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EXTENSION SERVICE

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Commercial Strawberry Production in West Virginia

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Strawberries (*Fragaria* sp.) are a profitable fruit crop for West Virginia producers. Production and marketing of strawberries can provide cash flow throughout the growing season if the correct varieties and production practices are implemented. Factors to consider before growing strawberries commercially are: (1) marketing, (2) cultivar selection, (3) site selection and fertilization, (4) production method, (5) pest and disease management, and (6) harvest and postharvest handling.

Figure 1. Strawberries are a popular fruit for market in West Virginia. All photos by Lewis Jett.

Marketing

Per capita strawberry consumption is approximately 5 pounds/person/year, and the berries are available in supermarkets year-round. Since strawberries have a relatively short shelf life and are shipped in from distant regions, they are often below optimal quality when found in grocery stores and markets. As a result, West Virginia has a strong market demand for local, vine-ripened strawberries.

In West Virginia, fresh strawberries can be marketed as “pre-picked” or “u-pick.” When grown in small field plantings or in high tunnels, selling strawberries as a pre-picked product can be profitable. With larger plantings, growers may need to harvest and market the crop partially or exclusively as u-pick (Figure 2). With u-pick marketing, growers must consider many factors, including premise liability insurance, customer parking, harvest scheduling, and advertising.

Figure 2. U-pick strawberry production is one market outlet for commercial growers.

Cultivar Selection

A farmer's selection of suitable strawberry varieties is crucial for success. Several types of strawberries can be successfully grown in West Virginia (Table 1). The traditional type is often called a "short day" or "June-bearer." June-bearing varieties are typically grown as a matted row, although some varieties can be grown on plastic mulch with drip irrigation (often referred to as plasticulture).

Table 1. Recommended strawberry cultivars for West Virginia.

Variety	Type	Maturity	Plasti-culture[1]	Comments
Annapolis	June-bearer	Early	No	Medium to large fruit with light red color.
Earliglow	June-bearer	Early	No	Very good flavor; Does not keep size through harvest.
Northeaster	June-bearer	Early	No	Large fruit. Size runs out similar to 'Earliglow'.
AC Wendy	June-bearer	Early	No	Productive variety for early harvest. Produces abundance of runners
Galletta	June-bearer	Early	No (?)	Large, early yield.
Honeoye	June-bearer	Mid-Early	No	Large berry with excellent winter hardiness.
Allstar	June-bearer	Mid-season	No	High yield of light-colored berries.
Darselect	June-bearer	Mid-season	Yes	Suitable for matted row or plasticulture
Cabot	June-bearer	Late Midseason	Yes	Huge fruit. Produces few runners.
Jewel	June-bearer	Late Midseason	No	Excellent yield and quality.
Lateglow	June-bearer	Late Midseason	No	Vigorous plants. Fruit is light-colored.
Chandler	June-bearer	Early	Yes	Medium to large fruit; Good shelf-life
Camarosa	June-bearer	Mid-Early	Yes	Hardy in zone 6. Well-suited to high tunnel production.

Variety	Type	Maturity	Plasti-culture[1]	Comments
Sweet Charlie	June-bearer	Early	Yes	Ripens a week earlier than 'Chandler'.
Seascape	Day-neutral	Early; full-season	Yes	Sweet, medium-sized berries.
Albion	Day-neutral	Full-season	Yes	Firm berry with good size and flavor. Produces many runners.
San Andreas	Day-neutral	Full-season	Yes	Firm berry with large size

June-bearers typically flower in April or May in West Virginia and produce daughter plants (runners) during the longer days of summer. In the fall, these types of strawberries initiate flower buds for the following year. Some cultivars of June-bearers are planted in late summer/early fall in West Virginia and are allowed to initiate flower buds in the fall for early-season production the following spring. These June-bearing varieties are often established on raised beds with plastic mulch and drip irrigation for maximum production (Figure 3). Varieties which tend to runner less are best suited to plasticulture production (Figure 4).

Day-neutral strawberries are well-suited to the cooler climates of West Virginia. These types of strawberries produce flowers, fruit buds, and berries continuously over the growing season with a peak harvest from late summer through fall. Day-neutral strawberries tend to produce fewer runners and more crowns per plant than June-bearers. Day-neutral strawberries can be planted in spring/early summer and fall in West Virginia.

