

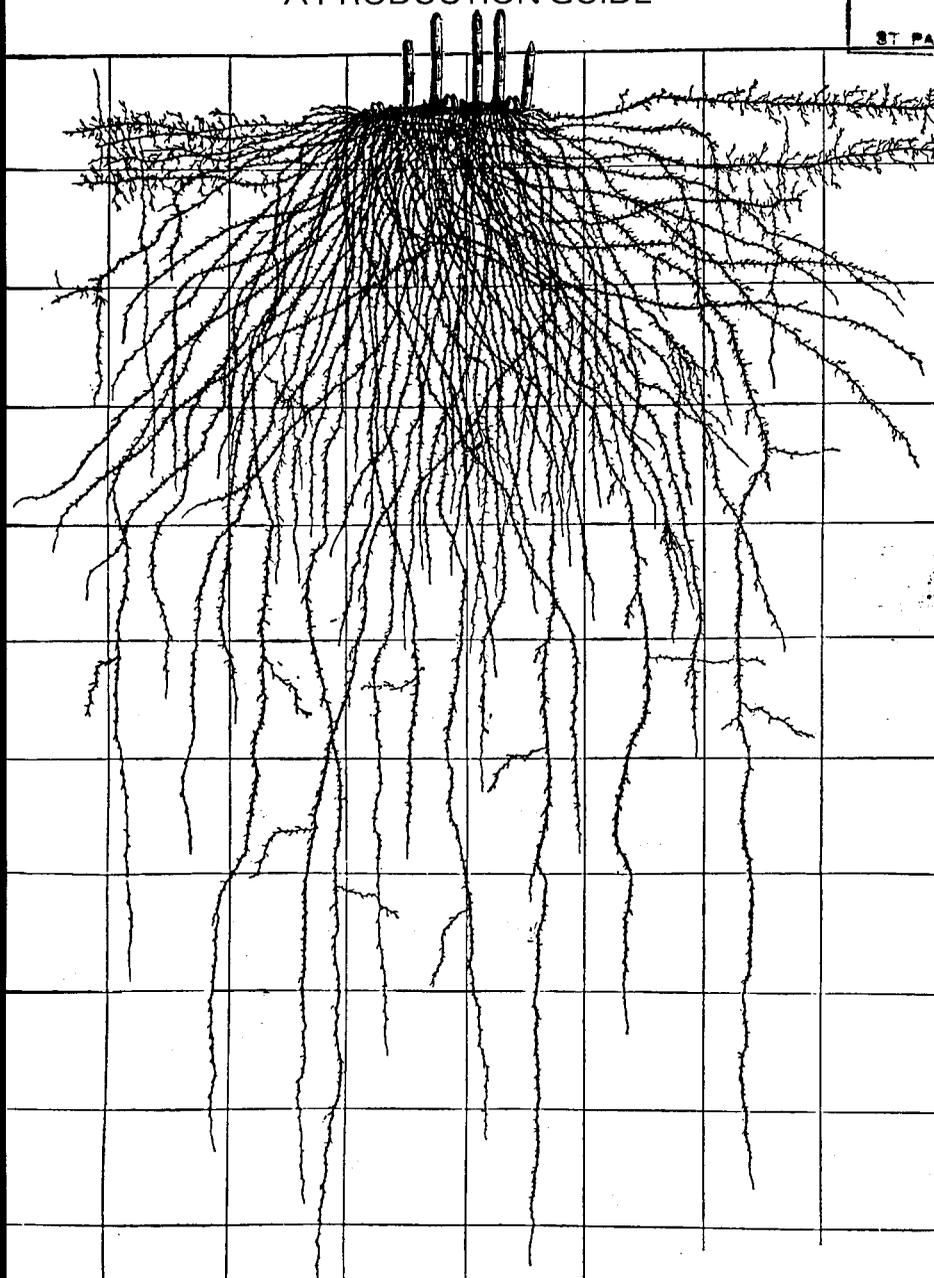
GROWING ASPARAGUS IN MINNESOTA

A PRODUCTION GUIDE

UNIVERSITY OF MINNESOTA
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William D. Hutchison, Frank L. Pflieger,
Carl J. Rosen, Leonard B. Hertz,
Vincent A. Fritz, Jerry A. Wright,
Rhoda L. Burrows

Asparagus is a high value specialty crop and the earliest producing spring vegetable. It currently is priced as a gourmet item and will remain in this category until growing, harvesting, and processing costs can be reduced. Although production in the United States is concentrated in California, Washington, and Michigan, many other areas have great production potential climatically and geographically. Minnesota has great potential for becoming a large asparagus producing region, for Minnesota-grown asparagus has proved to be of high quality. The decision to grow asparagus is one that should be thoroughly investigated. This publication describes the cultural practices that must be considered to produce asparagus successfully.

