Fruit & Vegetable Production Unit for Plant Science Core Curriculum

Student Reference

Instructional Materials Laboratory
College of Education • University of Missouri-Columbia

Agricultural Education Section Division of Career Education
Department of Elementary and Secondary Education, Jefferson City, Missouri

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Fruit and Vegetable Production Unit for Plant Science Core Curriculum

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Foreword

Missouri offers a variety of opportunities for fruit and vegetable producers. *Fruit and Vegetable Production Unit for Plant Science Core Curriculum* was developed to provide students with an overview of fundamental production concerns as well as useful information about specific crops.

This student reference contains six lessons: Managing Financial Resources, Developing a Marketing Plan, Site Evaluation, Integrated Pest Management, Vegetable Production, and Fruit Production.

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Fruit and Vegetable Production Unit for Plant Science Core Curriculum

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Fruit and Vegetable Production

Lesson 1: Managing Financial Resources

Growing fruits and vegetables can be a very rewarding experience. However, risks are involved. In fruit and vegetable production, as with any new business, it is important to have a plan before investing time, money, and energy.

The Importance of Financial Planning

Financial planning is the process of defining goals and developing and implementing a plan to finance the goals. A financial plan that is correctly put together reveals how much money is received and allows the planner to closely monitor spending. The information compiled can be used to manage money and help achieve goals.

Financial planning is very important in fruit and vegetable production because the products are highly perishable. This means that the time period in which marketing and selling can occur is limited. Because of this time limitation, careful planning must take place to ensure that money is available throughout the year when earnings have decreased or are not coming in. Planning not only enables individuals to manage finances throughout the year, it also promotes critical thinking about what crops to plant. Careful planning of seasonal and year-round crops, varying planting times, and planting a variety of crops are all ways to extend the time period in which income is received.

The Importance of Goals and Objectives

A goal is a statement of what an individual wants to accomplish both personally and financially. Goals give an individual direction for using financial resources. Together, goals and a financial plan can be used to allocate funds where they are needed. Achieving goals gives an individual a feeling of satisfaction and the self-esteem to continue setting goals and striving to attain them.

Goal setting and financial planning are especially important when entering fruit and vegetable production. As mentioned before, fruits and vegetables are highly perishable. Careful planning needs to occur during planting, growing, and marketing to ensure a saleable product and an income for the year.

Labor is another reason that goal setting and financial planning need to occur. Labor is a major expense and can be difficult to find in certain areas. Different fruit and vegetable operations require different means of labor. In a you-pick operation, for example, there is less labor involved than in an operation where the owner/operator harvests the product. Therefore, determining labor needs and costs is an important part of setting the goals for fruit and vegetable operations.

Preparing the Financial Plan

Once the overall goals and objectives are determined, the financial plan can be prepared. There are three main steps in financial planning.

- Record a projection of income and expenses.
- Make a list of wants and needs.
- Implement the financial plan.

Recording Projected Income and Expenses

The first step in preparing the financial plan is to record a projection of how much money will be received (income) and how much money will be spent (expenses). The income (receipts) may be received weekly, every two weeks, monthly, or even once or twice a year. A record book should be used to keep track of income and expenses. Use the receipts pages in the record book to show the income that is received, where it came from, and the date it was received.

With any financial plan, it is essential to know the difference between gross income and net income. Gross income is the total amount of money the business takes in before any deductions are made. Net income is the amount of money the business has after expenses have been met and deductions, such as taxes and Social Security, have been taken out. If more money is spent than the business makes, the business experiences a net loss. If there is money left after expenses and deductions, the business makes a net gain or profit. All businesses want to make more money than they pay out, so it is very important to document all expenses. An expense is money that is spent to obtain a goal or purpose. Use the expenditures pages in the record book to keep track of how much money is spent and where it is going.

Businesses incur two types of expenses: fixed and variable. Fixed (ownership) costs are paid regularly, regardless of the amount of sales the business makes. The major areas of fixed costs are rent, insurance, depreciation, taxes, interest, and repair. Some examples of fixed costs in fruit and vegetable production are rent, land insurance, repair of structures, and interest on principal.

Variable (operating) costs change according to the production level and amount of use. The major categories include labor (salaries), fertilizer, chemicals, seeds / plants, gasoline and oil, inventory, supplies, advertising, utilities, telephone bills, and principal payment. Some examples in fruit and vegetable production are labor (both seasonal and full-time), fertilizer, growing media and chemicals, water, electricity, and advertising.

Making a List of Wants and Needs

The second step in preparing the financial plan is to make a list of wants and needs. Needs are items and expenses that are necessary for the survival of the business. Wants are items and expenses that are desired but not essential. The purpose of this step is to bring the overall business objectives together with the financial information to set specific short-, intermediate-, and long-term goals. The business owner must make sure that business needs are taken care of first and that other items come later, as finances allow. This will help ensure that funds are available to pay expenses throughout the year. This is especially important for a fruit and vegetable operation, since in most cases income only occurs from May through October.

Implementing the Financial Plan

The third step is to implement the financial plan. It is important to remember to continue keeping current and accurate records of all income and expenses once the plan is under way. This information will be used to monitor progress toward reaching the business goals.

Remember that sometimes even the best plans run into problems. Mistakes can get made, and factors such as weather, insects, and disease can cause unexpected expense. When this happens, make adjustments to the plan. Many times, making adjustments does not mean giving up on goals but simply changing the time frame in which they are achieved. Make sure that needs are met first and make adjustments to goals that are not essential. Being able to adapt to changing conditions is an important skill for any business owner and can help build confidence and understanding of the business.

Summary

Financial planning is an integral part of a business and should be done to help establish goals and reach objectives. Receipts and expenditures should be recorded to keep accurate records of how much money is received and how much money is being spent. Always be sure to factor fixed and variable costs into the financial plan. As the financial plan is put into action, monitor business activity and adjust the plan as necessary to attain the established goals and objectives.

