Commercial Strawberry Production in Minnesota

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Growing Strawberries in Minnesota

Strawberries can be successfully grown on a commercial scale throughout much of Minnesota and are also well suited for small-scale and part-time farming operations. Although the number of acres in Minnesota is relatively small, the value per acre provides a significant amount of revenue for Minnesota growers. The initial investment is high but is primarily related to the cost of land preparation, planting, and equipment. In addition, factors such as topography, establishment costs, labor, marketing, and water availability need to be considered before an enterprise is started.

The strawberry (*Fragaria*) is in the family Rosaceae. While there are numerous *Fragaria* species, the most common commercially grown strawberry is *Fragaria* × *ananassa*. Strawberries suited for Minnesota are of two major types, June-bearing and day-neutral. The essential difference between June-bearing and day-neutral strawberry cultivars is the length of the day under which they initiate flower buds. For more information on day-neutral strawberry production and cultivars, see our publication, Day-Neutral Strawberry Production in Minnesota.

The strawberry is comprised of a crown (shortened stem), where the leaves and axillary buds are formed. Runners (stolons) arise from the axillary leaf buds, and at the end of the runner a runner, or daughter plant forms (Figure 1). Strawberry flowers develop from buds that arise from a node on the flowering stem (Figure 2). June-bearing strawberry cultivars initiate flower buds in the late summer and early fall of the year prior to fruiting when the length of the day is declining. June-bearing plants produce fruit from early June in southern Minnesota through mid to late July in the northern areas. These plants are usually grown as perennials.

Figure 1. Diagram of a strawberry plant.

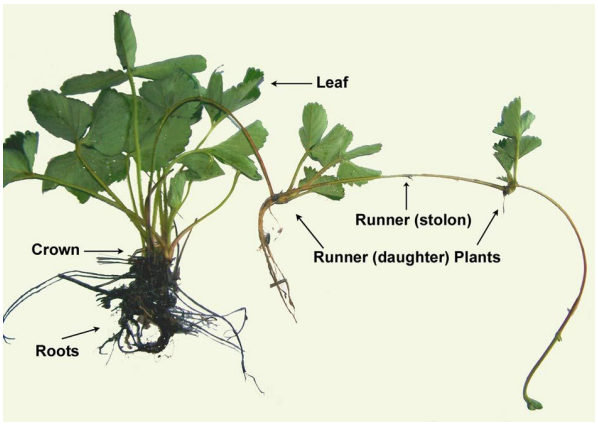
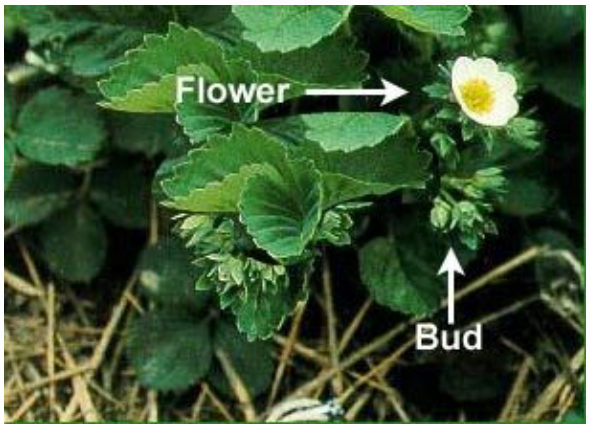


Figure 2. Strawberry flower and bud.



Nutritional Benefits

Strawberries are arguably the most popular summer-time fruit. In addition to the wonderful flavor of June-bearing cultivars, they also provide us with many nutritional benefits. They are low in calories and a good source of many vitamins and nutrients that a healthy body needs. Besides vitamin C, strawberries contain folate, potassium and ellagic acid, a nutraceutical that has powerful antioxidant and anti-carcinogenic properties. As consumers have become more health-conscious, growers can feel good about providing a healthy product to their customers. For more information on the health benefits of strawberries, see the University of Illinois fact sheet, Strawberries and More.

