

Specialty Crop Profile: Asparagus

Anthony Bratsch, Extension Specialist, Vegetables and Small Fruit



Introduction

Asparagus, (*Asparagus officinalis*), is a hardy perennial vegetable belonging to the Lily Family. It is grown for its succulent early spring vegetative shoots that originate from an underground crown (Figure 1). Nutritionally, asparagus is almost 92 percent water, and it provides fairly high amounts of carbohydrates, vitamin A, riboflavin, niacin, thiamine, and phosphorus. A native of coastal Europe, asparagus has naturalized over much of the eastern United States. With the assistance of man and birds that have spread the seeds, asparagus can be found in gardens, old homesteads, fencerows, roadsides, and railroad right of ways across the state. It is well adapted to most of Virginia, preferring well-drained loam soils and easily tolerating winter cold and summer heat. Asparagus is long lived, and a well-managed planting can last 10 to 15 years. For those considering it as a potential crop, good planning and soil preparation are essential for long-term success.



Figure 1: Emerging asparagus spear.
(Photo by A. Bratsch)

Market Potential

Asparagus is familiar to most consumers. Through importation, it is now available as a fresh product on a year-round basis, is incorporated into frozen vegetable mixes, and is canned. It is considered an early-season crop, with fresh-cut spears usually enjoying strong local demand. Depending on location and spring soil warming characteristics, asparagus shoots will begin emergence in late March to mid-April. In a mature planting, the harvest/market window will continue for six to eight weeks. For direct marketers, asparagus is a good opening-season crop, with some overlap with strawberries and early-planted cole and leafy green crops.

Usually asparagus is sold by the bunch (one pound), or in 25-pound crates for bulk or wholesale deliveries. Expect to receive at least twice the price for retail product as for wholesale. Depending on the direct market venue, retail prices usually range from \$1.50 to \$4.00 per pound. The average annual yield for a mature planting ranges from 3,000 to 4,000 pounds per acre or more. Growers should consider the initial cost of establishment (approximately \$3,000 per acre), the time it takes for the planting to reach full production (four to five years), and annual maintenance costs (approximately \$700 per acre). To ensure a quality product, harvests must be made regularly (daily, depending on weather). The availability and cost of local labor are also important considerations. A budget for asparagus can be found in *Selected Costs and Returns Budgets for Horticultural Food Crops Production/Marketing*, Virginia Cooperative Extension publication 438-898, available through local Extension offices or online at <http://www.ext.vt.edu/pubs/vegetables/438-898/438-898.html>.

Cultivars

Asparagus is dioecious, meaning there are male and female plants. In older cultivars (cultivated varieties), the typical male-female ratio in a given seed lot is about 50 : 50. Female plants produce more spears than male plants, but they also drop seeds that can sprout and create overcrowding conditions in the rows or between rows. Seed production also decreases female spear diameter/yield. Recent research and hybridization has brought a new generation of all male cultivars that have been bred for disease resistance (Asparagus Rust and Crown Rot, see the Pest Management section) and higher yields. Male plants also produce thicker, larger, and more uniform spears, lack the seedling weed problem, and yield two to three times more than standard varieties.

Cultivar Suggestions

Jersey “Super Male” Hybrids (all with good rust and crown rot resistance):

- Coastal and Southern Piedmont: ‘Jersey Knight,’ ‘Jersey Supreme,’ ‘Jersey Giant’
- Upper Piedmont and Mountains: ‘Jersey General,’ ‘Jersey Knight,’ ‘Jersey King’

Synthetic varieties:

- ‘Syn 4-56,’ ‘Syn 53’ (Note: Similar to Jersey hybrids.)

Open Pollinated:

- ‘Martha,’ ‘Mary Washington’ (The old standards, average rust resistant, M/F)
- ‘Purple Passion’ (Novelty type, sweeter, purple color, M/F)

Site Selection and Preparation

Because asparagus is a long-term perennial crop of significant cost to establish, particular attention should be paid to site selection and preplant soil preparation. Select a well-drained planting site with full sunlight exposure that has never had asparagus on it. Even with resistant cultivars, replant of older sites should be avoided or at least delayed for five to six years to reduce the risk of crown rot diseases. Avoid light, sandy soils, as grains of sand can be difficult to clean from the spears. Rocky soils and very windy sites should also be avoided, as both can cause crooked or bent spears as they emerge through the soil. The site should allow for good cold air drainage to reduce frost damage in the early spring. Southern facing slopes will advance emergence as compared to northerly aspects.