Credits

Agribusiness Sales, Marketing, and Management. University of Missouri-Columbia: Instructional Materials Laboratory, 1997.

Everhart, E., and B. Lovitt. *Selling Fruits and Vegetables.* Iowa State University Extension. http://www.extension.iastate.edu/Publications/PM1887.pdf (accessed March 7, 2006).

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Fruit and Vegetable Production

Lesson 2: Developing a Marketing Plan

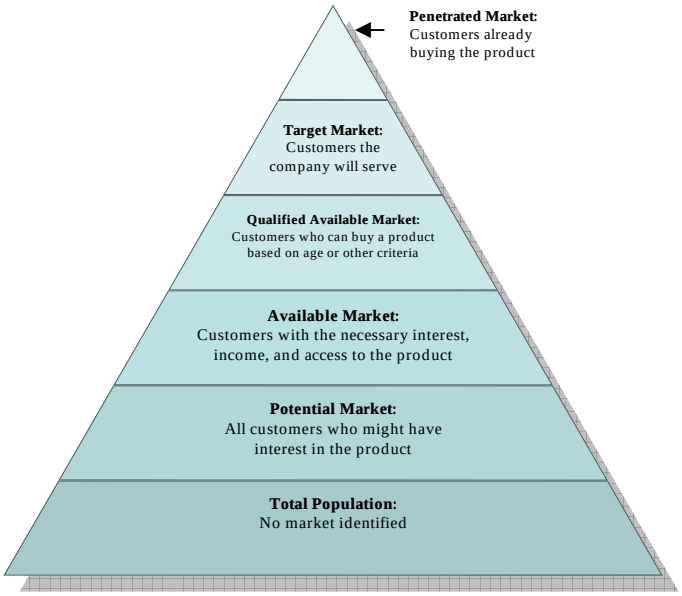
Producers must have a strategy for selling the fruits and vegetables they grow. This strategy is called a marketing plan. It is essential that growers have their marketing plan in place before their produce is ready to sell. The purpose of the plan is to identify potential customers and determine how to attract and keep their business.

Identifying a Customer Base

The first step in creating a marketing plan is identifying the market. A market is all the potential customers for a particular product or service. No single product appeals to everyone, and no business could afford to sell to every consumer. Therefore, businesses must determine which customers they will serve. These customers are a business's target market.

There are six steps in defining a business's market that move from the total population, in which no market is identified, through the potential, available, qualified available, and target markets, and finally to the penetrated market, which is composed of customers who are already buying the product. Each step toward the target and penetrated market narrows the field to the customers who have the most interest in a product and who are able to purchase it. Figure 2.1 illustrates these steps.

Figure 2.1 – Identifying a Market



Understanding the target market for a particular product is essential to establishing the market and creating a source of income. Establishing a target market allows producers to tailor advertising and products to the customers' needs and wants.

Wholesale and Retail Markets

Identifying a customer base depends on several factors. The first factor is deciding whether to sell to wholesale or retail customers. Selling wholesale means selling goods to a buyer who sells the goods again. Wholesalers sell in bulk and do not deal directly with the individuals in the general public who buy the product to use or consume. For example, a wholesaler might sell fruits or vegetables to a chain of restaurants or grocery stores. In contrast, retailers sell relatively small amounts of products directly to the people who will use them. An example of a retail sale is selling produce from a roadside stand.

Wholesale and retail sales are very different types of selling. Each has its own characteristics. Producers who sell to wholesale customers typically have a few customers who purchase their entire crop. Wholesale customers aren't interested in product displays and retail ads, and producers don't need to provide the same kind of customer assistance that they do for retail customers. On the other hand, the producer makes less on each item sold. When selling to retail customers, the

producer can charge more per item, but in turn is expected to provide more customer service, such as ample parking, convenient business hours, knowledgeable sales staff, attractive displays, and appealing ads and specials—all of which take time and money. Producers should consider how they prefer to work with customers and the strengths of their operation when deciding on wholesale and retail selling.

Producers should also determine what customers exist in their market. One of the best techniques for identifying customer is to conduct market research. Characteristics such as age, income level, population of surrounding areas, location of residential areas, and influx of travelers to the area should all be considered to help determine the target market. The local Chamber of Commerce, census bureau, university extensions, and trade associations are among the resources that may be used to obtain these statistics.

Venues to Sell Products

Fresh produce may be sold through a variety of outlets, such as roadside stands, farmers' markets, community-supported agriculture (CSA) organizations, pick-your-own businesses, restaurants, grocery stores, and wholesale cooperatives. Each has its own characteristics that should be considered when developing a marketing plan.

Roadside Stands

Roadsides stands are an easy way to sell directly to customers. Operating a roadside stand allows the grower to determine the hours, prices, and products sold, and sales provide immediate income. Produce may be sold from the back of a truck or from display tables, so a small roadside stand can be started with little setup cost. Safe and adequate parking should be available. Ensuring there is shade, either from trees or a canopy, can make the area more comfortable for the seller and customers. It is important to remember that roadside stands are subject to zoning, licensing, and insurance requirements that will vary from place to place. Be sure to thoroughly research local and state requirements before opening a roadside stand.

Farmers' Markets

Farmers' markets are a low-cost way to sell fresh produce to a large number of customers within a short period of time. Producers have the opportunity to network with other growers, widen their own customer base, and develop their marketing skills. Producers also share the costs of advertising and promotion. Farmers' markets offer many advantages to those involved, but there are some

potential drawbacks to consider. Every farmers' market has its own set of rules and regulations to follow, as well as specific times, locations, and days of operation. Growers and sellers must adhere to the rules and regulations regarding hours and days of operation, space availability, and products sold, so there is some loss of flexibility. Contact the farmers' market manager to find out about specific information, such as vending fees, guidelines about what can or cannot be sold, and other details.