Figure 3. Plasticulture production of strawberries can significantly increase marketable yield and quality.

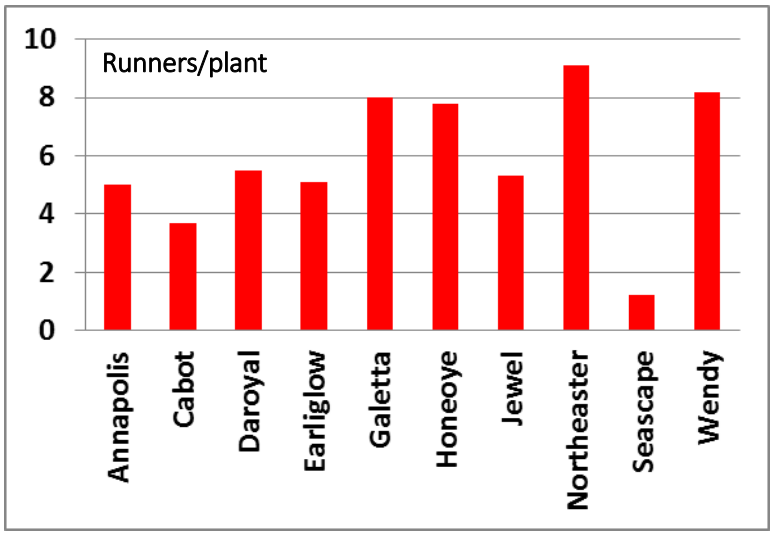

Figure 4. Runner production of select strawberry cultivars grown on plastic mulch, 2011.

Site Selection and Fertilization

When choosing a site for strawberry production, avoid fields with low spots which can accumulate water or cold air. Strawberries do best on level to moderately sloped land with good water drainage. Avoid areas which were previously cropped with raspberries, potatoes, peppers, tomatoes or eggplants since these plants share soil diseases with strawberries. The chosen site should not have significant perennial weed infestation. Raised beds can significantly improve soil drainage, warm the soil, and make it easier to harvest the berries. If the site has not been recently tilled or previously cropped, cover crops can be grown the year preceding planting the strawberry crop to increase soil organic matter. Suitable summer cover crops include Sudan grass, buckwheat, alfalfa and clovers. Winter cover crops which can be used include cereal rye, ryegrass, triticale, clovers and hairy vetch.

A soil analysis should be performed prior to planting strawberries. The optimal pH range for strawberries is 5.8 to 6.5. Granular fertilizer (10N-10P-10K) can be broadcast and incorporated prior to making raised beds and laying plastic mulch. Approximately 70 to 100 pounds (per acre equivalent) of nitrogen is sufficient for strawberries. Phosphorus and potassium applications should be based on soil test results. Approximately 40 to 50 percent of the total nitrogen required can be applied prior to planting, and the remainder metered through the drip irrigation system over the course of the growing season.

Production Method

Plasticulture Production

Plasticulture production of strawberries is becoming increasingly popular in West Virginia. With plasticulture, the strawberries are planted on a plastic mulch (white or black, depending on the strawberry type) (Figure 3). Micro or drip irrigation is used to provide water to the growing plants. Plastic

mulch has many advantages including: raised or lowered soil temperature, reduced weed growth, reduced soil moisture loss, reduced diseases, and cleaner fruit for harvest.

Black plastic mulch warms the root zone and is very effective for promoting early and late-season growth of strawberries. White plastic mulch can be used to cool the root zone and may be effective in warmer areas of West Virginia for production of day-neutral strawberries. Plasticulture can require significantly greater startup costs compared with matted row strawberry production, but the advantages are significant.

Strawberry plants can be established as bare-root plants or plugs. Bare root, dormant plants are purchased in early spring with the optimal planting date in April or May in West Virginia. Strawberry plugs can be grown or purchased throughout the growing season and planted April to September depending on variety and type of strawberry. Plugs cost more per plant, but have a greater rate of survival and growth after transplanting. When purchasing strawberry plants, it is important to choose a reputable nursery with disease-free planting stock.

Figure 5. Strawberry plants can be mechanically transplanted on plastic mulch with a Rain-Flo™ Water Wheel Transplanter.