Asparagus roots deeply, and it is important that an assessment of the seasonal water table level be conducted over the course of a year before planting. This can be done by digging a four to five feet deep pit, and monitoring water accumulation and holding depth. Sites with winter water tables reaching closer than three to four feet from the surface should be avoided, or significant loss of roots will occur each winter by drowning. The plant expends energy to regrow these roots when the water recedes, but this regeneration/loss cycle can weaken the plant over time and reduce yield. In soils that have slow internal drainage, raised bed planting may help to drain water more quickly around the crowns, helping to reduce the incidence of crown rot pathogens. Beds should be formed three to four feet wide and four to eight inches high.

During the year prior to planting, perennial weeds should be identified in the site and eradicated using translocated, systemic herbicide such as glyphosate (e.g. Round-up™). A soil test should be taken to establish site fertility and pH status. Depending on initial soil test, additional phosphorus (P) and potassium (K) may be needed, and both nutrients should be added to meet high test levels. On low test sites, as much as 200 pounds per acre of P as P_2O_5 and 300 pounds per acre K as K_2O should be applied before planting. Asparagus prefers a higher soil pH than most vegetable crops, and lime may be needed to bring soil pH to 6.5 to 7.0. This, too, should be done a year in advance of planting. All preplant amendments should be broadcast over the field and well incorporated in the soil.

Establishing the Planting

Planting should be done between April 1 and May 30. In addition to preplant amendments, a starter fertilizer (500 pounds 10-10-10 per acre or 50 pounds nitrogen (N) per acre) should be applied over the rows and tilled in. Planting can be done several ways, including direct field seeding, as growing transplants, and as dormant crowns (Figure 2). For large acreage plantings, direct seeding is the most economical method; however, precision seeding equipment is needed. For smaller operations, crown planting is recommended, though it is more expensive. Growers can raise their own one-year-old vegetative crowns from seed in a propagation bed the year prior, or can purchase them from a reputable nursery. In mid-April, sow seeds one and one-half inches deep in well-prepared soil, using 10 to 12 seeds per foot in rows 24 to 30 inches apart. Soaking the seed for four days will hasten emergence. In late fall to early



Figure 2: Asparagus crown with new shoot. (Photo courtesy South Dakota State University, <http://hflp.sdstate.edu/PestAlert/alert801.htm>)

winter, crowns should be dug, size sorted, and kept in cold storage (35° to 40°F) until spring. Asparagus can also be established from greenhouse-grown seedling transplants in peat pots or plastic cell trays, but time to first harvest is delayed by one season as the seedlings are not as vigorous as one-year-old crowns (Figure 3). Seeds will germinate and emerge in 10 to 14 days at 70° to 75°F. Greenhouse temperatures should range from 65°F at night to 85°F during the day. Seedlings will be ready for transplanting in eight to 12 weeks when they are six to 10 inches tall. Like direct field seeding, growing greenhouse seedlings or raising your own crowns in seed beds may not be as economical or practical as buying nursery crowns for plantings of an acre or less.



Figure 3: Asparagus seedlings grown in plastic cell trays. (Photo by G. Welbaum)

Asparagus is planted deep as compared to other crops. Planting trenches are in rows that are five to six feet apart, and six to eight inches deep and wide. Both crowns and transplants are set into the trenches. The distance between rows may be increased, depending on the harvesting and field equipment to be used. Orienting the rows north-south may promote faster drying of rain and dew from the foliage and may help delay the onset of fungal disease problems.

Prior to planting, an additional banded application of commercial phosphate (0-46-0) or slow-release rock phosphate fertilizer should be made on the trench bottoms, using 50 pounds actual P per acre. Contact with this fertilizer will not hurt the newly set plants, and it provides additional long-term P for the life of the planting.

Maximum yield at maturity will be a function of site fertility, cultivar, soil type, and field density. Various recommendations on plant density often reflect the research done with a particular cultivar on particular sites or soil types. A general density range is 12 to 24 inches apart in single rows. Non-hybrid varieties are often set at higher densities (12 inches), while the all-male hybrids, especially on fertile sites, can obtain large plant and crown size and should be placed 15 to 18 inches apart. Growers on limited spray or organic programs, wishing to encourage more air movement to reduce foliar disease, may consider setting plants up to 24 inches apart; however, the trade-off with overall yield per acre should be considered. Higher densities using double rows 12 inches apart and in-row plant spacings of six to 12 inches have been used in some sites. These high-density plantings have the advantage of higher yields and returns early in life of the planting. However, the long-term performance and economics of these plantings should be compared to a standard, single-row planting. In general, when increasing between-row spacing beyond six feet to accommodate equipment, in-row spacing can be increased to compensate. Table 1 provides information on plant populations at various between- and in-row densities for single rows.