Community-Supported Agriculture

Community-supported agriculture (CSA) is a partnership between a grower and individuals who become members by purchasing shares of the season's harvest. By purchasing shares, members help the grower pay for seeds, fertilizer, water, equipment maintenance, and labor. In return, the CSA members receive a supply of fresh, locally grown produce throughout the growing season. CSA members assume the same risks, costs, and rewards of the crop as the grower. Shares are typically purchased at one time or in installments throughout the growing season. A benefit of CSA is that the grower starts receiving income as soon as work begins, not just at the end of the growing season.

A financial plan is especially important to a CSA operation because the costs are divided up to determine the price for shares the CSA members buy. The grower and operators of the CSA farm draw up the financial plan, including salaries, land payments, maintenance, seeds, tools, labor costs, and other expenses to set the share price.

Shareholders are not only partners but also the grower's market, so the grower should consider what crops members want and how a diversified crop may be produced. In some instances, growers can work together to form a CSA operation. This allows each grower to specialize in producing certain crops while generating a variety of produce for CSA members to receive.

Pick-Your-Own Businesses

Pick-your-own businesses are a popular option for many growers because they require less harvesting labor than traditional fruit and vegetable operations. Pick-your-own operations do require long working hours for the grower, additional liability insurance, and room for parking and traffic. The business must also be easily accessible and close to a population that is large enough to support it.

One factor to consider before starting a pick-your-own business is whether the growers and operators are willing to work on weekends. Customers typically frequent pick-your-own businesses on the weekend because this is the time they

have free. Another important factor is image. Customers want to see a neat, clean facility with a neat, clean staff ready to help. Location and appearance will bring in more customers than low prices. People will pay more when they perceive the product to be worth it. Finally, one of the most important factors in the success or failure of a pick-your-own business is the weather. Rainy weekends will limit the number of customers that attend and severely cut into the profits for the year. This is why farmers rarely sell their produce by a pick-your-own business alone.

Whether at a roadside stand or a pick-your-own farm, when growers sell to retail customers, appearance and customer relations are key factors. Characteristics of many successful retail produce businesses include the following:

- Phone with an answering machine that provides essential information, such as prices and hours of operation
- Weekend, summer, and holiday hours
- Accommodations for children and a family friendly environment
- Barrier-free access to all services and facilities
- Sufficient parking and clear roads and trails at pick-your-owns
- Large, readable signs with vital information for customers
- Well-mannered, knowledgeable employees
- Free drinking water (Selling cold sodas, candy, and juices is also a good idea.)
- Containers supplied for customers who forget to bring one
- Plenty of shade
- Clean restrooms
- Attractive, well-stocked displays (Pick-your-owns should also have some produce on display, ready to purchase, for customers who prefer this option.)

Business and Institutional Markets

Restaurants, grocery stores, and wholesale cooperatives are other potential markets in some areas. Institutions such as schools, hospitals, and nursing homes also sometimes purchase produce from local growers. It is important to note that an agreement with this type of venue is usually made with a contract. The business or institution will normally purchase produce on a weekly basis and will require prompt, regular delivery and consistent quality. Buyers will often want to see samples of produce before committing to a purchase.

Advertising

Advertising is the way businesses communicate with customers about their products or services and encourage customers to make a purchase. Advertising is essential to building a business. As with other parts of the marketing strategy, advertising needs to be planned in advance and used effectively to reach as many customers as possible.

There are many different ways to advertise. Print and broadcast media are two of the most popular and effective means of advertising. Newspaper and magazine ads, billboards, and direct mail are popular and commonly used forms of print advertising. Radio and television ads are examples of broadcast advertising. The Internet is a relatively new medium that has rapidly become a mainstay of advertising for many businesses.

When deciding on what type of advertisement to use, it is important to consider what forms are available and what will be most useful for a particular business. Television and general-interest magazines reach many consumers and often have very creative and effective ads. However, theses ads are also very expensive, and many of the viewers and readers may not be interested in a particular product. Businesses should focus their efforts on an advertising plan that directly addresses their target market. Below are some of the most common and useful methods of advertising and some of the factors to consider when developing a marketing plan.

Newspapers

Newspapers are a main form of advertising for many businesses because they offer a number of advantages. Local newspapers are available in most communities. This allows businesses to reach a large number of potential customers in their area for relatively little cost. Newspapers research their circulation, which can help businesses gear their ads toward readers. In addition, newspapers also enable businesses to create or change advertisements quickly and create sales within a relatively short amount of time. However, newspapers have some potential disadvantages that businesses should consider. The newspaper's circulation may be much wider than the business's target market. If so, the business would be paying to reach people with no interest in the product. The high number of ads in the paper means increased competition for the reader's attention, and the production quality and appearance of newspaper ads are frequently low.

Billboards

Billboards are usually located on major highways and are a way of advertising to passing motorists about services that are available in nearby communities. Messages on billboards need to be concise and direct since customers only have a short period of time to read them. Billboards are used by local and national advertisers because they are relatively inexpensive compared to other forms of advertising and can be seen by potential customers 24 hours a day. Businesses located next to commonly traveled roads may consider installing billboards on their property. However, because of concerns for safety and scenic beauty, billboards have been regulated in some areas. Research should be done before installing billboards to ensure adherence to all laws and regulations.

Direct Mailing

Direct mailing can be a useful way to notify customers of upcoming events and specials. Producers can be selective in sending out advertisements, which helps ensure that they reach their target audience. Direct mailing can be a timely way to keep customers informed, and there are many options for how the ad will appear. Unlike an ad in a newspaper or magazine, a direct-mail advertisement doesn't compete with other businesses' ads on the same page. However, it is important to keep direct-mailing lists current. This helps ensure that only people who are interested in the product receive the mailing and the business spends its advertising budget effectively.