Since June-bearing plants growing on plastic mulch cannot root runners, yield is determined by how many branch crowns are formed on the mother plants. Thus it is important to select varieties which produce relatively few runners when using the plasticulture production system. Annual varieties such as Sweet Charlie and Chandler are planted as plugs in mid-August, which discourages runner growth and promotes production of branch crowns. With other June-bearing or day-neutral varieties which are planted earlier in the season as dormant crowns on plastic mulch, the runners can be allowed to form. If labor is available, the runners can be clipped from the plants during the season. Many of the runners/daughter plants, however, do not usually survive the winter.

Strawberry plants should be planted at the proper depth for good survival and growth. The optimal depth is mid-level of the crown (Figure 6).

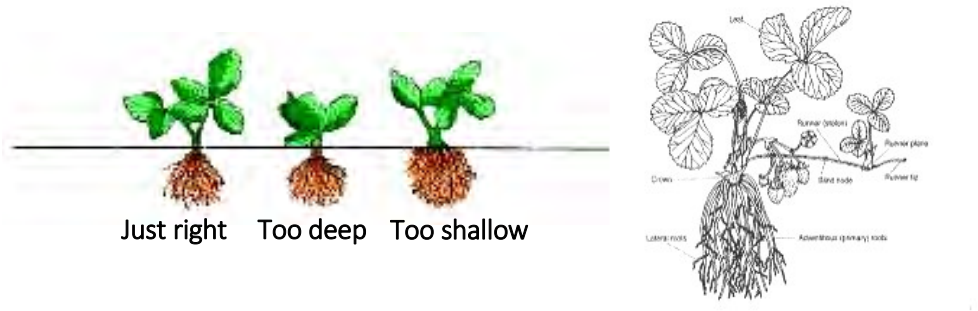

Figure 6. Proper planting depth of strawberries should be mid-level on the crown.

For plasticulture, strawberry plants within the row are planted approximately 12 to 15 inches apart, then the rows are spaced approximately 18 inches apart on a 36 to 42 inch-wide raised bed (Figures 4, 5).

Most June-bearing varieties planted early in the season on plastic mulch require first year bloom trusses to be removed from the plants to encourage growth of the mother plants. Branch crowns and fruit buds for the following spring are formed during the short days in the fall. Varieties transplanted in late summer such as Chandler, Camarosa and Sweet Charlie do not produce blooms in the fall. Other June-bearers will produce marketable yields the growing season following transplanting, and if the planting is disease-free, they can be carried over for a second harvest season.

To encourage vegetative and root growth, remove flowers from day-neutral varieties within the first 4 weeks of transplanting. Day-neutral varieties do not yield well when ambient temperatures exceed 85°F. In warmer regions of West Virginia, they will perform better if grown on white plastic or organic mulches which can keep the root zone cooler. Many day-neutral varieties will produce a small yield during July and August the same year they are transplanted, with peak production in September and October. These varieties can be overwintered for a second year in which they produce a late spring harvest.

In early December, place row covers over strawberry plants to provide winter protection (Figure 7). Row covers are lightweight, spun-bonded polypropylene blankets which can be used for both freeze and frost protection. For most regions of West Virginia, one to two layers of (1.0 to 1.5 oz/yd^2) row cover is sufficient. The row cover is available in varying widths and lengths to accommodate the size of the field. The edges must be secured against wind by using rocks or sand bags. Straw mulch is not typically used on plasticulture plantings, since this type of mulch reduces light to the plants and could reduce branch crown formation.

Figure 7. Row covers are applied over plasticulture strawberries beginning in early December and used for frost protection in fall or spring.

Row covers should remain on strawberries until March when the plants begin to emerge from dormancy and develop vegetative growth. Generally speaking, ten consecutive days with average temperatures of 50° F should occur before row covers are removed. Since row covers trap heat, they will accelerate flowering if left on the plants too long. Monitor air temperatures under the row covers to prevent overheating. Row covers will provide protection against frost during bloom and can be reapplied over the field in advance of frost. When the strawberries bloom, remove the row covers from the plants during the daytime to facilitate pollination by wind and insects.

Matted Row Production

Farmers in West Virginia have used the matted row production system as their traditional method of growing strawberries. Both June-bearer and day-neutral strawberries can be grown as matted rows (Table 1). For the matted row system, place strawberry plants 12 to 18 inches apart in single rows on 40 to 48 inch centers. Allow each row to form a 24 to 30 inch wide bed of daughter plants (Figure 8). If runners extend beyond the optimal row width, remove them or cut them off with cultivators. For June-bearers, set the plants in early spring and remove the bloom trusses the first year. Do not use plastic mulch since the daughter plants root to fill in the bed. Control weeds with a combination of herbicides, cultivation, and organic mulches.