(continued on next page)

Cultivar Selection

Always select cultivars that are adapted to the local climate. New cultivars are introduced each year; however, not all are suitable for Minnesota climatic conditions. New cultivars that do not have a local performance record should be planted on a small scale initially, and limit the number of cultivars to as few as you need to meet market requirements (for example, a pick-your-own operation may need several cultivars to extend the harvest season). Qualities to look for in addition to local adaptability are productivity, season of maturity, berry size, firmness, flavor, freezing ability, color, and disease resistance. These are some of the most common June-bearing cultivars recommended for Minnesota growers, arranged by harvest season.

Table 1a. Early season cultivars

Cultivar	Yield[1]	Hardiness	Vigor	Fruit size	Attractiveness	Firmness	Texture	Flavor	Comments
Annapolis	Md-Hi	Good	Md	M-Lg	Good	Excellent	Good	Good	Red stele resistant
Earliglow	Md	Fair	Md	Md	Excellent	Excellent	Excellent	Excellent	Red stele resistant
Evangeline	Md	Good	Hi	Md	Very good	Good	Very good	Very good	--
Sable	Md-Hi	Very good	Md-Hi	Sm-Md	Good	Poor	Very good	Excellent	--
Veestar	Md-Hi	Good	Hi	Md	Good	Fair	Good	Good	Mildew susceptible
Wendy	Md	Good	Md	Md	Excellent	Very good	Very good	Good	--

Table 1b. Early midseason cultivars

Cultivar	Yield[1]	Hardiness	Vigor	Fruit size	Attractiveness	Firmness	Texture	Flavor	Comments
Brunswick	Hi	Good	Hi	Md-Lg	Excellent	Very good	Very good	Very good	--
Honeoye	Hi	Very good	Hi	Md-Lg	Good	Very good	Good	Good	--
Itasca	Md-Hi	Very good	Md-Hi	Md	Good	Good	Very good	Good	Red stele, mildew resistant
L'Amour	Md	Fair	Hi	Md-Lg	Very good	Very good	Very good	Very good	--
Redcoat	Hi	Very good	Hi	Md	Good	Fair	Good	Fair	--

Table 1c. Late midseason cultivars

Cultivar	Yield[1]	Hardiness	Vigor	Fruit size	Attractiveness	Firmness	Texture	Flavor	Comments
Allstar	Md	Poor	Md-Hi	Lg	Very good	Very good	Very good	Very good	--
Cavendish	Hi	Very good	Md-Hi	Lg	Good	Very good	Very good	Very good	Red stele resistant
Glooscap	Hi	Excellent	Hi	Md-Lg	Very good	Good	Very good	Very good	--
Kent	Hi	Very good	Md-Hi	Lg	Very good	Good	Very good	Good	Leaf spot and scorch susceptible
Jewel	Hi	Fair	Md	XLg	Excellent	Excellent	Excellent	Excellent	--
Lateglow	Md-Hi	Poor	Hi	Md-Lg	Very good	Very good	Excellent	Very good	--
Mesabi	Hi	Excellent	Md	Md-Lg	Excellent	Good	Excellent	Excellent	Sensitive to high pH soil

Table 1d. Late season cultivars

Cultivar	Yield[1]	Hardiness	Vigor	Fruit size	Attractiveness	Firmness	Texture	Flavor	Comments
Bounty	Md-Hi	Good	Md-Hi	Md	Good	Fair	Very good	Very good	--
Clancy	Md-Hi	Poor	Hi	Md-Lg	Good	Excellent	Very good	Good	--
Gov. Simcoe	Md-Hi	Good	Md	Lg	Very good	Very good	Good	Good	--
Micmac	Md-Hi	Good	Md	Md-Lg	Excellent	Very good	Good	Very good	--
Ovation	Md	Fair	Md	Lg	Very good	Very good	Good	Good	--
Sparkle	Hi	Very good	Hi	Md	Fair	Fair	Good	Excellent	--
Winona	Md-Hi	Very good	Md-Hi	Lg	Fair	Fair	Excellent	Good	Red stele resistant

Site Selection & Preparation

Strawberries require full sunlight. The strawberry field should be fairly level with a 2 to 3 percent slope to allow good air circulation and to minimize soil erosion. Cold air will move to low areas, creating frost pockets and damaging flowers during the spring blooming period. A southern exposure will result in an earlier bloom, while a northern exposure will delay flowering, an advantage in an area of late spring frosts. The site should be near a source of irrigation water.

