

Asparagus is a perennial crop that can remain productive for 10 to 15 years. The plant is composed of ferns, a crown, and the root system. The fern is a photosynthetically active modified stem. The crown is a series of rhizomes (underground root-like stems) attached to the base of the main plant. New crown buds, from which spears (immature ferns) arise, are formed the previous year. Larger buds generally result in larger spears, while smaller buds yield small spears. Bud size is most influenced by the plant's overall vigor the previous year. Growing conditions that favor healthy fern development and the accumulation of carbohydrates (food reserves) in the crown and root system thus enhance size and vigor of buds and subsequent spears.

Asparagus has an extensive root system composed of fleshy storage roots and finer feeder roots. The mature asparagus plant's root system can reach 5 to 10 ft deep and 10 to 12 ft wide. Storage roots attached to the crown that store carbohydrates are the diameter of a pencil. Fibrous feeder roots develop from storage roots to accumulate nutrients and absorb moisture.

Asparagus has separate male and female plants. Open-pollinated varieties (non-hybrid varieties allowed to cross-pollinate freely) produce almost equal numbers of male and female plants. The plant's sex has a pronounced effect on the quality and quantity of spears and on crop management practices. Female plants produce larger diameter spears, but lower yields. They also produce seed that can become a serious weed problem for the established stand if allowed to germinate and establish. Lower yields for females are probably caused by energy used for seed production at the expense of carbohydrate accumulation that could be used for subsequent spear production. Male plants have higher yields, live longer, begin to produce earlier in the spring, and do not produce seed.

## PLANTING

Asparagus grows best when growing conditions include high light intensity, warm days, cool nights, low relative humidity, and adequate soil moisture. Compared to most other vegetables, asparagus is relatively winter hardy, with higher heat, drought, and salt tolerances.

Spear initiation and root growth begin when the soil temperature is above 50°F. Sandy soils warm earlier in the spring and encourage early spear production, while irrigation cools the soil and retards spear production. Optimum productivity occurs at 75 to 85°F in the day and 55 to 66°F at night. High daytime temperatures during harvest will loosen the spear tip and develop fiber in the stem, both of which reduce crop quality.

High winds and abrasion caused by windborne soil particles can cause considerable damage to growing asparagus spears, causing the spear tips to curve into the wind. If curving is excessive, the spear becomes a cull. Windbreaks and grain cover crops can reduce wind damage, particularly on sandy sites.

## SOILS

Asparagus grows in a wide range of soils, ranging from pure sand to heavy clays and mucks. An ideal site includes a sandy loam soil with good drainage and aeration, water table below 4 ft, and a pH of 6.8 to 7.5.

## SITE PREPARATION

Avoid sites with established perennial weeds, particularly bindweed and nutsedge, which are persistent and difficult to control. Check with your county Extension agent for current registered herbicide recommendations for asparagus site preparation.

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Planting sites should be deeply plowed, disked, and laser-leveled if flood irrigation is to be used. Organic matter should be incorporated 6 months before planting to allow the material to break down (green manure crops or weed-free manures, 20 t/ac). These materials are not essential, but can be used if they are readily available.

Before planting, a pre-plant broadcast application of phosphorous should be incorporated into the soil along with a starter application of nitrogen at a rate of 200 lb/ac of P<sub>2</sub>O<sub>5</sub> and 75 lb/ac of nitrogen. Phosphorous can also be chiseled into the planting furrow, slightly below the bottom of the furrow. Do not apply nitrogen in this manner, because it may burn the roots. A soil analysis early in the season is the best guide to determine fertilizer rates.

## VARIETY SELECTION

Select varieties that are adapted to local growing conditions. Quality, yield, earliness of production, plant vigor, and disease tolerance are all important variables to consider.

Several hybrid asparagus varieties have been developed that are commonly used in place of open-pollinated varieties. Hybrid varieties are more expensive than older, heirloom varieties, but yields are often higher and most offer greater resistance to diseases. Below is a list of promising varieties that have performed well in New Mexico.