Climate

Production is most successful in areas where freezing temperatures or drought terminates plant growth and provides a rest period. Without this rest period reduced yields are likely. Asparagus tolerates great temperature variations: it grows in the Imperial Valley of Southern California, where temperatures can reach 115° F., and it grows in Minnesota, where temperatures can plunge to -40° F. Asparagus can be grown in a wide range of soils and under various climatic conditions, but it thrives in fertile well drained soils in moist temperate regions that have long growing seasons and sufficient light for maximum photosynthesis.

In Minnesota, asparagus is susceptible to late spring frosts that may kill emerged spears, delaying subsequent spear development. Therefore, production fields should not be established in low areas or in other frost-susceptible locations.

Site Selection and Preparation

Unlike most other vegetables, asparagus is a perennial crop which can be productive for 15 years or more. Consequently, it is important to pay particular attention to site selection and preparation for this crop. In Minnesota, asparagus is grown on many different soils ranging from sandy coarse-textured soils to clay fine-textured soils. Highest yields are usually obtained on medium-textured sandy loam to loam soils. Asparagus plants have a deep root system that will penetrate at least six feet. Shallow soils or soils prone to a high water table should be avoided. Asparagus roots will not tolerate saturated soil conditions.

Soil Fertility Requirements - New Plantings

Field preparation should take place the year prior to planting. Soil tests (0-12") can be used to determine needs for lime, phosphorus, and potassium. Asparagus will not tolerate extreme acid soil conditions and grows best at a pH of 6.5 - 7.0. The objective during the first 3 years after planting is to encourage maximum fern growth so that plants build extensive storage root systems.

Plow down soil amendments before furrow construction or bed shaping. All furrows should be 6 to 8 inches below the normal soil surface. Rates of fertilizer for asparagus are dependent on soil test values and relative organic matter levels. Refer

to Tables 1, 2 and 3 for suggested rates of fertilizer. For nitrogen, (N) approximately 1/3 to 1/2 of the recommended rate should be broadcast after planting. The remainder of the N should be sidedressed at the first cultivation. Most of the phosphorus (P) and all of the potassium (K) should be broadcast and incorporated prior to furrow construction or bed shaping. Apply 25-30 lb/A P_2O_5 in the trench before crown setting. If soil test P is high, omit the broadcast application and apply only that recommended for the trench.

For the second and third year following crown setting, disk in during the spring prior to spear development (40-60 lbs. N/A and recommended rate of P and K according to a soil test). An additional 30-40 lbs. N/A should be applied as the soil warms up.

Soil Fertility Requirements - Established Plantings

Once the plants are established, the primary objective is to maintain plant vigor. Asparagus has a very fleshy root system which is capable of storing a large quantity of nutrients. It has been estimated that the roots can store 150 lbs. N/A, 37 lbs. P/A and 170 lbs. K/A. These stored nutrients, in part, can be used for the development of spears in the early spring. The actual amount of nutrients removed by a 2.5 T/A harvest is 23 lbs. N/A, 3 lbs. P/A and 20 lbs. K/A. Generally, it is not necessary to apply fertilizer for an asparagus crop until after harvest. Delaying fertilization until after harvest can reduce early weed growth. For sandy coarse-textured soils, 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 topdressed after harvest to encourage fern growth.

Secondary and Micronutrients

Asparagus response to application of secondary and micronutrients is not well documented in Minnesota. Most soils low in calcium (Ca) and magnesium (Mg) are acid and should be limed with dolomitic lime prior to planting. Sulfur may be limiting on sandy soils with low organic matter. In general, asparagus response to micronutrients is low. Nutrient ranges from healthy mature asparagus ferns are presented in Table 4. Suspected nutrient deficiencies should be confirmed with soil tests and/or tissue analysis.

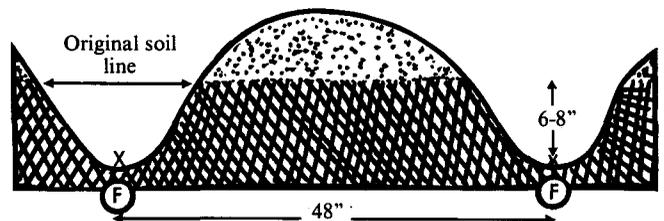


Figure 1. Side view of typical furrow construction. X = crown or transplant placement; F = fertilizer placement (two-three inches below the bottom of the furrow).

Irrigation

Irrigation should be used on asparagus fields containing sandy soils or shallow root restrictions in central Minnesota. Inadequate soil moisture during fern development can cause significant reduction in next spring's spear production. Dry soil conditions during spear growth can also affect quality and yield.

Adequate soil moisture is also necessary for newly planted crowns to establish good root development and 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 rooting zone (See cover). Maintaining adequate soil moisture in this zone during the fern stage especially should be the goal of an irrigating producer. Asparagus plants will use .10 to .20 inches of soil water per day during fern growth depending on climatic conditions.

To maintain healthy fern development, soil moisture during this period should not be allowed to deplete more than 50 to 60% 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.