Strawberries grow well on many different soil types. A well-drained soil is needed to maintain plant vigor and reduce disease potential. Very light and heavy soils are not as desirable as a well-drained loam or sandy loam soil. Avoid muck or peat soils in low-lying sites because they have greater potential for standing water and frost injury.

The previous crop history of a site also must be considered. To reduce the chance of Verticillium wilt disease, we advise waiting at least three years before planting strawberries in fields where potatoes, tomatoes, peppers, or raspberries were grown previously.

In addition, thought must be given to the intended market. A pick-your-own operation must consider population density or proximity and existing production in the area, whereas a wholesale grower must consider transportation costs.

Nutrient Management

Healthy soil is achieved by increasing soil organic matter, biological activity, and nutrient availability. By increasing soil organic matter through the use of cover crops and crop residues, the soil can provide nutrients to the strawberry plant.

A green manure crop the year before planting will add organic matter to the soil and help maintain desirable soil physical properties. Sow green manure crops such as rape (12.3 lb seed/A), Camelina (4.5 lb/A), rye (63 lb/A), or oats (60.5 lb/A) between April 10 and May 4. Soybean and foxtail millet (75 lb/A and 18 lb/A), soybeans and Japanese millet (75 lb/A and 19 lb/A), and proso millet (38 lb/A) can also be used. Well-rotted barnyard manure worked into the soil will, over time, improve soil physical properties and fertility.

Test soil fertility and acidity (pH) before planting. Strawberries prefer a slightly acid soil (pH 5.3 to 6.5). Soil pH is a key factor in maintaining a favorable root environment. It not only affects root growth but influences availability of many nutrients. If the pH is less than 5.3 you will need to add lime. Follow soil test recommendations for rates of lime to apply. Incorporate the lime thoroughly at least one year prior to planting. Fertilizer suggestions are provided below. More information on fertilizer recommendations is included in Nutrient Management for Commercial Fruit and Vegetable Crops.

Table 2. Nitrogen (N) recommendations for June-bearing strawberries.[1]

	Soil organic matter (O.M.) level[2]				
	Low	Medium	High	Organic soil[3]	Method/Timing[4]
	Nitrogen to apply (lbs/acre)				
First year	80	70	60	25	Split application: 1/2 pre-plant;, 1/2 in August during runnering.

Subsequent years	80	70	60	25	Immediately after renovation.

1. Leaf analysis should also be used to help determine nitrogen needs.
2. Low = less than 3.1% O.M., medium = 3.1-4.5% O.M., high = 4.6-19% O.M.
3. Organic soil = greater than 19% O.M.
4. Suggested methods of application are a general guide and can be modified when appropriate; if nitrogen is applied in the spring, do not apply more than 15-20 lbs/acre.

Table 3. Phosphorus (P) recommendations for June-bearing strawberries.[1]

	Soil test P level (ppm)					
Bray-P1 Olsen-P	0-10 0-7	11-20 8-15	21-30 16-25	31-40 26-33	41-50 34-41	51+ 42+
	P_2O_5 to apply (lbs/acre) based on soil test reports[2]					
Establishment year	150	125	100	75	50	25
Subsequent years[3]	150	125	100	75	50	25

1. Application rates are listed below test results.
2. Apply and incorporate before planting. If needed during subsequent years, apply immediately after renovation.
3. Leaf analysis should also be used to help determine phosphorus needs.