Once crowns or plants are set in the planting trench, cover and firm with two to three inches of soil, and irrigate the area if rainfall is lacking. Over the course of the first season, gradually fill the trench until it is level, and irrigate during drought periods. Do not cut any emerging spears during the first year.

Table 1. Plants per acre required for various field densities

Between-row spacing	In-row spacing			
	12 inches	15 inches	18 inches	24 inches
5 feet	8,712	6,970	5,808	4,356
6 feet	7,260	5,808	4,840	3,630
8 feet	5,445	4,356	3,630	2,723
10 feet	4,356	3,485	2,904	2,178

Crop Development and Harvest Guidelines

Each spring, spears (shoots) will emerge from buds formed on the crown the previous season. The emerging spears quickly lengthen, and begin to branch out, forming a canopy of fine-textured “fern” growth (Figure 4). Managing the fern growth is critical to success with asparagus. During the growing season, the ferns are actively building the crowns and buds for the next harvest season. Disease and insects can defoliate ferns by mid-season, and growers should be vigilant to maintain green and actively growing ferns until they are killed by fall frost.



Figure 4: Healthy asparagus field and fern growth near the James River, Virginia. (Photo by A. Bratsch)

The year after planting, a light harvest is possible for about two to three weeks, taking no more than four to six spears per plant. Harvest only spears larger than pencil diameter, and allow others to grow. During the third season, harvest for four to six weeks, and in following years, six to eight weeks or until the majority (75 percent) of spears coming up are less than three-eighths inch in diameter. A common mistake is to over-harvest, which reduces crown vigor, and increases susceptibility to diseases. It also reduces the time that the plant has to grow ferns and develop next year’s crop, which is especially important in regions of the state that typically have an early fall frost.

Morning is the best time to harvest. Harvesting is usually done by hand, and requires hours of back-bending work. Harvest aides have been developed which allow workers to sit, and ride over the rows while cutting. For larger plantings, this piece of equipment is recommended. Air temperatures dictate frequency of harvest and under warm conditions, twice daily may be necessary. Any frost-damaged spears should be cut and discarded, as well as small, bent, or otherwise unmarket-

able spears. Non-marketable or missed spears should not be allowed to grow out while the harvest is in progress (i.e. keep the field “clean-cut”). Spears should be harvested when they are eight to 10 inches long (Figure 5), and cut just below the surface, or snapped at ground level. With snapping, the fibrous white base is left. Both methods are acceptable. All spears should be trimmed to a uniform length (Figure 6) and washed clean of soil particles prior to sale. For retail sales, the spears should be bundled in one-pound bunches. For wholesale markets, spears are packed upright in wooden crates designed for asparagus. Spears should always be stored in an upright position or the tips will bend and turn upward. For direct marketing, spears can be set in a tray of shallow water, with the butt-end immersed. Fresh asparagus should be marketed as soon as possible, but can be held for about seven to 10 days in a cooler at 33° to 36°F with the bases kept moist and the humidity high. Asparagus quickly loses quality and become fibrous at temperatures above 40°F. Do not allow ice to come into direct contact with spears as this may cause chilling injury.



Figure 5: Harvesting asparagus at or below ground level with sharp knife. (Photo by A. Bratsch)



Figure 6: Trimming spears in bundle to equal length. (Photo by A. Bratsch)

Seasonal Culture

Fertility

Following the harvest period, the seasonal care of ferns should not be neglected, as the next year's crop is dependent on successful fern growth through the summer and up to frost. After the last cutting, fertilize with 50 to 75 pounds N per acre. This rate can be split using an early-spring application before spears emerge or in the fall after ferns have died-back. Results from timing experiments of supplemental N as well as overall N rate studies have been variable. Therefore, specific site conditions and the age of the planting will influence how much and when N is applied. A soil test should be taken every two to three years to monitor soil pH and K levels. When needed, supplemental lime and K (as 0-0-60, muriate of potash) can be broadcast over the field to keep pH levels optimum and K levels in the moderate range. If ample P was applied at planting, it is unlikely that the crop will respond to supplemental P. If it is applied, P should be banded into the soil, as a broadcast application will not reach the roots. Like N, both lime and K applications will be carried into the root zone over time.