Several soil moisture monitoring methods are available to assist the grower in proper timing of irrigation water to maintain healthy plant growth. A discussion of the typical monitoring methods can be found in Minnesota Extension Service bulletin AG-FO-3875, Irrigation Water Management Considerations for Sandy Soils in Minnesota.

Light, frequent irrigation applications should be avoided during fern growth to minimize foliage disease development. On the other hand, over irrigation should also be avoided as it may cause some of the applied nitrogen to be leached below the plant's root zone and possibly into the ground water.

Water scheduling is an essential management practice for irrigated asparagus production. Utilization of any of the available soil moisture monitoring tools requires only about 30 minutes a couple times a week to provide an operator with valuable information for scheduling the next irrigation.

Asparagus Varieties

Asparagus varieties should be both high yielding and disease resistant, although no available asparagus variety is highly resistant to rust or to fusarium crown rot. Asparagus is a dioecious (dye-EE-shus) plant, meaning that there are both male and female plants. Generally, females produce larger spears than males, but the males produce greater numbers of smaller diameter spears. Only female plants produce berries. Breeding work is in progress worldwide to produce high yielding all male asparagus lines. The main benefit from an all-male hybrid is that it doesn't produce seed, which can later germinate and create a significant weed problem. Only a few varieties of asparagus are available for commercial plantings. Until recently, varieties have been various strains of the Washington type, which are comprised of both male and female plants. Several of the all-male hybrids recently developed in New Jersey hold promise for high

yields and increased rust resistance tolerance to fusarium. Jersey Giant, Jersey Knight, and Jersey Prince have done well in Minnesota. Greenwich, not tested in Minnesota, has done well in light-textured soils in Illinois, and Jersey Gem has done very well in Michigan. Jersey Centennial, a new cultivar recently released by the New Jersey Agricultural Experiment Station, is reported to be more vigorous, productive, and rust resistant than Mary Washington. Other varieties that may be used in Minnesota are Viking, KB-3, Martha Washington, Waltham Washington, Faribo hybrid, and Green Giant. The California varieties UC 157, 800, 66, 309, 500W, 711, and 500 all have been bred for warm climates and do not possess the longevity or hardiness needed in Minnesota.

Asparagus Bed Establishment

Commercial asparagus plantations can be established either by traditional crown planting or by transplanting seedlings. Direct seeding into a permanent location is discouraged because of the difficulty of establishing a stand. If you are planting a large acreage, asparagus crown nurseries offer the opportunity to produce many crowns per acre easily. Generally, ten production acres can be established from the crowns produced in a one-acre nursery. Asparagus seed with a high germination percentage should be seeded on level ground about one inch deep and spaced about two inches apart within rows. The spacing between rows should be planned to facilitate mechanical digging. A modified potato digger has been used successfully to dig crowns. Generally, single rows spaced about 24 inches apart will allow enough space for large crown production. This spacing scheme requires 130,000 seeds per acre for the planting. An 80-percent recovery of crowns will net approximately enough plant material to plant ten production acres with four feet between rows and one foot between plants within rows. Usually one ounce of asparagus seed contains 700 seeds.

To grow high quality crowns, obtain seed with a high germination percentage. Plant the seed in sandy soils so crowns can be easily dug and will be relatively free of soil. Apply and incorporate phosphorus and potassium fertilizers prior to seeding the nursery at the rates suggested in Table 2. Apply approximately 50 pounds per acre of nitrogen after the first shoot ferns out, and topdress an additional 50 pounds per acre in midsummer.

The slow rate of germination is a problem with direct seeding. Optimum temperatures for germination range from 77° to 86° F. Although lower soil temperatures slow germination, it is advisable to plant asparagus seed as soon as the soil is workable in Minnesota. Since the growing season needed to produce large crowns is limited in Minnesota, early spring seeding will allow germination to occur as soon as the soil environment becomes favorable. To prevent infection by soilborne pathogens, asparagus seed should always be treated with fungicides.

Weed control in direct-seeded asparagus presents a second challenge. A few satisfactory preemergence herbicides are labeled for direct-seeded asparagus (see Table 3). Adjust the rate according to the texture of the soil type. Inevitably, mechanical cultivation is necessary in the nursery. Any cultivation should always be shallow to prevent damage to asparagus roots, which

Table 1. Nitrogen recommendations for asparagus

	Organic matter level			How to apply
	Low	Med.	High	
	N to apply lb/A			
Asparagus new planting	120	100	80	1/2 broadcast, 1/2 sidedress during cultivation;
Established planting	80	60	40	Topdress after harvest

Table 2. Phosphorus recommendations for asparagus

Phosphorus (P) Soil test ppm	Amount of Phosphate (P ₂ O ₅) to apply (lb/A)	
	New	Established
0-10	200	100
11-20	150	75
21-30	100	50
31-40	50	25
41 +	25	0