Radio

Radio advertisements are short spots, between 15 seconds and one minute in length. Radio ads are typically inexpensive, particularly when compared to advertising on television or in widely circulated magazines. Businesses can target their market by placing ads on stations their potential customers are mostly likely to listen to. Radio stations usually do extensive market research about their listeners' characteristics, which can help businesses tailor their ads.

Most communities have radio stations and many people listen to the radio at home, work, or on the go, so it is very likely that potential customers will hear an ad. However, there are some drawbacks to radio advertising. Many people listen to the radio while they are doing something else, therefore it is very easy for them to become distracted or ignore the ad. Another disadvantage is that producers cannot use visual images to appeal to customers.

Internet

Compared to print and traditional broadcast media, the Internet is a relatively new but potentially very important way of advertising. For fruit and vegetable producers, especially those in a CSA, pick-your-own, or orchard setting, Internet advertising could be a significant part of an overall advertising plan. Internet advertising has numerous advantages, including the possibility of reaching millions of potential customer at a relatively low cost, creative advertising with audio and visual appeal, and customer accessibility 24 hours a day, seven days a week. Potential drawbacks to advertising on the Internet include maintaining the Web site and the difficulty customers might have finding the site among all of the Web sites available.

Summary

A business must find a market for the goods it sells in order to survive. The producer narrows the field from the total population of all individuals to the target market that will be pursued. Establishing a target market allows the producer to tailor advertising and products to the customers' needs and wants. Producers may choose to sell wholesale or retail. In general, the producer makes less per item selling wholesale but spends less on customer relations. When selling to retail customers, the producer can charge more per item, but in turn is expected to provide more customer service. Advertising is the way businesses communicate with customers about their products or services and encourage customers to make a purchase. Advertising is essential to building a business. As with other parts of the marketing strategy, advertising needs to be planned in advance and used effectively to reach as many customers as possible. Businesses should focus their efforts on an advertising plan that directly addresses their target market.

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Fruit and Vegetable Production

Lesson 3: Site Evaluation

Before deciding what to plant, it is important to evaluate the prospective site to determine if it is suitable. Several key environmental and nonenvironmental elements must be assessed. Evaluating a site requires forethought and effort, and long-term goals should be kept in mind to reach the desired results. Carefully considering each of the essential factors before selecting a site can help avoid problems in the future.

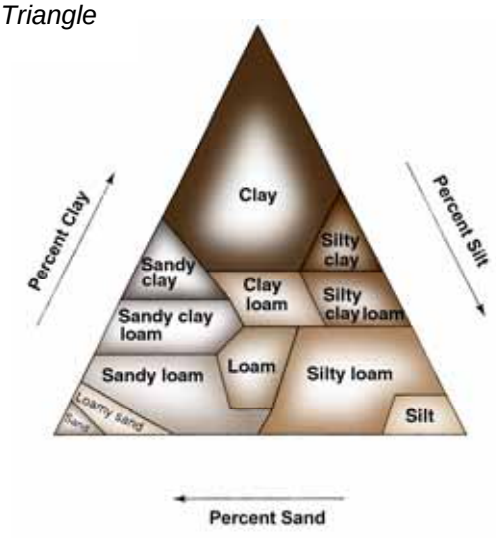
Environmental Evaluation Concerns

Soil

Soil is a living, naturally occurring, dynamic system at the interface of air and rock. Soil forms in response to forces of climate and organisms that act on organic and geologic material in a specific landscape over a period of time. Having the appropriate soil conditions is essential for optimum plant growth.

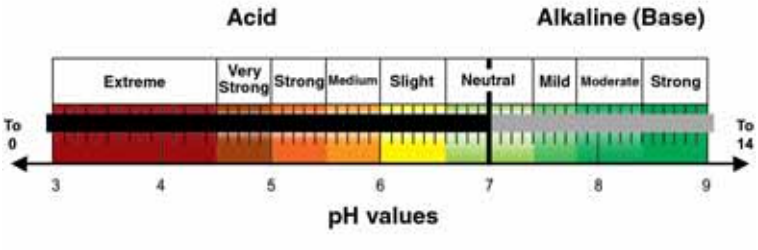
Texture is an important soil property because it is closely related to many aspects of soil behavior. Soil texture refers to the percentage by weight of sand, silt, and clay in a soil. The ease of tilling and plant root development within the soil are both influenced by soil texture. Texture affects the amount of air and water a soil will hold and the rate of water movement through the soil. Plant nutrient supplies are also affected by soil texture. Figure 3.1 shows the soil texture triangle, which illustrates the various combinations of silt, sand, and clay possible and identifies them by their textural name.

Figure 3.1 – Soil Texture Triangle



Soil pH is also important to consider. The pH scale measures acidity to alkalinity. The scale goes from 0 to 14, with 0 being the most acidic and 14 being the most alkaline or basic. (See Fig. 3.2.) Soil with a neutral pH is neither acidic nor alkaline. The pH value of the soil gives a quick estimate of the balance between the plant nutrient elements in the soil and other non-nutrient elements.

Figure 3.2 – pH Scale



There are nine essential macronutrients and eight essential micronutrients needed for plant growth. Different pH levels affect available nutrient levels and should be monitored to reduce the likelihood of nutrient deficiencies. Table 3.1 lists the essential macronutrients and micronutrients and their sources.

Table 3.1 – Essential Plant Nutrients

	Nutrients	Source
Macronutrients	Ca Calcium Mg Magnesium K Potassium	Mineral solids
	P Phosphorus S Sulfur	Mineral solids; organic matter
	N Nitrogen	Organic matter (primarily)
	C Carbon H Hydrogen O Oxygen	Water and air
Micronutrients	B Boron Cl Chlorine Co Cobalt Fe Iron Mn Manganese Mo Molybdenum Zn Zinc Cu Copper	Naturally in soil; can be added with fertilizers

A fertile soil produces high-yielding, healthy crops. Although a fertile soil has nutrient balance and quantity, nutrients alone are not sufficient to make a soil fertile. Soil fertility depends on soil texture, structure, rooting depth, organic-matter content, available water capacity, aeration (porosity), length of growing season, and physical support. Physical support includes such factors as erosion control and good plant residue management.