Variety	Selection Notes
'Jersey Giant'	High yield, rust-resistant, tolerant to Fusarium wilt.
'Jersey Knight'	High yield, rust-resistant, tolerant to Fusarium wilt and crown and root rot.
'Jersey Supreme'	High yield, rust-resistant, tolerant to Fusarium wilt.
'Atlas'	High yield, heat-tolerant.
'UC 157'	Heat-tolerant; rust, Fusarium wilt, and crown rot tolerant.
'Purple Passion'	Sweet, tender shoots. Produces unique purple spears.
'Millennium'	Cold-tolerant.
'Mary Washington'	Older, heirloom variety.
'Martha Washington'	Older, heirloom variety.

## PLANTING TECHNIQUES

While the accepted methods of planting asparagus employ either crowns or transplants, crowns are traditionally used. Growers using crowns should buy medium to large grades that are disease-free and locally adapted from a reputable asparagus nursery. If crowns cannot be planted immediately, they should be stored in a cool (35–40°F), moderately dry environment to maintain their viability. Avoid drying, high temperatures, and freezing. Schedule delivery of crowns to coincide with planting to avoid prolonged crown storage.

To ensure rapid establishment, plant crowns in the spring after the soil temperature has reached 50°F. Conventional asparagus spacing is 12 in. between crowns and 5 ft between rows (8,712 crowns/ac). Make a wide furrow 6 to 8 in. deep with a double moldboard plow or lister.

Place crowns in the bottom of the furrow with buds facing up, then cover with 2 to 3 in. of soil. Crowns planted without proper bud orientation will survive, but will emerge more slowly in spring, resulting in lower yields. Crowns planted with buds facing down also tend to push to the surface of the soil.

When crowns are planted and covered, apply irrigation water to settle the soil and provide soil moisture for growth and crown development. Furrow irrigation can be used as long as erosion is avoided. If sprinkler or drip irrigation is used, make sure the ground is thoroughly soaked to a depth of 1 to 2 ft.

After emergence, apply additional nitrogen (75 lb/ac). Gradually add more soil to the crowns as ferns develop. Furrows should be filled in by the end of the first growing season.

Seedling transplants can be used instead of crowns. Field-ready transplants grown in a greenhouse can be ready for transplanting in 10 weeks, versus one year for a crown. Transplants also eliminate digging injuries associated with crowns.

Water transplants thoroughly before planting in the field. Plant in the center (bottom) of the planting furrow. Soil should be added gradually to the furrow as spears develop into mature ferns. Land preparation, planting depth of the transplant's crown, spacing, fertilization, and irrigation recommendations are the same for transplants as for crown plantings.

Another transplant technique is the use of a double row configuration. This requires twice as many plants, but results in greater yields, especially early in the planting.

Double-row management requires a wider furrow, with centers 5 ft apart. Plant transplants on both sides of the furrow so the rows are 12 in. apart, allowing 12 in. between plants within the row. All other establishment techniques are the same as for the single-row transplant.

## FERTILIZER REQUIREMENTS

Soil and plant tissue should be analyzed yearly to provide the grower with specific information on nutrient status of the soil and the plants in the field.

Nitrogen leaches from the soil and thus needs to be applied annually. Application rate depends on site-specific conditions, but asparagus usually needs 100 to 150 lb of N/ac/yr. A split application of 75 lb/ac before and after harvest is preferred to a single application of 150 lb/ac, as the split method results in more efficient fertilizer use. Nitrogen deficiency symptoms include an overall yellowing of the ferns and weak vigor.

Micronutrients, specifically iron and zinc, may also be required, as these nutrients can become unavailable for plant uptake in highly alkaline soils. Iron deficiency symptoms include chlorosis, or yellowing, of the new growth. In severe cases, growing tips will appear white. Foliar applications of ferrous sulfate (20% Fe) at 2 to 3 lb/100 gal water should be made as soon as symptoms appear.