Table 3. Potassium recommendations for asparagus

Potassium (K) Soil test lb/A	Amount of Potash (K ₂ O) to apply (lb/A)	
	New	Established
0-50	250	100
51-75	200	75
75-100	150	50
101-150	100	25
151-200	50	0
200+	0	0

Table 4. Nutrient concentration ranges in healthy asparagus ferns

Stage of growth	Part Sampled	Nutrient concentration ranges										
		N	P	K	Ca	Mg	Fe	B	Cu	Zn	Mn	
		%			ppm							
Mature fern	Fern from 18"-36" up	2.4	0.3	1.5	0.4	0.15	-	50	6	20	20	
		3.8	0.4	2.4	0.5	0.20	-	100	11	60	160	

are very near the soil surface. Although asparagus is quite drought-tolerant, irrigation should be available for use in case of dry spells.

Asparagus crowns should be dug in early April or before the buds have begun to grow. Old plant tops should be mowed and removed from the field if they interfere with crown digging. A potato digger, peanut digger, or common moldboard plow can be

used to lift the asparagus crowns from the nursery row. Avoid injury to the crowns during digging and handling. If dug crowns need to be stored prior to replanting, keep them cool (about 38°F.) and dry. High humidity will cause rapid decay. Crowns can become overheated if they are stored in a deep pile. Crowns in storage should be stacked only a foot or so deep. Avoid freezing temperatures in storage, since severe injury or even complete loss is probable.

Crown Plantations

For small plantings, it is easiest to buy one-year-old crowns from a reliable grower. Insist on only one-year-old crowns, which transplant easier, produce as vigorous plants as two-year-old crowns, and are cheaper. Crowns should be large, with many storage roots and buds (see Figure 2). Each bud will eventually produce a spear. Storage roots contain high levels of sugar that nurture the developing spears. The larger the crown, the more vigorous the resulting asparagus plant will be.

Crowns usually are hand planted with buds up, spaced 12 inches apart within rows in furrows four feet apart (11,000 crowns per acre). Six to eight inches is the optimum depth for crown planting (see Figure 1). Shallower planting depths cause production of spindly, thin spears, whereas deeply planted crowns produce fewer spears of larger diameter and emergence is delayed. Planting crowns closer than 12 inches results in reduced spear size and quality. Spacing crowns farther than 18 inches apart may result in larger spears but fewer spears per acre.

After placement in the furrows, cover the crowns with two to three inches of soil (see Figure 3). Gradually fill in the furrow as shoots emerge. By the end of the season, the furrows should be entirely filled in, although the developing asparagus fern should never be buried.

Weeds cause the greatest problem in establishing an asparagus bed from crowns. Apply an appropriate herbicide immediately after the crowns are covered should control weeds until the asparagus is large enough to be cultivated easily and safely.

Seedling Transplants

Transplanting seedlings into the field is an acceptable alternative to crown planting. Seedlings are produced in greenhouses and are usually transplanted into permanent commercial fields when they are about 10 to 14 weeks old. The young seedlings can be mechanically transplanted, which reduces planting costs. Studies indicate that survival rates are comparable to those of crown plantings. The plant spacing is the same as in crown planting (see Figure 3). A transplant solution of 10-52-17 or 9-45-15 should be used at planting time. Follow the manufacturer's recommendation for mixing. Each transplant should receive at least 4 oz. of transplant solution. For best results, irrigation should be applied if rainfall is insufficient to maintain adequate soil moisture. Seedlings should be thoroughly hardened off before field planting. Place the plants in a moderately shady location and keep them moist. After about three days, transplant them to the field. In many cases, the asparagus fern will totally yellow and die; this is normal.