Table 4. Potassium (K) recommendations for June-bearing strawberries.[1]

	Soil test K level (ppm)					
	0-40	41-80	81-120	121-160	161-200	201+
	K_2O to apply (lbs/acre) based on soil test reports[2]					
Establishment year	200	150	100	50	25	0
Subsequent years[3]	200	150	100	50	25	0

1. Application rates are listed below test results.
2. Apply and incorporate before planting. If needed during subsequent years, apply immediately after renovation.
3. Leaf analysis should also be used to help determine potassium needs.

Weed Management

Controlling weeds requires the use of many techniques and strategies to achieve economically acceptable weed control. Since strawberries are generally grown as a perennial crop, weeds must be managed throughout the year. To start, proper field and bed preparation prior to planting is essential for a good weed control program. In particular, a weed eradication program one year prior to planting is recommended if perennial weeds are a problem. This can be accomplished using herbicides, however, consult herbicide labels to avoid potential carry-over problems for the new

strawberry planting. In addition to eradication, a pre-plant harrowing of a prepared field will reduce weed populations.

Following planting, the field may be cultivated to remove any newly emerging seedlings. Once the strawberry plants are established, their shade will reduce weed growth within the rows. Hand-weeding, hoeing, cultivation, and spot-treatment of herbicides may be needed throughout the first year. In late fall, an herbicide may be applied to suppress early spring weeds. More information on weed control is available in the Midwest Small Fruit Management Handbook.

Plant Source & Planting

Purchase plants from a reputable nursery that are free from insects, viruses, and fungal diseases. Contact the Minnesota Department of Agriculture for a listing of local firms. The plants may be either dormant or spring-dug. Dormant plants can be stored for a few weeks before planting, but spring-dug plants must be planted as soon as possible after arrival. Store dormant plants in a cool, fairly humid area until planted. Soaking plants in water for a few hours prior to planting is beneficial. Trim the roots to 4 to 5 inches immediately before planting.

Matted Row System and Plant Spacing

The main planting system used for June-bearing cultivars is the matted row. In this system, planting strawberries in early spring ensures good runner plant development, which leads to higher productivity the following season. Planting after August 1st is not recommended due to insufficient plant growth prior to freezing temperatures. The number of plants needed per acre depends upon the spacing system used (Table 5). Be sure that planter shoes on your transplanting equipment or hand tools penetrate deeply enough to facilitate proper planting. Plants should be set with the middle of the crown level with the top of the soil (Figure 3).

Set the plants 1½ to 2 feet apart in rows spaced 3 to 4 feet apart. Between row spacing is determined, in part, by equipment width and picker needs. Let the runners develop until the row is 1 to 1½ feet wide. This system allows for good light penetration into the plant canopy which eases weed control, harvest, reduces fruit rot, and foliage diseases.

Figure 3. Planting depth of strawberry transplants (Image from www.asktheberryman.com.)

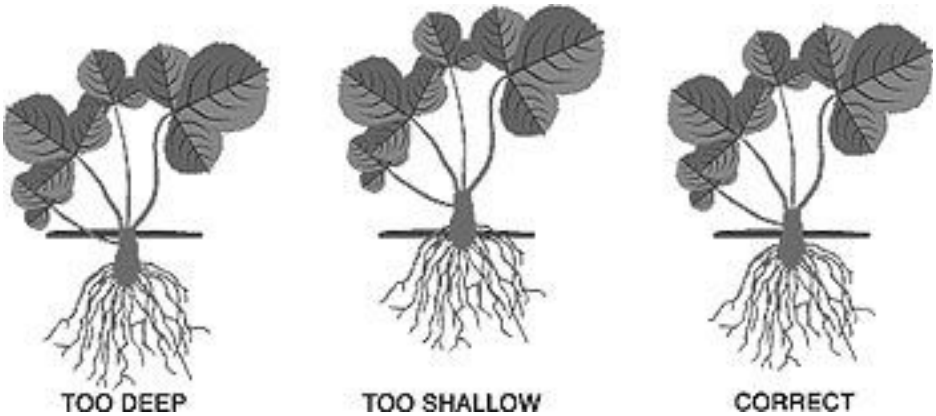


Table 5. Number of plants required per acre at various spacings.