In late fall, mulch matted row plants with 2.5 to 3 tons/acre of straw to provide winter protection. The following spring, remove the mulch from the plants to provide weed control and keep the fruit clean (Figure 8). In August, renovate June-bearer matted row beds by mowing off the leaves and narrowing the row width to 12 inches. Apply additional nitrogen fertilizer to promote fruit bud development. Typically growers can carry over the crop for two additional production seasons provided weed and disease pressure remains minimal. Day-neutral strawberries do not require renovation.

Figure 8. Matted row production system for strawberries. Straw is used to provide winter protection and suppress weed emergence.

High Tunnel Production

High tunnels are unheated, plastic-covered, solar greenhouses (Figure 9). Their ventilation is passive through roll-up side walls, ridge vents, and roof vents. Crops are grown in native soil under the high tunnel. The high tunnel protects the growing crop from environmental extremes such as wind, hail, rainfall, insects, wildlife and diseases which allows for significantly earlier and higher marketable yields. Since high tunnels have low start-up and operating costs, a single crop can provide enough revenue to pay for the cost of the structure.

The main advantage of the high tunnel for strawberry production is the ability to harvest an early or late-season crop of strawberries. June-bearers can be harvested beginning in April in most regions of West Virginia. If day-neutral varieties are chosen, late summer and fall production extending through late November is realistic. Most high tunnel strawberry varieties yield at least 1 lb of marketable fruit per plant. Rather than the two-row bed used in field production, plants are spaced 12 inches apart on a three-row bed. Each bed is mulched with plastic and drip irrigation is used to water the plants. For more information about high tunnel strawberry production, consult the WVU Extension Guide: Growing Strawberries within High Tunnels.

Figure 9. High tunnels can be used for early- and late-season strawberry production.

Pest Management

Wildlife are often the most significant pests of commercial strawberries in West Virginia. Deer, rabbits, and other wildlife will browse on new and established plants. Row covers and a perimeter fence can deter deer from strawberries (Figure 10b). Insect pests such as tarnished plant bug, spittlebug, strawberry clipper, spider mites and slugs also damage strawberries. Leaf spot, powdery mildew and Botrytis fruit rot are common diseases of strawberries (Figure 10a). Consult the Midwest Small Fruit Spray Guide for additional information on pest management options for insects and diseases of strawberries.

Figure 10a and b. Botrytis fruit rot (left) and wildlife pests can cause significant problems for commercial strawberry growers.

Harvest and Postharvest Handling

Most strawberry varieties are ready to harvest 30 days after flowering. Since they do not ripen after harvest, strawberries are picked when the fruit has a full red color. Harvest strawberries as soon as the plants dry in the morning, since berries picked while still wet will rot more quickly. Fruit which is sold as pre-picked can be harvested in plastic clamshell containers or pulp pint or quart baskets (Figure 11). Most strawberry varieties will need to be harvested approximately 3 times per week. Harvested fruit can be stored at 33°F until market.

Figure 11. Strawberries for direct market should be harvested in pint or quart containers.

Additional Resources

Midwest Small Fruit and Grape Spray Guide. WVU Extension Publication No. 865
Mid-Atlantic Commercial Vegetable Production Guide
The Mid-Atlantic Berry Guide

Strawberry Plant Sources[1]

Walker Bros. Inc.
105 Porchtown Rd.,
Pittsgrove, NJ 08318
856-358-6493

Nourse Farms, Inc.
41 River Rd.,
South Deerfield, MA 01373
413-665-2658

Daisy Farms
28355 M-152
Dowagiac, MI 49047
269-782-6321

Krohne Plant Farms
65295 CR 342
Hatford, MI 49507
269-424-5423

Indiana Berry and Plant Co.,
5218 West 500 South
Huntingsburg, IN 47542
800-295-2226

Lassen Canyon Nursery
P. O. Box 992400
Redding, CA 96099-2400

[1]Listing of plant suppliers does not imply endorsement of those mentioned or exclusion of others not mentioned. Other strawberry nurseries can be found at: www.ncstrawberry.org.

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