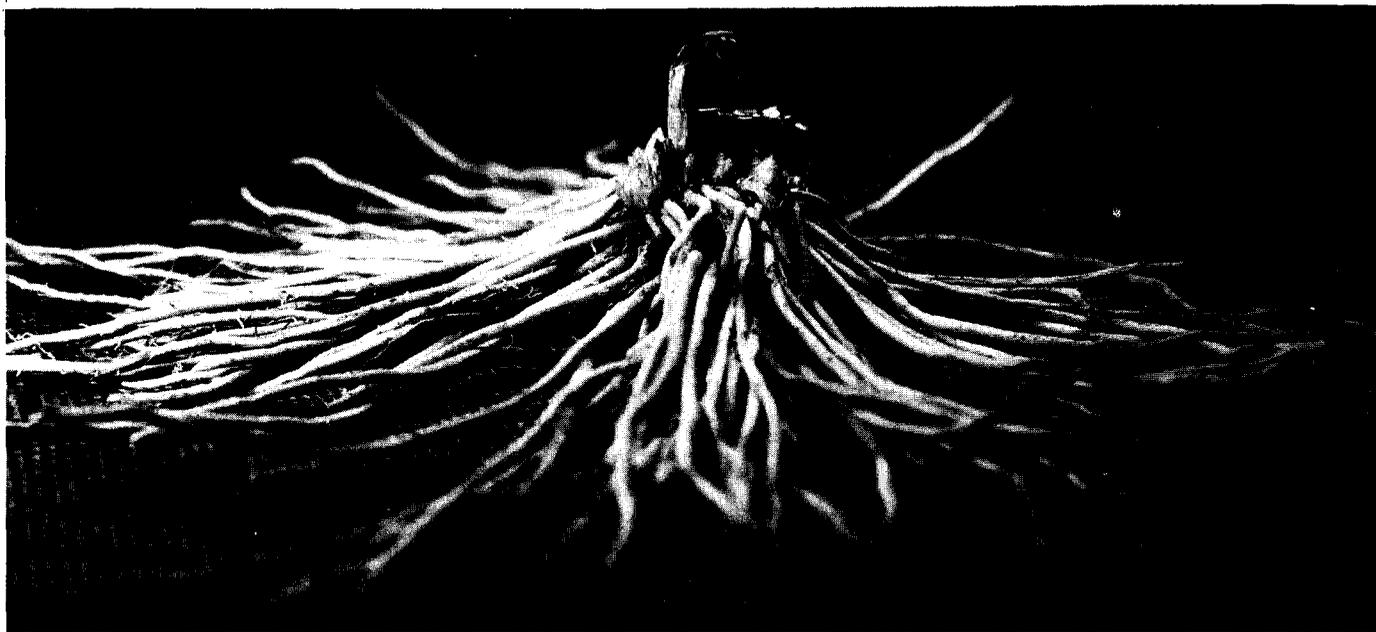


Figure 2. A high quality asparagus crown.

Transplanting may take place either in the spring (early May) or in the fall (early to mid-September). While spring transplanting is more common, fall transplanting has proved successful in Minnesota, and provides flexibility in the scheduling of both labor demands and greenhouse space. Regardless of the timing, the transplants should be as large and vigorous as the transplant equipment will allow, and without becoming rootbound in the original containers.

Weed control is a challenge in the transplanting of asparagus (Table 5). Cultivation will be necessary to fill in the furrows as the fern grows and as herbicides lose their residual activity.

The question of whether to use transplants or crowns is still unanswered. They are comparable in price, but crowns are one-year-old plant material, whereas transplants are only 10 to 12 weeks old. Since the growing season is short in Minnesota and transplants do not grow to a large size in their first season, both crowns and transplants may come into harvest in the beginning of the third season.

Pest Management

Insects

Asparagus grown in Minnesota is relatively free of insect pests compared to many other vegetable crops. The asparagus beetle (black with white markings) is the most common insect that attacks asparagus. Adult beetles, which overwinter under debris along field edges, begin to move to asparagus as the plants first emerge in spring. Beetles feed on the spears and glue rows of black eggs, usually on the tips. 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.

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

When asparagus beetles and spotted asparagus beetles are present at harvest, they can cause extensive damage. Early-season feeding by adult beetles causes a distorted "shepherd's crook" growth of the spear. The presence of eggs also renders the spears unacceptable for market.

On nursery seedlings, defoliation of the plants by asparagus beetle larvae should be watched for carefully; insecticides should be sprayed if a field has 5 - 10 adults/100 crowns or 2% of the spears have eggs. After the harvest season, limited feeding by larvae on established plantings may be tolerated; treatment threshold for adults increases to 5-10 adults/10 crowns. Recommended insecticides for controlling both asparagus beetles are listed in Table 5.

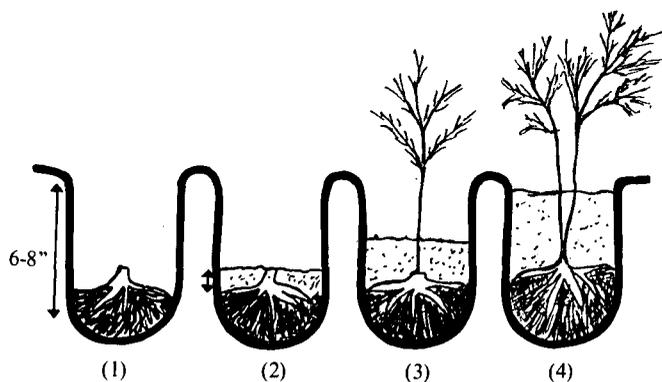


Figure 3. Planting crowns: (1) set crowns upright in wide furrows six to eight inches deep, with roots spread. (2) cover with two inches of soil, (3 and 4) gradually fill the furrow as the plants grow.

Cultural controls for both species of beetles include following good cultural practices that promote plant vigor and thorough harvesting of spears to reduce the number of beetles that hatch in the spring. Chemical control of adult beetles may have to be repeated, since the beetles emerge from overwintering sites over an extended period.