Irrigation

Because asparagus is deep rooted, supplemental watering is usually not needed in an established planting. However, it is important for the year of establishment. If there is drought during the first two to four years, irrigation may help improve the size of spears. There is little benefit to irrigating fields during the harvest period, and wet soils during harvest will only compact the field.

Notes on Fern Management

Following frost in the fall, ferns die and turn brown (Figure 7). They can be left on or mowed-off using a brush or flail-type mower. In smaller plantings, a WeedEater® with an attached blade works well. Stalks should be trimmed as close to the ground as possible. Depending on the site and local ordinances, dried ferns can also be burned. In colder regions, dead ferns catch snow and help retain soil moisture. They also reduce winter soil erosion, which can be a concern on sloped sites. Ferns left on through the winter and early spring can delay spear emergence by virtue of shading and keeping the soils cool and moist as compared to bare soil. This can be advantageous where late spring frosts

are a problem or if the grower is interested in delaying harvest onset for other reasons (such as timing the crop to overlap better with strawberries). If there has been difficulty with asparagus beetle or rust during the growing season, it is best to remove the ferns. Mowing followed by light tillage over the rows can be done to destroy overwintering habitat for these insects and reduce inoculum of asparagus rust (see the Site Tillage section). Light tillage will also help to incorporate chopped fern stems, and speed their breakdown.



Figure 7. Winter-killed asparagus ferns. (Photo courtesy Kansas State University, <http://www.oznet.ksu.edu/hfrr/hnews-let/2004/ksht0442.htm>)

Notes on Growing White Asparagus

White or blanched asparagus is asparagus that has been grown in the absence of light. It is not a special cultivar, but rather a method of growing that uses various techniques to exclude light from emerging spears. White asparagus production is highly specialized and intensive, but results in a crop that usually receives a premium price, often two to three times that received for green asparagus (Figure 8). It is favored by high-end restaurant chefs, and has a distinct flavor and textural difference. Various methods have been employed



Figure 8. White asparagus culture using a soil ridge. (Note green tips resulting from contact with sunlight.) (Photo by A. Bratsch)

to grow white asparagus. Soil mounding over the beds has been the historical method and is still used by some growers. As spears grow through the soil ridge, they are cut as they begin to crack the soil surface, and before they are exposed to light, which will turn the tips green. A long knife is used to cut the spear near its base and lift it through the soil. Black plastic or breathable black fabric secured and supported over the rows by metal hoops is another method used, and on a wider scale that soil ridging. Spears are removed through brief access by lifting the plastic on the edges of the bed. Harvested spears should be kept from the light (except on market shelves). They are trimmed and handled the same way as green asparagus.

Pest Management

Weed Control and Site Tillage

Control weeds by mulching, hoeing, or using registered herbicides on established beds. Given the range of herbicide materials available, a weed-free planting is possible (Figure 9). Both pre- and postemergence herbicides are available for asparagus, and pre-emergence materials can be applied at several critical times (early spring, after the last harvest, and late fall) for season-long control. Weeds can be partially managed by light tillage (one to two inches deep) when spears are not present, such as the very early spring before spears emerge, just after the last clean-cut harvest, or in the late fall when the tops die down. These tillage windows coincide with, and can be used to incorporate pre-emergence herbicides and supplementary fertilizer. **Special care should be taken to adjust tillage equipment depth to avoid damage to crowns.** In older plantings, determining the crown location/depth should be done carefully as crowns tend to “rise” in position over time. Also for direct-seeded fields, crowns will be



Figure 9. Weed free asparagus planting utilizing tillage and herbicides. (Photo by A. Bratsch)

closer to the surface. Periodic light tillage also helps to loosen soils that become compacted during the harvest season. This is especially true with heavier clay soils. Light tillage in heavy soils may help to reduce bending as the spears emerge. As noted previously, tillage is also a means to incorporate fern residues, reducing disease inoculum and insect overwintering sites. Growers should note that risk of damage to crowns with tillage can be significant, and the benefits of this practice are currently under review. For light, loamy soils the only benefits may be timely weed cultivation and incorporation of herbicides.

