• Space rows further apart to promote air movement within the stand. As described in the Planting section above, plant rows at a minimum of 4 feet. Research in Oklahoma showed that spacing rows at 6 feet instead of 5 feet increased air flow and slowed canopy closure.

Additionally, burning the dead ferns in late fall or early spring destroys fungal disease spores, delaying or reducing infection later on. If cultural controls prove insufficient for controlling a significant cercospora infection, select foliar fungicides can be applied throughout the growing season with a focus on disease prevention during wet, hot, humid periods.

Resources for Cercospora leaf spot:
• https://apps.extension.umn.edu/garden/diagnose/plant/vegetable/asparagus/spearspots.html
• plantmanagementnetwork.org/pub/php/review/asparagus/
• http://entoweb.okstate.edu/ddd/diseases/cercospora.htm

Phytophthora Root Rot

Phytophthora root rot is caused by oomycetes (or water molds) in the Phytophthora genus. It is not a common pathogen in Minnesota, but growers should still practice prevention. Phytophthora asparagi is the most common species that causes damage to asparagus in the Midwest. As the name suggests, Phytophthora root rot starts in the roots, but it can spread to the crowns over time if conditions are right. Phytophthora can go unnoticed for years in asparagus because it begins in the roots and spreads slowly.

Symptoms: At first, you may simply notice reduced yields and fern development. If you were to dig up a plant, you would notice reduced root vigor and discoloration. The first aboveground symptoms are water-soaked lesions, or a general water-soaked appearance on the spears at the soil line. As the disease progresses, spears can become crooked or hook-shaped, and the water-soaked lesions eventually become brown and shriveled. In severe or advanced cases, the spears become yellowish brown inside. In a field, growers will typically see distinct affected patches, particularly in low lying areas.

Conditions: Phytophthora is soilborn and typically causes damage in wet conditions. It is particularly problematic in areas with poor drainage, and during seasons with frequent, heavy rainfall. Severity of symptoms can vary from year to year, but once a plant is infected, there is no cure.

Management: Prevention is key. Buy healthy crowns, and inspect them for disease at planting. Phytophthora symptoms in crowns manifest as grayish colored, water-soaked roots. Select your planting site carefully, and make sure there is ample drainage. If possible, avoid planting new asparagus crowns in an area that was previously infected. The variety Jersey Giant is less susceptible to P. asparagi than Jersey Supreme or Millenium (Woods & Hausbeck, 2018).

Resources
• https://www.canr.msu.edu/news/phytophthora_in_asparagus
• http://www.phytophthoradb.org/species.php?a=dv&id=290294

Fusarium Root and Crown Rot

Fusarium crown and root rot is caused by a variety of soil fungi in the Fusarium genus, and it is common in all places where asparagus is grown. It typically affects mature stands of asparagus, but it can also affect seedlings. If the crowns are infected at the time of planting, Fusarium can spread quickly.

Symptoms: In older plantings, Fusarium is typically first noticed due to chlorosis, or yellowing of the ferns. This process can be gradual, with a general decline in productivity and growth. Eventually the chlorosis, or yellowing of tissues, progresses down the stem, and infected tissues become necrotic. In younger plantings, Fusarium can simply manifest as wilt, which will often progress to kill infected plants.
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**Conditions:** Most soils naturally contain strains of Fusarium that are capable of infecting asparagus. Soils with a low pH and low organic matter are more likely to have problems.

**Management:** Start with healthy crowns; inspect crowns to ensure that the roots are white, not discolored, and not shriveled. Avoid planting asparagus in areas where it has been grown within the past five years, and if possible select a site with good drainage, high organic matter, and a moderate to high pH. Fusarium has been associated with deep plantings; in fields with known Fusarium problems, consider planting at a more shallow depth. Focus on organic matter building strategies in your soil, and test your soil regularly to prevent Magnesium and Manganese deficiencies. Drought, weed competition, insect pressure, and overharvesting have all been correlated with increased severity of Fusarium infection.

Most of the common varieties in Minnesota are tolerant to Fusarium including Jersey Giant, Jersey Knite, Jersey Supreme, Purple Passion, and Millennium.

In fields with known Fusarium problems, fumigating, or using anaerobic disinestration, and incorporating manure or other organic matter can help to reduce pathogen populations in the soil. For fumigant recommendations, see the Great Lakes Vegetable Production Guide, which is updated annually.