Zinc deficiency symptoms are similar to iron deficiency symptoms—stunting and yield reductions. Foliar applications of zinc sulfate (22% Zn) at 2 to 4 lb/100 gal water should be made as soon as zinc deficiency is identified, or if plants do not respond to corrective iron sprays.

## **IRRIGATION**

Furrow, sprinkler, or drip irrigation can be used to maintain asparagus plants. Irrigation schedules will depend upon local weather conditions, soil textures, and current stage of growth. Irrigate fields often enough to maintain good soil moisture and vigorous fern growth during the growing season. Asparagus usually needs irrigation every two weeks during the summer, but irrigations are reduced in early fall as plants begin to go dormant. No irrigation is needed during the dormant period.

Begin irrigation in spring just before spear emergence. Avoid stressing plants during the harvest season. Irrigating every other row during harvest season is one way to avoid moisture stress and continue to harvest. Increase irrigation frequency as ferns begin to develop. Overhead sprinkler irrigation should be applied in the morning to avoid foliar disease such as asparagus rust and *Cercospora*, and possible salt injury.

## **DORMANT SEASON MANAGEMENT**

Remove ferns in early winter when they are completely dormant and brown. Removing ferns makes harvesting easier in spring and reduces overwintering sites for insects and diseases. Ferns can either be burned, mowed, or baled.

Before spear emergence, lightly rototill the beds to remove any remaining fern material. Be careful not to damage crowns under the soil surface. A layer of soil 2 to 3 in. deep should then be added to the tops of the beds with a border disk. The rototilling and extra soil make harvesting easier, creating a clean bed. The additional soil also tends to increase spear diameter.

## **GENERAL PEST MANAGEMENT**

Pests in asparagus plantings include weeds, insects, and diseases. It is important to identify and know the life cycle of the pest that is present. Control measures include varietal resistance or tolerance, cultural practices, and chemical controls, and every effort should be made to minimize pesticide use. However, when no other management tech-

nique can prevent unacceptable crop losses, labeled pesticides may be used. Always read and follow label directions and check with the county Extension agent for the latest recommendations for pest control.

## **WEED CONTROL**

Shallow cultivation can be used on tops of beds in early spring before spears emerge if the cultivator does not damage crowns. Sweeps can be used to clean furrows if they are set to avoid root damage. Herbicides can also be used to control specific weeds.

## **INSECTS**

Common insect pests on asparagus in New Mexico include the asparagus aphid, asparagus beetles, and cutworms. Asparagus aphids, a powdery gray-green aphid, damage the fern by injecting toxins into the plant while feeding. The toxins will stunt the fern and cause abnormal growth.

Two types of beetles feed on asparagus in New Mexico: the common asparagus beetle and the spotted asparagus beetle. Both species feed on foliage and reduce asparagus quality by depositing eggs on emerging spears (appearance problem).

Adult common asparagus beetles are ¼-inch-long, brightly colored beetles. The wings are black with red margins and three large, yellow, squarish spots. The blue-gray larvae have black heads. Asparagus spears with beetle eggs are considered culls, as the larvae feed on the ferns and reduce their ability to produce carbohydrates.

The adult spotted asparagus beetle is the same size as the common asparagus beetle, but its wings are covered with six reddish-orange spots. Larvae are orange. This beetle mostly damages the seed berry, but it also may be present on the ferns and spears.

Control of both species includes removal of the old ferns where these pests overwinter and use of labeled insecticides.

Cutworms can also damage asparagus spears. Cutworms feed on the spear tip or on the side of the spear. This brown to pale yellow larva lives in the soil and can be up to 2 in. long. Because adult cutworm moths usually lay eggs on weeds, good weed control reduces cutworm populations.