Plant spacing (feet)		
In row	**Between rows**	**Plants per acre**
1.5	3	9680
1.5	3.5	8296
1.5	4	7260
2	3	7260
2	3.5	6223
2	4	5445
2.5	3	5810
2.5	3.5	4980
2.5	4	4356

New Planting Care

To encourage vegetative plant growth, June-bearing strawberry plants should have all flowers removed during the planting year. Strawberry plants are shallow-rooted with most of the root system in the top three to six inches of soil. This necessitates the need for irrigation. Proper irrigation will improve fruit quality and yield next year. Effective weed control is essential during the first season to reduce the number of weeds the following year and maintain yield.

Nitrogen, phosphorus, potassium, and other soil nutrients are required for vigorous crown and runner development. Soil tests will identify the nutrient needs (see Tables 2-4). In general, phosphorus, potassium, and part of the nitrogen should be applied at or before planting. Apply nitrogen again in August during runner plant production. Keep in mind, however, that strawberry growers tend to overemphasize the importance of fertilizers and underestimate the importance of water. Yields are more frequently reduced from lack of water, poor soil drainage, and poor soil physical properties than from a lack of fertilizer.

Table 6. Quick reference guide for timing of activities.

Establishment year

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Plan planting	■	■										
Order plants		■	■	■								
Prepare site, till				■	■							
Install irrigation				■	■							
Fertilize if needed					■	■						
Plant dormant transplants					■							
Apply pre-emergent herbicide					■		■					
Water as needed				■	■	■	■	■	■			
Control weeds				■	■	■	■	■	■	■		
Apply winter mulch											■	■

Harvest years

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove mulch			■	■								
Apply grass herbicide if needed					■							
Monitor and manage insect pests				■	■	■						
Monitor and manage diseases				■	■	■	■	■				
Apply fungicide at 10% and 50% bloom to control botrytis				■	■							
Water as needed				■	■	■	■	■	■	■		
Harvest berries						■	■					
Renovate								■	■			
Fertilize if needed							■	■				
Apply fall herbicide if needed											■	

Care of June-bearing Cultivars During Production Years

Spring care of June-bearing cultivars begins with mulch removal in mid April – early May. If there was a heavy weed infestation in the fall and no fall herbicide was applied, a spring herbicide application may be necessary. If so, this must be applied within a few days of mulch removal. Begin scouting for insect pests and disease presence after mulch removal and throughout the fruiting period (see the Insect and Disease Management sections).

Nutrient Management

Do not apply nitrogen before harvest unless plant vigor is very poor. Nitrogen will promote excessive vegetative growth and reduce fruit quality. Spring nitrogen applications may be used on coarse-textured soils (sands, loamy sands, sandy loams) that are low in organic matter. Please see the publication Nutrient Management for Commercial Fruit and Vegetable Crops in Minnesota for more information.

Foliar Feeding

In general, foliar feeding is used as a means of supplying supplemental doses of both minor and major nutrients, plant hormones, stimulants, and other beneficial substances. Foliar feeding began in the 1950's when Michigan scientists H.B. Tukey and S.H. Witter found that foliar feeding of plant nutrients was from 100% to 900% more effective than when the nutrients were applied to the soil. In contrast, in a study conducted by Rosen et al. Minnesota researchers have found no yield benefit by using foliar feeding. In theory, foliar feeding can elicit plant responses ranging from yield increases, to insect and disease resistance, to improved drought tolerance. Foliar applications are often timed to coincide with specific vegetative or fruiting stages of growth, and the fertilizer formula is adjusted accordingly. Foliar feeding is not a substitute for creating a healthy soil environment. Foliar feeding is best used as a supplement.

For more information on foliar feeding, see the section on foliar feeding in Nutrient Management for Commercial Fruit & Vegetable Crops in Minnesota.

Weed Management

Weeds need to be managed throughout the lifetime of the planting. Many of the practices described earlier are applicable here. Hand weeding is important in late spring to clean up any weeds missed by fall and early spring herbicide treatments. Several weeds can become established and flower by late spring which can contribute to weed problems later in the summer. More information on weed control is available in the Midwest Small Fruit Pest Management Handbook.