Organic matter is an important factor in soil evaluation because it supplies most of the nitrogen that is naturally present in the soil and may account for about half of the phosphorus. It also improves soil structure and aids in good soil aeration and healthy root development.

All crops require particular soil conditions for optimal yields. One of the best ways to evaluate the soil of a potential site is by performing a soil test. Soil testing can reveal the percentage of organic matter, pH, and amount of available nutrients in the soil. A soil test is a good guide for determining the proper amount of fertilizer and soil amendments for the site. Soil testing should be done when selecting a site and also should be performed periodically to monitor conditions and diagnose any problems. Amending the soil before crops are planted can help save time and money in the long run.

Topography

Topography refers to the relative positions and elevations of the natural and fabricated features that describe the surface of an area. Topography affects soil condition and what types of plants can grow well in the area and also is a significant factor in regard to accessibility for machinery.

Topography determines how wind and water move toward, over, and away from an area. This interaction between the topography and the wind and water significantly affects the soil erosion, soil drainage, and water-holding capacity of the site. Soils in low areas tend to be moist and poorly drained while soils in more sloping areas tend to be drier and well drained. On steeper slopes, topsoil may erode, exposing the subsoil or parent material.

To some extent, topography explains why similar enterprises are located in similar regions. Whatever the type of enterprise, the topography must be able to support the operation’s activities profitably.

Accessibility

Accessibility refers to how readily a site can be reached and used. It should be easy to get into and out of the area with all the equipment and supplies needed to plant, maintain, and harvest the crop. There should be access to any utilities that are needed, such as water and electricity. Consideration should also be given to where roads currently are and where they will need to be built on the property to provide access.

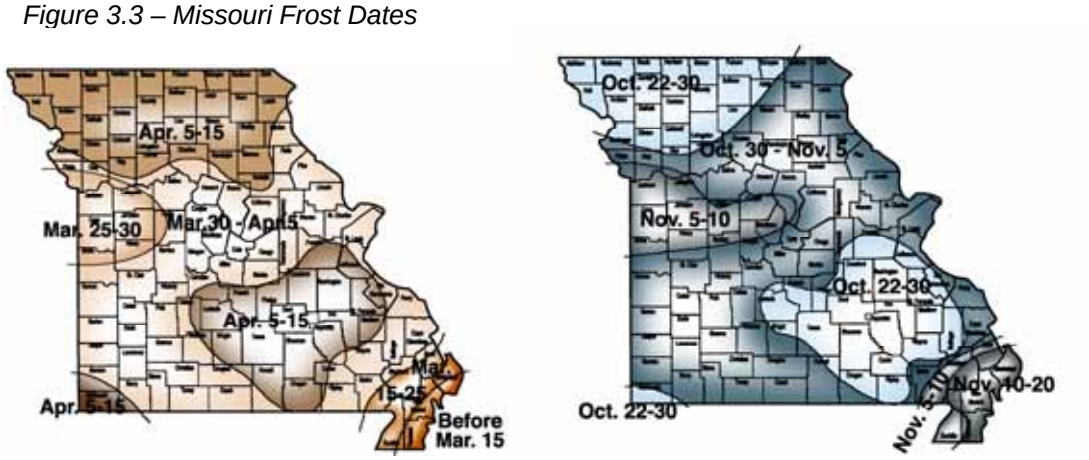
Traditionally, it was primarily the owners, operators, and workers who needed access to the farm. However, producers who are considering an operation such as a pick-your-own or CSA farm must also determine whether the site is accessible to the public. If consumers will be frequenting the farm, it is important that the farm have sufficient parking, clear roads and trails, and barrier-free access to all services and facilities.

Climate

Another environmental factor to consider when selecting a site is the climate. Climate is all the atmospheric influences, usually considered over a number of years, that combine to influence the land forms, soils, vegetation, and land use of a region. The principal atmospheric influences are temperature, moisture, wind, pressure and evaporation. The climate of the area will help determine what plants will thrive during the growing season.

Climate and region will determine the frost dates of the area. The frost dates are the estimated dates of the last frost in spring and the first frost in fall. The time between the frost dates is the growing season in which plants can reach maturity and produce fruits and vegetables that are ready to harvest. Frost dates are determined by the U. S. Department of Agriculture based on historical data. Because the dates are estimates, there is always a chance of unexpected early or late frost. Figure 3.3 shows the spring and fall frost dates for Missouri.

Figure 3.3 – Missouri Frost Dates



Within climates, there are also microclimates. A microclimate is an area in which the climate is different from the area around it. Microclimates may be large or small, and they may be naturally occurring or caused by human construction and activity. A valley, which is colder than the area around it, is an example of a large naturally occurring microclimate. A sheltered area next to a fence or building, which is warmer than the surrounding area, is an example of a small constructed microclimate. Producers can take advantage of microclimatic differences by the varieties of plants they choose and how they position their crops.

Nonenvironmental Evaluation Concerns

Utilities

A site should also be evaluated for the ease with which utilities and services can be provided. The distance to services and utilities should be considered because it will affect the cost of bringing them to the site. Water should be readily available and plentiful, and water quality should also be considered. Depending on what equipment will be used, electricity might also be needed.

Zoning

Zoning controls the physical development of land and dictates the kinds of uses allowed on individual properties. Zoning laws determine the areas in which residential, industrial, recreational, and commercial activities can occur. Local governments commonly control zoning. Prior to starting production, be sure to check with the local zoning board about the regulations concerning the specific site.