## **DISEASES**

Common asparagus diseases in New Mexico include Fusarium wilt, asparagus rust, and *Cercospora* needle blight. Fusarium wilt is a destructive disease with no known treatment for infected plants. This disease is caused by soil-borne fungi that cause plants to lose vigor and die. Infection can occur through wounds caused by insects, cultivation, or harvesting, or through root tips. Symptoms include shriveling spears or yellowing ferns,

and eventual dead ferns. Infected roots are reddish-brown. Crowns eventually turn reddish brown, rot, and die. To control Fusarium wilt, avoid planting in land where asparagus previously grew, plant resistant varieties, and avoid stressing or damaging plants.

Asparagus rust and Cercospora needle blight are potential problems in prolonged, rainy weather. Asparagus rust is caused by a fungus that infects ferns after harvest. Extensive infection reduces the fern's ability to produce carbohydrates, causing an overall decline in crown vigor. Reddish-brown pustules on ferns indicate the fungus is present. Spores are spread by wind and rain. Control measures include resistant varieties and preventive chemical sprays.

Cercospora needle blight is also caused by a fungus. Its symptoms occur midway through the growing season, causing ferns to die prematurely. Infected ferns are characterized by small, tan-to-gray, oval or elliptic spots with reddish brown margins.

Premature plant defoliation at this crucial time will reduce carbohydrate accumulation. The fungus can spread quickly under conditions of high rainfall and humidity. A registered, preventive fungicide should help control this disease.

## HARVESTING

Asparagus spear production depends on carbohydrates stored in the crown from the previous season, as sufficient stored carbohydrates are necessary after harvest to produce vigorous ferns. To have healthy, productive plants the following year, avoid excessive harvesting. When average spear groundline diameter declines to ¼ in., harvest should be stopped and plants allowed to produce ferns to replenish carbohydrates for the next season.

The harvest interval is usually three times/week early in the season when soil and air temperatures are low. Daily harvesting is possible toward the end of the season as temperatures warm. The New Mexico asparagus harvest season begins in southern New Mexico in early March, and moves north with harvests in the Los Lunas area in early April and Farmington in early May. Dates vary yearly depending upon local climate conditions.

Asparagus can either be snapped or cut with a special long-handle knife. Snapping asparagus is faster than cutting asparagus and gives completely tender spears. Cutting asparagus results in greater yields because spears are cut 1 to 2 in. below ground. The bottom of the spear will, however,

be white and partially lignified. Harvesters should avoid damaging crowns with the harvesting knives. Harvest asparagus early in the day while the spears are still cool, and refrigerate as soon as possible after cutting.

Harvest duration depends on method of establishment, overall plant vigor, and age of planting. In southern New Mexico, where the growing season is longer, one-year-old plants established from crowns can be lightly harvested the first year after planting. This harvest can last up to three weeks, assuming stem diameters are not less than an average of ¼ inch.

Do not harvest transplants the first year after planting, but both crown and transplant asparagus can be lightly harvested the second season. For the next two years, harvest up to eight weeks. From year four on, harvest a maximum of 10 weeks/year. Pick the field clean so none of the spears develop into ferns during the harvest season. Early fern production attracts insects and disease problems and depletes food reserves needed for additional spear production. Harvest duration will depend upon the vigor of the plants the previous season. **Do not** overharvest and weaken plants if you want to maintain long-term viability of the planting. Stop harvesting when the diameter of emerging spears is less than that of a pencil (approximately ¼ inch).

## STORAGE

Asparagus is highly perishable and should be cooled as soon as possible to maintain quality. Asparagus can be hydrocooled with ice water and put into cold storage. Optimum storage temperature is 32 to 36°F at 95% relative humidity, making storage of two to three weeks possible. Storage below optimum temperatures can lead to limp, mushy, discolored spears. Storage above optimum temperatures will result in partially open bracts and potential disease and rot problems. Phytophthora, Botrytis, and Fusarium rots can all occur when asparagus is stored at temperatures above the optimum range.

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