Insects and Diseases

Important insects that attack asparagus include asparagus beetles and cutworms. Adult asparagus beetles overwinter in crop debris and in the early spring begin laying eggs on emerging spears and later on fern stalks. The eggs are difficult to remove and can make the spears unmarketable. Larvae feed on ferns during the growing season (Figures 10a, 10b, and 10c). If the numbers are high enough, significant defoliation occurs. Ferns will not leaf-out again and will turn brown and die. Further information regarding asparagus beetle control is available in *Asparagus Beetles*, Virginia Cooperative Extension publication 444-620, available from your local Extension office or at <http://www.ext.vt.edu/pubs/entomology/444-620/444-620.html>.

Cutworms emerge from the soil and will feed on emerging spears. Damage caused by their ground-level chewing causes the spear to bend in the direction of damage. One species of cutworm will climb the spear and girdle it above the soil line. During harvest, scout for egg-laying activity of asparagus beetles and cutworm damage and take appropriate measures to limit the damages. During the fern season, asparagus beetle adults and larvae should be monitored and controlled when threshold levels of damage occur. In areas where Japanese beetle activity is known, these insects should also be monitored and controlled to prevent excessive foliage feeding.

Asparagus rust, *Puccinia asparagi*, and crown rot, *Fusarium oxysporum* v. *asparagi* and *Phytophthora* spp., are the primary diseases of concern with asparagus. Both crown rot species are best managed by proper site selection and preparation to ensure good soil drainage and by practicing crop rotation, and planting (Fusarium) resistant varieties. Crown rot results in weakened spear development and outright loss of the crowns. Over



Figure 10a: Common asparagus beetle adult. (Photo courtesy Oklahoma State University, <http://entopl.okstate.edu/ddd/insects/asparagusbeetle.htm>)



Figure 10b: Common asparagus beetle larva feeding on fern growth. (Photo courtesy Kansas State University, <http://entopl.okstate.edu/ddd/insects/asparagusbeetle.htm>)



Figure 10c: Eggs of common asparagus beetle on asparagus stem. (Photo courtesy Department of Entomology, Kansas State University, http://www.oznet.ksu.edu/entomology/extension/KIN/KIN_2004/kin-7/04ksnew.07.htm)

time, the planting becomes less productive and eventually not economical to manage. Early signs of crown rot should be monitored and aggressively addressed with application of registered fungicide drenches. In addition, it has been noted that nitrogen fertilizers may enhance this disease, and total rates should be reduced in subsequent years. Most new cultivars are noted for their asparagus rust resistance. However, under conditions of high rainfall and humidity, the disease should be monitored and controlled, particularly toward the end of the summer when ferns are building the crowns for next year's crop. Ferns with rust will gradually turn brown as the disease spreads. Pustules containing rust spores will be visible on the stems. A preventative versus a curative disease program is recommended using registered fungicide materials.

Cercospora leaf spot/blight (*Cercospora asparagi*) is a foliar disease that can be problematic under conditions of high humidity and high temperatures. This blight causes the browning and drop of needles, which can greatly reduce yields in following years. Spraying with a registered fungicide every seven to 10 days after first noticing the disease can help reduce secondary infection levels.

Insects and diseases can be managed by timely insecticide and fungicide applications and the implementation of cultural methods. It is beyond the scope of this publication to address the various agricultural materials available for use in asparagus. For a complete list of these pesticides, as well as herbicides, and their use recommendations can be found in the *2005 Commercial Vegetable Production Guide*, Virginia Cooperative Extension publication 456-420, online at <http://www.ext.vt.edu/pubs/vegetables/456-420/456-420.html> or in print through the local Extension office. The Extension agent can also assist in making pest management and other crop production decisions.

Summary

Asparagus is a unique perennial specialty crop that fills an early-season market niche. For direct marketers, it heralds the start of the season and is quickly followed by strawberries and early spring-planted vegetables. Initial establishment costs are high, but compared to other vegetable crops, annual maintenance costs are low. Growers should consider the harvest labor requirements and cost, and the physical nature of the work. An understanding of the various aspects of cultural management is needed to ensure productiv-

ity from year to year. Asparagus is a long-term crop investment that will continue to yield for 10 or more years if properly cared for. Marketing the crop requires planning and consideration, and growers will be rewarded by diligent attention to detail in post-harvest handling and product preparation.

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