One of the most devastating insect pest that attacks asparagus is the asparagus aphid (*Brachycorynella asparagi*). The aphid was first reported in southern and central Minnesota in 1982. The asparagus aphid is a minute, blue-green sucking insect that usually feeds on asparagus fern. In the process of feeding, it injects a toxin into the asparagus plant that is translocated down the stem into the dormant buds. 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. Although the relationship between aphid infestations and economic damage is unknown, younger plants, including those 1-2 years after transplanting, are most susceptible to damage. 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. When populations are increasing rapidly and biological control does not appear to be effective, malathion (Cythion 5E) should be used at 2 pints per acre (Table 5). Lannate is also effective, but usually more expensive. Sevin is not recommended for aphid control.

The asparagus aphid lays its eggs in late summer or early fall. The eggs overwinter on the fern and fall to the ground by spring. Unharvested asparagus, which ferns out in early spring, is highly susceptible to early aphid infestations because egg masses are allowed to hatch and the aphid's life cycle begins. Asparagus that is harvested into early summer is not at risk until the fern is allowed to develop. The aphid feeds only on the fern, not on asparagus spears. Removing asparagus fern in late fall after it has dried down greatly reduces potential aphid infestations the next year, but this is seldom possible before the first snowfall. If an asparagus aphid infestation is suspected, immediately contact your county extension service for instructions on diagnosis.

Cutworms can cut off asparagus spears below ground and even cause damage by feeding on the tips of spears above ground. Shoots damaged by cutworm feeding develop into crooked spears and must be picked and culled. Chemical control is warranted if one or more worms/10 crowns are found. (Sevin) applied as a bait, Lorsban, Lannate and permethrin are registered for cutworm control.

Weeds

A number of herbicides are available for use on asparagus (see Table 5). Depending on the type of asparagus plantation (direct-seeded nursery, transplants, crowns, or established asparagus beds), choosing the most effective herbicide and rate represents

a challenge to the grower. The desired herbicide should produce long-term weed control, be safe to use on the asparagus fern, and be legal to use. As outlined, each type of asparagus plantation presents a different set of problems.

Direct-Seeded Asparagus. Producing asparagus crowns in a nursery for eventual digging and establishment of new production fields is still a popular practice. The slow germination and emergence rate of asparagus seedlings and their slow growth rate present outstanding weed control problems. Therefore, the major weed control objective in nursery production of crowns should be to use an herbicide that has long weed-killing activity yet remains safe on the delicate asparagus seedlings. The herbicide should remain active at least until the seedlings are large enough to be mechanically cultivated safely. This may take as long as two to three months after seeding.

Transplants. The use of seedling transplants to establish new asparagus acreage in Minnesota is increasing. Since furrow opening and planting is a one-step operation, herbicides to control weeds must be applied "over-the-top" of the transplant fern or directed to the ground after planting to avoid the asparagus fern. Primary concerns include: selecting a herbicide and a rate that is toxic enough to control weed species but not seriously set back the growth of the asparagus plant, and determining the application method.

Crowns. Traditionally, most new asparagus production fields are established by planting one-year-old nursery grown asparagus crowns into deep furrows. Since the first new shoots may take many weeks to emerge and grow to a size that can be cultivated, weeds in the furrow may become large and not controllable by cultivation. Therefore, an easily applied preemergence herbicide of long, dependable activity is necessary to reduce the number of mechanical cultivations needed to keep fields weed-free.

Established Asparagus. Many herbicides are now labeled for use on established asparagus and can be applied before the harvest begins (preemergence), after harvest (delayed application), before and after harvest (split application), or throughout the harvest season (multiple application). The problems facing the grower are choosing an application method that complements the operation and choosing a chemical and rate that will control weeds after harvest for the duration of the growing season.

Table 5 lists the herbicides labeled for use in Minnesota. Recommendations for herbicides in the direct-seeded nursery, on crown plantations, and on transplant plantations appear under Asparagus Bed Establishment.

Diseases

There are several important diseases that can cause asparagus losses. These diseases are Fusarium root rot, wilt and decline, rust and Stemphylium purple spot. Fusarium root and crown rots and wilt are present in most all soils responsible for asparagus