Insect Management

Management of insect pests begins with proper identification of the egg, larva, and adult stages of both insect pests and beneficial insects. The correct identification of insects will aid in the grower's efforts to prevent economic damage to the crop. Table 7 lists insect pests common in MN strawberry fields. A scouting program with regular monitoring can help determine both the pest pressure and

presence of beneficial insects. Beneficial insects such as predators and parasites are important in preventing outbreaks of insect pest populations. To encourage the presence of beneficial insects it is important to increase the plant diversity in an agricultural setting. Generally, crop diversity can be achieved by using crop mixtures, crop rotations, border crops or windbreaks, or plants known to be attractive to beneficial insects. More information on beneficial insects and the benefits of plant diversity can be found in the SARE publication, Manage Insects on Your Farm.

To assess the activity of insect pest and beneficial insects, the use of sticky traps or visual plant samples is needed. Most flying insects are attracted to the yellow or blue color of sticky traps. These traps are sheets coated on both sides with a sticky non-toxic compound. Traps can be used for detecting presence of arthropods or for mass trapping of pests such as aphids and thrips. More information on insect management can be found in the Midwest Small Fruit Pest Management Handbook, and the Integrated Pest Management Manual for Minnesota Strawberry Fields, developed by the Minnesota Department of Agriculture.

Table 7. Common insect pests in Minnesota strawberry fields.

Common Name	**Scientific Name**
Tarnished Plant Bug	*Lygus lineolaris*
Strawberry Bud Weevil	*Anthonomus signatus*
Two-Spotted Spider Mite	*Tetranychus urticae*
Eastern Flower Thrips	*Frankliniella tritici*
White Grubs (June beetle)	*Phyllophaga spp.*
Root Weevils	*Otiorhynchus spp.*

Disease Management

Strawberries are affected by several diseases that vary widely in their occurrence and severity; therefore learning to recognize common strawberry disease problems in order to treat them quickly and effectively is important. Soil health and management are a significant component of successfully controlling plant diseases. A soil with adequate organic matter can house numerous organisms such as bacteria, fungi, nematodes, protozoa, arthropods, and earthworms that may suppress soil-borne pathogens. Increasing soil organic matter by incorporating cover crops or adding compost and organic fertilizers will help maintain beneficial organisms.

Rotating strawberries with other crops is critical. The site should be plowed and planted to a crop that is not susceptible to Verticillium wilt for a minimum of two years. Many soil-borne pathogens form specialized survival structures and are capable of surviving for several years in soil, even when strawberries are not present. Crop rotations lasting longer than two years are encouraged, however, crop rotation is not enough to provide adequate control of red stele. Using disease resistant cultivars and improving soil drainage are necessary.

For complete descriptions of the diseases affecting strawberries, consult the Compendium of Strawberry Diseases, available for purchase from the American Phytopathological Society. Or, try the MDA publication, Integrated Pest Management Manual for Minnesota Strawberry Fields.

You must time pesticide applications and harvests to observe reentry and pre-harvest intervals stated on the pesticide label. Failure to observe the pre-harvest intervals is illegal, and can result in high levels of pesticide residues in the fruit, and can expose harvesters or customers to unnecessary risks. For more information about strawberry diseases and control see The University of Minnesota Extension's What's Wrong with my Plant, and the Midwest Small Fruit Pest Management Handbook.

Water Management

Frost Protection, Irrigation, and Cooling

Water is one of the most important elements in the production of small fruits. Supplemental irrigation is a necessary water management practice for small fruit production systems in Minnesota.

Sprinkler irrigation is crucial to prevent frost damage in June-bearing cultivars after the mulch is removed in early spring. Irrigate whenever the air temperature drops below 34˚ F. Apply 0.1 inch of water per hour with one sprinkler head revolution per minute. Sprinkler irrigation should protect flowers and developing fruit to 20˚ F.