Labor

The type of labor needed will depend greatly on the type, size, and scale of production being considered. The availability of a labor force in the area should also be investigated. Depending on the crop and production scale, labor may be automated or done by hand. Hand labor is work done by people working manually with the crops. Automated labor is done by people operating machines.

Summary

When considering a site for fruit and vegetable production, a number of environmental and nonevironmental factors should be considered. Environmental factors include soil, topography, accessibility, and climate. Nonenvironmental factors include utilities, zoning, and labor. Carefully considering these factors before selecting a site can help avoid problems in the future.

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Fruit and Vegetable Production

Lesson 4: Integrated Pest Management

The same factors that make a site desirable for planting a crop—fertile soil, adequate moisture, and a hospitable climate—also make it susceptible to many pests and diseases. To have a profitable yield and a healthy crop, producers must have a system of preventing pest infestation and protecting crops that can be utilized throughout the entire production process.

Pest Control Basics

Pests are plants, animals, or other organisms that occur where they are not wanted or where they can cause damage. Common types of pests include weeds, insects, and bacteria. A pest control program should protect crops from pests, increase plant resistance to pests, and reduce or eliminate pest populations. There are four basic methods of pest control: biological, chemical, cultural, and physical and mechanical.

Biological Pest Management

Biological pest management is the use of living organisms to control pests. Trap plants may be used to lure pests away from crops. Natural predators and parasites can be used to reduce pest populations. Biological pest management is usually done in one or more of three ways:

- Conserving or encouraging species in the area that control the pests
- Supplementing existing predator populations with additional members of the same species
- Introducing new species to the environment specifically to control pests

Biological methods tend to take longer than other management methods and do not completely eliminate pests.

Chemical Pest Management

The use of chemicals to protect and treat plants and to repel or destroy pests is called chemical pest management. The most common type of chemical pest management is the use of pesticides. There are many different types of pesticides. Table 4.1 shows some common types of pesticides and the pests they treat.

Table 4.1 – Pesticides for Specific Pests

Type of Pesticide	Pests Treated
Bactericide	Bacteria
Fungicide	Fungi
Herbicide	Plants
Insecticide	Insects
Miticide	Mites, ticks
Molluscide	Snails, slugs
Nematicide	Nematodes

Pesticides can be a very useful tool in managing pest populations, but they do pose potential risks. Pesticides are specifically designed to adversely affect or kill the pests they target. If mishandled, they can present health risks to humans and cause damage to the environment. Pesticide use is monitored and regulated by various local, state, and federal agencies, including the U. S. Environmental Protection Agency (EPA). The EPA evaluates new pesticides and reviews old ones to determine that they can be used safely and without causing an unreasonable threat to the environment. Growers should follow all directions and regulations regarding the proper use, handling, and storage of any pesticides they use.

Pests can develop resistance to chemicals over time, so using pesticides alone should not be the only method for treating pests. Pesticides should be used only when necessary and at the lowest rate of application that will effectively control the pests. This reduces expense, helps prevent pests from becoming resistant, and lowers health and environmental risks.

Cultural Pest Management

Cultural pest management is controlling pests through the use of proper planting and growing techniques. Good cultural pest management begins by choosing varieties that are suited to the area and planting them so that growing conditions are optimized and stress on crops is reduced. Providing adequate water and nutrients helps ensure strong plants, which are more resistant to pests and diseases and more able to outgrow weeds. Crop rotation, proper disposal of plant residue, and planting and harvesting to avoid coinciding with pests are also examples of cultural management strategies.

Cultural pest management works by optimizing conditions for crops while minimizing opportunities for pests. Cultural management strategies have the advantage that many of them can be implemented before pests appear.

Physical and Mechanical Pest Management

Physical and mechanical pest management strategies use physical barriers and labor to prevent or limit pest damage. Examples of physical pest management would include using fencing, traps, row covers, and trenches to keep pests off crops. Mowing, plowing, and hand-picking insects off plants are examples of manual operations that can be used to control pests. Holding produce in cold storage to kill pests or slow or stop their development is also a type of physical pest management.

Some physical and mechanical strategies, such as removing insects by hand, can require too much time and labor to be practical for larger operations. The size of the operation and the availability of a labor force should be considered before using physical and mechanical management strategies.

Integrated Pest Management

Integrated pest management (IPM) combines biological, chemical, cultural, and physical and mechanical strategies into a comprehensive system of pest control. Integrated pest management programs have the following goals:

- Limit pests to acceptable levels
- Promote healthy crops and good land management
- Reduce reliance on pesticides
- Promote long-term management strategies
- Improve health and safety for farm workers and consumers
- Limit damage to the environment

It is important to realize that IPM does not attempt to eliminate all pests. Some pests are acceptable, because limited pest populations help maintain the predator and parasite populations that are utilized for biological control. The key to IPM is knowing when the pest population passes the acceptable level—the point at which the cost of damage is greater than the cost of controlling the pests. This point is called the action threshold or economic threshold, and it is when the producer must take steps beyond any preventive measures already in place. Table 4.2 shows the general steps of an integrated pest management strategy.

Table 4.2 – Steps of Integrated Pest Management

Six Steps of IPM
1. Implement preventive strategies.
2. Scout plants for symptoms or presence of pests.
3. Identify pests and scope of damage.
4. Determine when action must be taken.
5. Implement management strategies.
6. Evaluate results.

There are a number of factors that should be considered when determining the action threshold, such as the level of damage and infestation, market price, stage of crop growth, and cost of pesticides.

A successful IPM strategy requires a thorough understanding of the crops, the potential pests and their enemies, and the surrounding environment. The producer must know how these elements interact, and monitoring the site for pest activity is critical.