Table 5. Herbicide, insecticide, and fungicide suggestions for asparagus*

WEEDS	Herbicide	Amount of product/acre	Remarks and limitations
SEED BEDS			
Emerged annuals	Gramoxone Extra	3 pt	Apply before asparagus emerges but after weeds emerge.
Germinating annuals	Sinbar 80 W	2 lb	Apply immediately after seeding. Spray activated charcoal over seeded row at 300 lb/A before application.
Emerged grasses	Fusilade 1 E	2 pt	Apply to non-bearing asparagus only. Add 1 qt crop oil concentrate per acre.
	Poast 1.5 E	2 pt	Apply to non-bearing asparagus only. Add 1 qt crop oil concentrate per acre.
ESTABLISHED BEDS			
Germinating annuals	Karmex 80 DF ✓	2.5-4 lb	Apply after disking or chopping fern in the spring before weeds emerge. May be reapplied after harvest season if needed.
	Princep 80W ✓	4 lb	Do not exceed a total of 5 lb/A/year.
	× Lorox 50DF	2 - 4 lb	Do not exceed a total of 4 lb/A/year.
	× Sencor 4F/Lexone 4L ↓	1 - 2 qt	Apply in the spring before asparagus emerges, or after harvest.
	Sinbar 80W	1.5 - 3 lb	Apply prior to spear emergence or after cutting season. Use lower rate on coarse soils.
	Devrinol 50W	8 lb	Apply before emergence in spring and incorporate.
Emerged annuals	Gramoxone Extra	3 pt	Apply before crop emerges or after last harvest.
Emerged perennials	× Roundup 3E	2-4 qt	Apply up to 1 week prior to spear emergence or last harvest. Do not contact fern growth.
Emerged broadleaves	2, 4-D amino (4 lb/gal)	2 qt	Apply before, during, or after harvest to actively growing weeds. Postharvest sprays should be made using drop nozzles to avoid fern contact.
INSECTS			
Asparagus beetle	carbaryl (Sevin XLR Plus)	2 pt	1 day phi; do not repeat within 3 days.
	malathion (Cythion EC)	2 pt	1 day phi
	methomyl 1.8L (Lannate)	2-4 pt	1 day phi; 90SP (0.5-1 lb; not restricted use)
	methoxychlor 2E	4 pt	3 days (unless washed or blanched)
Cutworms	carbaryl (Sevin) 20% bait	10 lb	1 day phi; do not repeat within 3 days.
	permethrin (Ambush 2 EC)	3.2-6.4 fl. oz	1 day phi; do not exceed 0.4 lb AI/acre/season
	(Pounce 3.2 EC)	2-4 fl. oz	1 day phi; do not exceed 0.4 lb AI/acre/season
Asparagus aphid	malathion (Cythion EC)	2 pt	1 day phi
DISEASES			
Rust	Fungicide Dithane, Manzate		Remarks and limitations Apply only on fern growth after spears have been harvested. Apply every 7 to 10 days to fern growth only.

*EC = emulsifiable concentrate; WP = wettable powder; R = restricted use pesticide; Post treated areas when required by label. Always verify current pesticide recommendations in the annually revised, "Commercial Vegetable Weed, Insect, and Disease Control Guide AG-BU-1880.

wilt and decline is *Fusarium oxysporum* f. sp. *asparagi*. The first symptoms caused by this disease usually occur midsummer when 1 or 2 fernstalks per plant turn yellow. Removal and cutting through the center of the crown reveals reddish vascular discoloration as well as red lesions on the exterior of the stalk. Similar lesions can also be found on storage roots where the fungus entered the roots. In addition to *Fusarium* wilt and decline, a brown dry crown rot disease caused by *Fusarium moniliforme* has been shown to be involved in the decline of plants. Symptoms are similar to those of wilt and root rot except this pathogen causes the roots to collapse rather than the typical reddish lesions. Reports of both these pathogens found in association with asparagus crowns in production fields exist and generally results in more rapid decline of plants. The intensity of these diseases can be increased by nutrient stress, drought, and insect damage. To help minimize losses due to these diseases and to establish a vigorous asparagus field, only disease free plants should be planted on well-drained soil. Soil pH should be maintained between 6.5 and 7.5 with moderate levels of fertility. Control of other foliar diseases and insects is important. If left unchecked, additional plant stress will predispose the crowns to *Fusarium* pathogens. Once *Fusarium* becomes established in the field, there are no simple controls. Since the pathogen is soil-borne, new beds should never be planted in fields previously in asparagus.

Asparagus rust caused by *Puccinia asparagi* is a potentially devastating disease. The symptoms of the disease are commonly first observed as orange spore patches on the base of the spears and on the fern branches (see Figure 4). High humidity and warm temperatures are conducive to spore germination. Wind rapidly moves the spores and with sufficient moisture an entire field may be infected in a relatively short time. Asparagus rust causes individual fern needles to fall. Where the disease is severe, an entire field may ultimately become infected with a brown appearance. The result of an uncontrolled rust infestation is a reduction in the size and number of spears produced. Later in the fall when cooler temperatures and less moisture are common, the fungus forms a different spore which may or may not occur in previously infected plant tissue which are black rather than red. The weakened plants are also very susceptible to the *Fusarium* decline disease. The most effective control of asparagus rust is to plant resistant varieties. Some of the varieties selected out of Washington strains have some rust resistance. Jersey Centennial is remarkably resistant to rust. Additional methods of control include destruction of old asparagus plants and volunteer seedlings in the vicinity. Timely fungicide applications will provide reasonably good control of rust (see Table 5). During periods of high humidity of extended rainfall, applications should be made every seven to ten days.