**Resources**

- https://nevegetable.org/crops/asparagus

**Note on pesticide use:** With all organic and synthetic insecticides, be careful to observe all label instructions such as pre-harvest interval, re-entry interval, application rates, and personal protective equipment. Insecticide labels can change frequently; the label is the final authority for current pesticide use rates and limitations. Rotate pesticide modes of action to reduce the risk of resistance developing. Resistance can and does occur with both organic and synthetic pesticides.

**HARVEST AND MANAGING THE FIELD AFTER HARVEST**

**Preparing for Harvest:** As soon as the field is passable in early spring, mow or chop the old asparagus ferns with a brush hog mower or flail chopper if not chopped in the previous fall. Alternatively, the ferns can be burned down with a controlled burn. Burning helps eliminate asparagus beetles that have overwintered in the old ferns.

Broadcast phosphorus and potassium fertilizers (as described in “Nutrient Management”) and give the entire field a very shallow disking (1-3 inches). Do not delay disking or disk too deep, as doing so can considerably damage the spears just below the soil surface and let in disease organisms.

If using herbicides for weed control, apply a pre-emergent and post-emergent herbicide at this time. Using a pre- and post-emergent together will reduce emergence of early season annual weeds and eliminate any weeds already present. Effective herbicide options are discussed in “Weed Management” later in this guide.
**Harvesting spears:** Spears are hand-harvested when they are between 6 to 10 inches long. In Minnesota, some farmers break the spears off by hand, while others use a special pronged knife to cut below the soil surface. Cut carefully to avoid damaging the neighboring developing spears and the crown. Place the knife near the spear, and tilt it on a 45 degree angle directed about two inches below the soil surface to cut the spear.

Using a knife increases time and labor costs compared to snapping spears by hand. Additionally, developing spears injured by cutting will not grow properly. The advantage to cutting spears below the soil is that the white, woody base restricts water loss, which preserves spear quality.

**When to Stop Harvesting Asparagus**

Harvesting spears for too long stresses the plants, potentially reducing yield the following year. Excessive harvest depletes the sugar reserves in the crowns and causes a gradual decline in plant health.

In Minnesota, the asparagus harvest season in a mature stand (over 3 years old) is 6-8 weeks long and ends in late June or early July depending on the year and location in the state.

Dry weather can cause the season to end sooner, and a late spring or more northern latitude may cause the season to start and end later.

Three signs to stop harvesting include:

- Spear growth and emergence has slowed down considerably
- Spear width is less than pencil size
- Heads are ferning out (expanding) on spears less than 6 inches tall

Daily harvest weights gradually decrease after the peak harvest in early June. Keeping daily records of how many pounds are harvested every day will help determine when spear growth starts to slow down and when it is time to stop harvesting. Harvest generally ends by July 1 in most of Minnesota.

New asparagus plantings less than 3 years old should have an abbreviated harvest. A 1-year old patch (planted one year ago) may be harvested for 0-7 days. Young crowns have not yet built up large enough energy reserves to withstand full harvest periods. While many growers in Minnesota choose not to harvest from one-year old stands at all, some will harvest 1-2 times within one week and then stop. This allows the plants to establish extensive root systems and accumulate sugar reserves.

**Freezing Temperatures During Harvest:** Because asparagus spears emerge so early in the spring, Minnesota growers should expect a night or two of freezing temperatures to occur early in the harvest season. If a hard freeze or frost is in the forecast, harvest all spears in the field regardless of size. These can be marketed as tender, early-season “shorties” at farmer’s markets and farm stands, or used for value-added goods like soups and pickled asparagus.

**Storing and Packaging Asparagus Spears:** Asparagus should be refrigerated upon harvest. For farmer’s markets and farm stands, they are packaged as 1 lb bundles tied with rubber bands. Store the bundles standing up in a bin, in a humid environment or in a container with a shallow amount of water to prevent drying. For restaurants and food service, the spears may be sold in small flats or according to the customer’s specific requests.

**We start harvesting around 30 lbs per day and have a peak of 75-90 lbs in late May. At the end of June it is about 45 lbs per day. Our field is about 1 acre. Prepare yourself for the work. One acre can almost be a full-time job for 6-8 weeks with picking, packing, selling and delivering.”**

– Paul Schmidt, asparagus grower, Preston, Minn.
Ending the Harvest Season: At the end of harvest season, harvest all remaining spears regardless of size. Then proceed to clean up and renovate the beds in preparation for fern growth, described in the next section.