There are many advantages to an integrated pest management system. Utilizing a variety of controls reduces the likelihood that pests will adapt to one particular strategy. A number of IPM strategies are simply good planting and management strategies, and therefore cost little or nothing extra to implement. Integrated pest management also reduces dependence on pesticides and helps promote healthy produce and a healthy environment. A healthy environment can support a balance between agricultural production, native plants and animals, and human inhabitants. An environment in which the natural resources have been depleted or misused cannot. Integrated pest management offers affordable, workable solutions that can benefit consumers and producers.

Summary

Protecting crops from pest damage is an essential part of raising a healthy, productive crop. The four types of pest management are biological, chemical, cultural, and physical and mechanical. Integrated pest management incorporates techniques from all four strategies into a comprehensive system of pest control.

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Fruit and Vegetable Production

Lesson 5: Vegetable Production

The term vegetable is generally used to refer to the edible portion of herbaceous (nonwoody) plants—the roots, stems, leaves, flowers, or fruit.

Plant Considerations

There are many different varieties and hybrids of most types of vegetables. A variety is a plant that occurs naturally or through cultivation and differs from other members of its species by one or more characteristics. A hybrid is a plant that results from interbreeding two distinct cultivars, varieties, or species. Varieties and hybrids offer certain desirable characteristics, such as good size, flavor, and appearance and resistance to certain pests and diseases. Consideration must be given to what varieties and hybrids are appropriate for a particular area and climate when choosing vegetables to grow.

Cool Season Crops

A cool season crop is a crop that grows best during the cool temperatures of fall and spring. Cool season crops prefer temperatures between 50°F and 70°F. These include beets, carrots, potatoes, cabbage, cauliflower, and many others. Cool season crops are very tolerant of cold weather and can usually stand a light frost.

Two primary types of cool season crops are root crops and surface crops. Root crops are vegetables that are primarily cultivated for their edible roots, tubers, or modified stems, which grow below ground. Surface crops are grown for edible parts—leaves, flowers, and “fruits”—that grow above ground.

Warm Season Crops

Warm season crops are crops that are severely harmed by frost and do not grow well until the temperature is at or above 70°F. Examples of warm season crops include tomatoes, eggplants, and corn. Warm season crops should only be planted when soil temperatures are warm enough to induce sprouting.

Long Season Crops

Long season crops are vegetables that require a relatively long growing season to mature compared to other plants. Examples of long season crops include pumpkins, gourds, and watermelons.

Vegetable Chart Components

Different types of vegetables will be explored in this lesson using a chart format. (See Fig. 5.1.) The chart addresses some of the most important factors that must be considered when deciding what vegetables to grow. Descriptions of each heading are given following the sample chart. Recommendations will vary depending on such factors as the local climate and region and the specific varieties of vegetables grown.

Figure 5.1 – Sample Vegetable Chart

Cool Season Root Crop

Days to Germination	
Days to Maturity	
Soil	
Spacing	
Harvest	
Postharvest	
Production Concerns	
Pests and Diseases	
Other Considerations	

- **Days to Germination:** The days to germination is the estimated number of days before a plant will begin to grow and sprout.

- **Days to Maturity:** The days to maturity is the estimated number of days from planting until a usable or salable product can be harvested.

- **Soil:** This section of the chart explains what soil conditions are desirable for the plant to grow, such as the recommended soil pH, texture, and drainage.

- **Spacing:** Spacing requirements provide a guideline for how much space to leave between plants and rows to allow adequate room for growth, cultivation, and harvesting.

- **Harvest:** The harvest section provides general guidelines to help determine when the crop is ready to be harvested and how to harvest the crop.

- **Postharvest:** Proper storage and handling procedures are listed in the postharvest portion of the chart.

- **Production Concerns:** Crop-specific information to facilitate proper growth and production is supplied in the production concerns section.

- **Pests and Diseases:** This section lists common pests and diseases that affect the specific crop.

- **Other Considerations:** This heading provides a place to include crop-specific concerns that are not associated with other areas of the chart.

Summary

Vegetables are the edible portions of herbaceous plants. They can be divided into three general categories based on their growing season: cool season, warm season, and long season crops.

The charts that accompany this lesson summarize a number of key elements needed to produce a successful vegetable crop. Recommendations will vary depending on specific crops and growing conditions.

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Fruit and Vegetable Production

Lesson 6: Fruit Production

Fruits are the matured ovaries of flowering plants that contain the seeds of the plant.

Although this definition is simple, people often have different ideas about what fruits are. For example, botanically, a tomato is the fruit of a tomato plant, but for a customer in a grocery store, it is probably a vegetable. A workable definition for fruit and vegetable production is that a fruit crop is a perennial crop that produces true (botanical) fruit that is edible and of economic value. Including the fact that they are perennial crops recognizes that production concerns for crops such as blackberries, pecans, and apples are more similar to each other than they are to production concerns for annual crops such as tomatoes and melons.

Plant Considerations

Growers must consider what varieties and hybrids of fruits will work well in their particular area and climate when deciding what crops to grow. A variety is a plant that occurs naturally or through cultivation and differs from other members of its species by one or more characteristics. A hybrid is a plant that results from interbreeding two distinct cultivars, varieties, or species. Varieties and hybrids offer certain desirable characteristics, such as good size, flavor, and appearance and resistance to certain pests and diseases. Fruit growers must pay particular attention to the size, flavor, and appearance of fruit when choosing the crops they will plant because these qualities play a large role in appealing to customers.