For more information on sprinkler irrigation for frost prevention, see the Alabama Extension publication, Principles of Freeze Protection for Fruit Crops, and the Iowa State University Midwest Plan Service handbook on Sprinkler Irrigation Systems. Spring frost protection is unnecessary during the planting year in day-neutral strawberries because the flowers are usually removed until the danger of frost is past. Frost protection may, however, be desired in the fall to extend vegetative growth.

Drip Irrigation

Drip irrigation is the slow, even application of low pressure water to soil and plants using plastic tubing placed directly within the rooting zone. Advantages of using drip irrigation include better control of foliar diseases and more efficient water and fertilizer use. Water savings with drip irrigation can amount to as much as 50 percent compared with an overhead sprinkler system. Although drip irrigation has many important benefits, there are a few challenges associated with this method of irrigation. Drip irrigation systems must be carefully designed and installed so that they operate with proper efficiency. The initial expense of drip irrigation systems is expensive, therefore the system should be designed and installed by competent irrigation industry representatives to ensure an operable and cost efficient system. Proper training and management skills are very important to the success of any drip irrigation operation.

Planning Irrigation Using Daily ET Estimates

Water usage will be optimized by keeping track of the crop's daily water use. Daily crop water use, also called evapotranspiration (ET), can be used to help plan irrigation scheduling. This, along with regular monitoring of in-field soil moisture is beneficial in optimizing crop growth while reducing the potential for leaching of compounds like nitrogen into the groundwater. The daily ET values should

be recorded in a log like an irrigation checkbook worksheet or computer spreadsheet for quick reference when making irrigation decisions. Irrigation checkbook spreadsheets can be found on University of Minnesota Extension website.

The Minnesota and Wisconsin ET website presents daily colored coded maps for the week; and displays a reasonable estimation of the potential ET value across the state based on the actual weather conditions of that day. Potential ET values are very similar to the actual daily crop ET when a crop is at full canopy. The daily values from the web site can also be sent directly to a user by email each day for a given field site within the map area if requested over the web site. These daily ET potential estimations, however, need to be modified by a correction factor when the crop canopy is less than 80 percent coverage or the plant is nearing the end of the season. This correction factor is dependent on plant size and canopy density and will vary from 0.2 at early emergence to 1.0 when the plant has reached full canopy closure. To estimate the daily ET value for a crop before full canopy or near maturity the ET value must be taken times a crop coefficient (Kco) constant that may range from 0.25 to 1.0 depending on the growth stage of the specific crop. As a crop matures, some crop types will have their actual ET decrease slightly each day as they come to maturity, hence the crop correction factor will go from 1.0 to maybe as low as 0.40 as the leaves senesce. The estimated daily ET for strawberries during the summer months is 0.20. For more information on how to use daily crop ET information contact your local Extension or Soil and Water Conservation District office. For more information on irrigation systems see the Penn State article, Irrigation for Fruit and Vegetable Production.

Harvest

Proper picking, grading, and packing are as essential as good cultural practices to success. The harvest frequency and duration depend on weather conditions, cultivars, soil factors, and cultural practices. Strawberries are almost entirely hand picked.

As a general rule for wholesale operations, six to nine pickers are needed for each acre. Pickers must be instructed by a competent foreman about proper picking (to prevent plant injury), fruit handling, and sorting (grading) in the field. The berries must be picked at the proper stage of ripeness (maturity). Harvest only berries that are red. Berries still showing white should be left for the next picking. The fruit is usually harvested every other day unless hot weather makes daily picking necessary.

Quickly place harvested berries in a cool, shady location such as a temporary field shed. Store the berries preferably at 32˚ F to 35˚ F and at a 90 to 95 percent relative humidity. Enrichment of the storage atmosphere with carbon dioxide to a 10 to 40 percent level using dry ice will extend the storage life to some extent. Under these conditions berries should remain salable for three to five days and losses during shipping, storage, and marketing will be reduced.