Post-Harvest Management

Asparagus is low maintenance after harvest, but it is not zero-maintenance. Postharvest tasks to keep the field healthy include moderate weed management, fertilization, and in some cases, irrigation. These tasks should not take much time, but ignoring them may decrease the plants’ health and vigor the following year. In the very late fall or following spring, cut or burn down old ferns.

Fertilization: Nitrogen fertilizer can be applied immediately after the last harvest, and before fern growth, to encourage maximum fern size, photosynthesis and energy storage. For more information, see “Nutrient Management” above.

Weed management: By the end of harvest, weed pressure may be heavy in the asparagus stand, especially if herbicides were not used. Remove weeds after harvest and before ferns start to grow. This prevents weeds from producing seed and reduces competition for the ferns.

Hand-pull large weeds and perennials. Immediately after removing all remaining spears, the rows can also be mowed once. Cultivation, cover crops, flaming, and mowing can be used between the rows. One pass of a mower or flame weeder will not kill thistles, so those must be hand-pulled.

A postharvest application of a pre- and post-emergent herbicide mix can be applied to kill small emerged weeds (less than 6 inches) and prevent new weed emergence. This application must occur in the small time window between the final spear harvest and fern growth, so it is best to do it the same day as the final harvest and fertilization. Plan the final harvest for a time when fertilizer and herbicides can be applied immediately afterward. The Midwest Vegetable Production Guide (https://www.extension.purdue.edu/extmedia/ID/ID-56-W%202020.pdf) discusses the relative effectiveness of each herbicide labeled for asparagus.

Irrigation: In times of severe drought or if the asparagus is grown on very sandy soils, irrigation can help maximize fern growth and subsequent yields. Read more about irrigation in the “Nutrient Management” section above.

REMOVING ASPARAGUS FERNS

The asparagus ferns gradually senesce (die) in the late fall, turning brown by winter. As they senesce, they transport carbon and nutrients down to the roots for winter storage. The ferns must be removed every year once they are completely yellow or brown. Do not remove green ferns, as this decreases energy storage in the plants.

Fern removal can either occur in the late fall or early spring. Late fall is preferred if possible, for elimination of insect pests that overwinter in the ferns. However, fall fern removal is rarely possible in Minnesota because the fields usually become covered in snow while the ferns are still green. Therefore, most Minnesota growers wait until spring to remove the ferns.

The ferns can be disconnected from the crowns by chopping, mowing, or burning. Unless the ferns are burned in the field, it is best to physically remove them from the field and burn or compost them elsewhere in order to minimize asparagus insect pests like asparagus beetles and pathogens that have been overwintering in the ferns. Incorporating the ferns to the soil via tillage would contribute relatively little organic matter and create insect pest problems.

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GROWING ASPARAGUS IN MINNESOTA

ABOUT THE AUTHOR

Annie Klodd is a statewide Extension Educator for fruit and vegetable production at the University of Minnesota. She works with farmers across the state to deliver research-based guidance on growing fruit and vegetable crops. She manages the UMN Extension Fruit and Vegetable Newsletter and co-hosts the UMN fruit and vegetable podcast called “What’s Killing My Kale?” Annie grew up on a vineyard in Iowa and holds a Masters degree in Plant Biology from Penn State University.

ABOUT THE SFA MINNESOTA ASPARAGUS PROJECT

Mission: To increase production of asparagus in Minnesota through improved soil health practices, and expand supply chain networks and markets, working with beginning and operating farmers.

Goals:
- To identify challenges and solutions to asparagus production including site selection, pest and disease management, weed control and marketing.
- To generate educational materials available for use by beginning and experienced asparagus farmers on various aspects of asparagus production and marketing.
- To reach hundreds of farmers through workshops and field days regarding asparagus production.
- To build a team of experienced asparagus growers who can serve as coaches and mentors to new and less experienced growers, increasing SFA’s farmer-to-farmer network capacity.
- To assist and work with farmers to plant, harvest and market at least 1/5 of an acre of asparagus, using soil health practices. In addition, the team will individually work with 10 or more farmers from underserved communities including women, Native Americans, new Americans, minorities and people with disabilities.

To access Minnesota Asparagus Project resources, visit sfa-mn.org/minnesota-asparagus-project

ABOUT THE SUSTAINABLE FARMING ASSOCIATION

SFA is a grassroots membership organization dedicated to sustainable production of our food and fiber that works to restore soil health and protect our air, land and water. Founded as a farmer network in 1989, SFA also promotes the production and distribution of safe, healthy, nutritious food, supporting consumers, family farmers and the communities dependent upon them. SFA promotes soil health and sustainable techniques that boost farmer profitability and local food availability.