Small Fruits

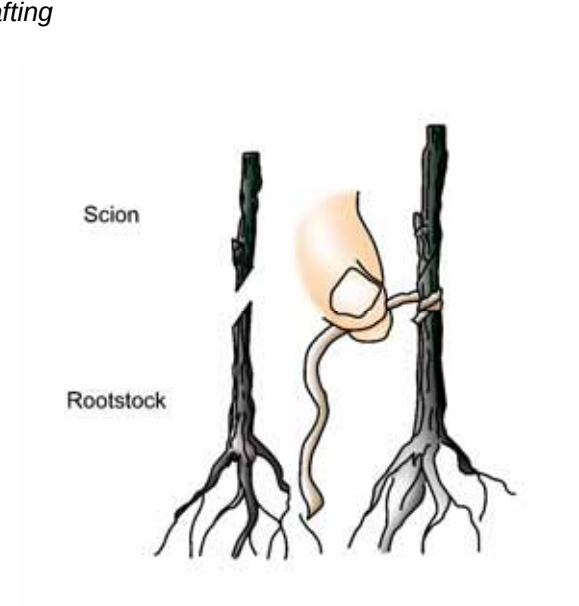
Small fruit crops are grouped together because they produce small, soft fruit, usually on vines, plants, or shrubs; however, not all small fruit crops are in the same botanical family. Examples include blackberries, blueberries, grapes, raspberries, and strawberries.

Small fruit crops require little space relative to the amount of fruit they produce and typically bear fruit one or two years after planting. Pests are generally easier to control on small fruits than they are on most tree fruits.

Tree Fruits

Tree fruits are edible fruit crops that grow on trees. Trees are woody plants that usually have a single main trunk and produce new growth in the branches of their canopy. This makes trees distinct from shrubs, which typically have several stems instead of a single trunk and produce new growth from the ground. This growth pattern also makes trees well suited to grafting, which is an important aspect of fruit tree production. Figure 6.1 shows a simple form of grafting called whip grafting.

Figure 6.1 – Whip Grafting



Grafting is a propagation method in which a bud, twig, or shoot—the scion—is taken from one plant and attached to a different but compatible plant, called the rootstock. The grower can choose one tree for its ability to grow in a particular region or type of soil, its height, or disease resistance, and another for its fruit. Grafting allows the grower to combine the best traits of multiple plants and produce a better product.

There are three primary types of tree fruit crops: pome fruits, stone fruits, and nuts. Each is discussed in the rest of this section.

Pome Fruits

Pome fruits are members of the Pomoideae subfamily of the family Rosaceae. The fruit, called a pome, forms from a flower with an inferior, compound ovary. The fleshy, edible portion of the fruit that surrounds the seeds is formed by the nonovarian parts of the flower. Pome fruits are generally well adapted to cool, temperate climates. Pome fruits typically have a long storage life if proper conditions are provided. Apples and pears are examples of pome fruits.

Stone Fruits

Stone fruits are members of the subfamily Prunoideae of the family Rosaceae. The fruit, called a drupe, forms from a flower with a superior, simple ovary. Stone fruits get their common name from the hard pit or “stone” in the center of the fruit. The stone is a specialized layer of ovary tissue called an endocarp that surrounds the seed. Cherries, peaches, and plums are examples of stone fruits.

Most stone fruit crops are native to warmer climates and therefore are very susceptible to injury from low winter temperatures. Stone fruits also bloom early in the spring, which makes their flowers vulnerable to damage from spring frosts. Stone fruits are extremely perishable, so they have a very limited storage life. This makes managing stone fruit crops more complex than pome fruits because growers must typically grow more varieties to extend their growing season and produce a profitable crop.

Nuts

A nut is a dry indehiscent fruit in which the seed remains unattached to the ovary wall, and the ovary wall—the shell—becomes very hard at maturity. Indehiscent means that the fruit does not open when it ripens. Some examples of nut fruits are black walnuts, Chinese chestnuts, and northern pecans.

Nut crops are not all in the same botanical family, but they do have similar processing requirements, such as hulling and drying. Nut crops are also typically high in protein and low in saturated fats. Nut trees can do well in less desirable growing conditions, which makes them a good choice for land that is too rough or steep for field crops.

Fruit Chart Components

Different types of fruits will be explored in this lesson using a chart format. (See Fig. 6.2.) The chart addresses some of the most important factors that must be considered when deciding what fruits to grow. Descriptions of each heading are given following the sample chart. Recommendations will vary depending on such factors as the local climate and region and the specific varieties of fruits grown.

Figure 6.2 – Sample Fruit Chart

Stone Fruit Trees

Interval From Planting to Fruiting	
Season of Ripening	
Soil	
Spacing	
Harvest	
Postharvest	
Production Concerns	
Pests and Diseases	
Structures and Equipment	
Other Considerations	

- **Interval From Planting to Fruiting:** The interval from planting to fruiting refers to the amount of time from planting until the first salable crop is produced.

- **Season of Ripening:** The season of ripening is a guideline for the time of year when the fruit will be ripe and ready to pick.

- **Soil:** This section of the chart explains what soil conditions are desirable for the plant to grow, such as the recommended soil pH, texture, and drainage.

- **Spacing:** Spacing requirements provide a guideline for how much space to leave between plants and rows to allow adequate room for growth, cultivation, and harvesting.

- **Harvest:** The harvest section of the charts provides general guidelines to help determine when the crop is ready to be harvested and how to harvest the crop.

- **Postharvest:** Proper storage and handling procedures are listed in the postharvest portion of the chart.

- **Production Concerns:** Crop-specific information to facilitate proper growth and production is supplied in the production concerns section.

- **Pests and Diseases:** This section lists common pests and diseases that affect the specific crop.

- **Structures and Equipment:** This section provides a guide to what structures and equipment are needed for proper growth and production.

- **Other Considerations:** This heading provides a place to include crop-specific concerns that are not associated with other areas of the chart.

Summary

Fruits are the matured ovaries of flowering plants that contain the seeds of the plant. Fruits can be divided into small fruits and tree fruits. Tree fruits can be divided further into pome fruits, stone fruits, and nuts.

The charts that accompany this lesson summarize a number of key elements needed to produce a successful fruit crop. Recommendations will vary depending on specific crops and growing conditions.

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