Pint or quart containers are usually filled in the picking fields and covered with plastic film or rigid plastic domes before shipping. The strawberries are then placed in fiberboard trays which hold twelve one- pint baskets to prevent damage. An attractive package with the fruit visible will bring premium prices.

Direct Marketing

Pick-Your-Own & Road-Side Enterprises

Pick-your-own (PYO) strawberry farms are the most popular method of direct marketing in Minnesota. PYO farms began when harvesting labor became scarce and increasingly expensive. The advantages of PYO farms include no direct harvest labor and transportation costs, improved quality, increased product availability for consumers, and reduced packing costs. Disadvantages are long hours including weekends (you work when customers can come to your farm), difficult customers, liability costs, parking areas, and damage to plants and equipment. For small farmers, however, operating a popular public picking field is the single most profitable method of strawberry production. Being able to charge higher than wholesale prices while avoiding the high labor costs can be a great combination.

Pick-your-own operations require attention to certain factors for successful harvest and marketing including: sufficient quantity of high quality fruit, proximity to population centers, convenient parking area off the highway, and effective advertising notifying customers of berry availability.

When planning a PYO farm, be sure that you:

- ❏ Provide clear instructions for pickers.
- ❏ Make sure containers are available before the customers arrive.
- ❏ Advertise your product.
- ❏ Make sure your insurance will cover your liability.
- ❏ Be extremely careful with reentry times for all pesticides.
- ❏ Organize your checkout so it runs smoothly.

For more information on marketing, consult the Penn State Agricultural Alternatives Publications: Fruit and Vegetable Marketing for Small-scale and Part-time Growers and the Direct Marketing Guide for Producers of Fruits, Vegetables, and Other Specialty Products from the University of Tennessee. .

Renovation

June bearing strawberry plantings should be renovated for many reasons, including, to narrow rows, rejuvenate the canopy, reduce leaf diseases and insect populations, and to stimulate runner production. Renovation should start immediately following the harvest.

Renovation should begin by scouting your fields to assess the weed populations. If you have a heavy broadleaf weed infestation, and you decide that a herbicide is necessary, apply a broadleaf herbicide such as 2,4-D amine after harvest and before August 1. Approximately one week later, mow off the old leaves, about two inches above the strawberry crowns. This height is recommended in order to prevent damage to the strawberry crown. Next, fertilize the planting with nitrogen, following the recommendations in Tables 2-4. After fertilizing, the strawberry rows should be narrowed using a rototiller, multivator, or other cultivator. The optimum row width at full canopy is between 12-14 inches; therefore the row can be narrowed to as little as 6 inches wide. Narrow rows will give better sunlight penetration, better disease control due to improved air circulation, and better overall fruit quality. Remember that yield is higher on row edges. Continue to cultivate your strawberries to throw soil over the plants. This is important for strong crown development because strawberry crowns

continue development at the top, and also for root development because new roots are initiated above old roots on the crown.

Subsoiling may be necessary in plantings that have suffered a great deal of soil compaction. Soil compaction can result from tractor use and picker traffic in the field, especially on heavy, wet soils. Subsoiling between rows will help break up compacted layers and provide better infiltration of water. A fall herbicide application can be made around October 15. Lay down straw mulch in late October or early November before temperatures drop below 20˚ F. Table 6 summarizes the timing of activities in a commercial June bearing strawberry operation.

Rotation

June bearing cultivars are perennials, but they become less productive after several years. In general, a highly efficient strawberry field will yield around 7,000 lbs./acre. Replace the plants every three to five years to maintain high quality fruit and yields, and to reduce problems with weeds, insects, and diseases. A detailed cost and productivity analysis should be performed to determine whether existing strawberry beds should be renovated or the old plants discarded and the entire field replanted with new plants. Iowa State University Extension presents sample strawberry and other budgets in the Iowa Fruit & Vegetable Production Budgets publication.

Strawberries can lend themselves well to both new and existing farms. The benefit of adding strawberries to your current farming operation is that they do not require an enormous investment to get started — a few acres, some basic equipment, a love of growing things, and a genuine enjoyment of hard work.