Another disease of concern in recent years is *Stemphylium* purple spot caused by *Stemphylium vesicarium*. This disease was first found in Minnesota asparagus fields in 1988. Symptoms on the spears appear as elliptical sunken, purplish spots which may cause rejection of product. The disease produces brown to tan lesions with dark purple margins on the ferns. In spring, spore are produced from last year's infected plants and spread by wind and water to newly developing plants. Infection occurs through



Figure 4. Rust infection on asparagus stems.

natural openings and wounds on current season asparagus tissue with favorable temperatures and moisture from rainfall or irrigation.

To date, fungicides have not provided effective control of purple spot. However, recent research in Washington state has shown the incorporation of asparagus debris from the previous season into the soil in the fall resulted in less disease severity than when debris was left on the soil surface. This work also discusses the importance of volunteer asparagus seedlings as they become infected during the harvest season and may serve as a source for disease increase as well as reservoir to carry the disease from the harvest period when the spears are removed to when the ferns are allowed to grow. Further studies are needed to provide additional information on purple spot but for now, one method of reducing disease severity is crop debris management.

Preparing for Harvest

In earliest spring, mow or chop the old asparagus fern with a brush hog mower or flail chopper. Add phosphorus and potassium fertilizers and give the entire field a shallow disking. Do not delay disking. Doing so can cause considerable damage to the developing but unemerged spears just below the soil surface. Wounds also provide a portal for disease organisms.

Apply a preharvest herbicide at this time. The advantage of an early season herbicide application is that it reduces or even prevents the establishment of winter annuals and other weeds not controlled by cultivation.

Harvest

Spears are hand harvested when they are six to eight inches long. A special pronged knife can be used to cut the spears below the soil surface, or they may be snapped at the soil surface. Cutting must be done carefully to avoid damaging developing spears and the crown below the soil surface. The knife should be placed near the spear, tilted on a 45 degree angle, and directed to cut the spear about two inches below the soil surface. Shoots injured by cutting will not develop properly and should be culled. Spears may be hand snapped just above the soil surface. Snapping severs the spear at the junction between the green tender tissue generally above ground and the white woody tissue below ground. The advantage to cutting spears is that the woody base restricts water loss, which preserves spear quality.

Depending on the planting method, asparagus beds require two to three seasons to become established. Transplants and crowns require two years for establishment before first harvest begins, whereas asparagus started from seed takes three full growing seasons before harvest. During the establishment years, fern growth, plant vigor, and health should be optimized with careful cultural management. For areas with short growing seasons, the USDA recommends a light harvest (two to three weeks) during the first season after plant establishment. A full harvest season of six to eight weeks may begin the following season, although the harvest should be terminated immediately any time spears are

reduced to pencil size. Harvesting may have to be performed every two days at the height of the harvest season. Spear emergence greatly increases in response to warm temperatures and slows considerably with cold temperatures.

Overharvesting greatly reduces the vigor of the asparagus plant by seriously draining the sugar reserves in the crown. Remember: next year's yields and profits are determined by how well the asparagus is treated this year.

Field Maintenance After Harvest

Asparagus plants need stored nutrients and time to recover from harvests. They also need weed-free environments, moderate soil fertility, and adequate moisture to build up food reserves in their crowns. Neglecting asparagus fields after harvest is a more significant contributor to poor yields in subsequent years than insect or disease damage.

After harvest, add nitrogen fertilizers according to soil test results. Since the asparagus plants will now be left to fern out, they need nitrogen to encourage maximum fern development, photosynthesis and storage of sugars in the roots for next year's crop. Research has consistently shown that the bushier the asparagus plant the better the yields will be the next season. Nitrogen should be incorporated very shallow. A postharvest herbicide application is necessary to extend weed control full season. A contact herbicide may be necessary to kill perennial weeds prior to fertilizer incorporation. In times of severe drought or if the asparagus is grown on sandy soils, use irrigation to maximize subsequent yields.

Asparagus is a rewarding crop to grow. But it is a perennial plant that will cause perennial problems if its culture and maintenance schedules are ignored.

Additional Resources on Asparagus Production

Putnam et al. Common Asparagus Pests. Michigan State Extension Service. E-959

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Thornton, R. et al. Washington Asparagus Production Guide. EB0997.
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Drought Advisory Bulletin 1988.
Cooperative Extension Washington State University.



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On the cover: Crown and root system of a six-year-old asparagus plant; each block represents one foot square.
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William Hutchison, extension entomologist and assistant professor, Department of Entomology; Frank Pflieger, extension plant pathologist and professor, Department of Plant Pathology; Carl Rosen, extension soil scientist and associate professor, Department of Soil Science; Leonard Hertz, extension horticulturist and professor and Vincent Fritz, extension horticulturist and associate professor, Department of Horticultural Science; Jerry Wright, extension agricultural engineer, West Central Experiment Station-Morris; and Rhoda Burrows, research fellow, Department of Horticultural Science. The authors extend their appreciation to R. Dufault, M. Burke, L. Waters, Jr. and W. Cranshaw for developing the previous edition of AG-FO-1861.

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