Fruit & Vegetable Production Unit for Plant Science Core Curriculum

Instructor Guide

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

Instructor Guide

Fruit and Vegetable Production Unit for Plant Science Core Curriculum

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1400 Rock Quarry Center
Columbia, Missouri 65211

First Edition: June 1984
Revised: June 2006

The activity that is the subject of this report was supported in whole or in part by funds from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. However, the opinions expressed therein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education or the Division of Vocational and Adult Education, and no official endorsement should be inferred.

Acknowledgments

Fruit and Vegetable Production Unit for Plant Science Core Curriculum is a curriculum designed to provide instruction about the production of fruit and vegetable crops for tenth grade students. Funding for the curriculum development project was provided through a grant from the Missouri Department of Elementary and Secondary Education (MDESE).

Recognition is given to advisory committee members for providing their valuable time and suggestions in developing the outline for this curriculum. The committee consisted of the following members:

Pat Bellrose, Fahr Greenhouse
Ron Dickens, Liberal R-II High School
Jeanne Holmes, Mineral Area College
Deanna Thies, Boonslick Technical Education Center
Jim Thies, Howard County High School
Tracy Vedder, Gasconade County R-I High School
Michele Warmund, College of Agriculture, Food, and Natural Resources, University of Missouri-Columbia

A special thank-you is extended to Terry Heiman, Director of Agricultural Education Division of Career Education, and Nancy Alford, Supervisor of the Southeast & South Central Districts of Agricultural Education for the Department of Elementary and Secondary Education.

Special recognition is extended to Michael A. Gold, Associate Director, University of Missouri Center for Agroforestry, for providing technical expertise.

Instructional Materials Laboratory
University of Missouri-Columbia

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.

Fruit and Vegetable Production Unit for Plant Science Core Curriculum is designed as a four-week course for tenth grade students. Lessons focus on planting and growing considerations as well as financial and marketing concerns. Lesson-level activities and a unit-level activity have been included to provide opportunities for students to apply skills and concepts covered in the curriculum and for instructors to assess student performance. Crosswalk tables are included to show where *Fruit and Vegetable Production Unit for Plant Science Core Curriculum* competencies relate to Missouri's Show-Me Standards, Frameworks for Curriculum Development, and Grade-Level Expectations for science. A suggested teaching calendar is included at the end of the table of contents.

This instructor guide and the corresponding student reference contain six lessons: Managing Financial Resources, Developing a Marketing Plan, Site Evaluation, Integrated Pest Management, Vegetable Production, and Fruit Production. In addition, the instructor guide includes completed production charts for over 30 fruit and vegetable crops as well as blank charts to copy and distribute to students to fill out during class discussion or as part of their assigned work. The instructor can also use the blank charts to develop additional charts for other crops he or she wishes to discuss.

Terry Heiman, Director
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Introduction

Fruit and Vegetable Production Unit for Plant Science Core Curriculum is a four-week course designed to introduce students to fundamental concepts and information related to the production of fruit and vegetable crops. Because of the broad scope of the material and the limited time available, the course has been arranged so that main topics related to fruit and vegetable production are discussed in the study questions and information regarding specific fruits and vegetables is included in supplemental charts, which will be chosen by the instructor to accompany the appropriate lessons. There are a number of advantages to arranging the curriculum this way.

- By putting crop-specific information in the charts, study questions can be used to focus on key concepts. Because an entire lesson is not needed to address each crop, the number of crops available to the instructor has nearly tripled compared to the previous edition of this curriculum guide.

- Having a wide variety of completed charts allows the instructor to tailor the material to his or her specific needs. Crops can be chosen based on regional production; the crops discussed can be changed from year to year; and new or specialty crops can be added or removed to reflect changes in the market. The instructor can also update and modify existing charts as needed.

- Because students will fill out their own charts, the instructor can use the charts as an additional tool for assessment, if desired.

- Having students fill out the charts for themselves is an interactive strategy that should aid in content retention and promote higher-level learning.

- The informational headings on the charts are based on points that will be addressed by lesson topics and study questions. This allows the instructor to reinforce these concepts by presenting them in a new context and by connecting them to real-world situations.

- As an additional feature, the resources used to compile the charts have been placed at the bottom of each chart as footnotes. In the case of links to Web resources, this allows the instructor to quickly and easily access additional information about a specific crop while online without searching through the complete list of references.

Instructional Materials Laboratory
University of Missouri-Columbia

Fruit and Vegetable Production Unit for Plant Science Core Curriculum

Table of Contents

COMPETENCIES/OBJECTIVES

1. Explain the importance of financial planning in fruit and vegetable production.
2. Describe approaches for the marketing of fresh fruits and vegetables.
3. Classify characteristics of selecting and planning for fruit and vegetable production.
4. Explain management practices for pest control.
5. Identify characteristics of cool season, long season, and warm season vegetable crops.
6. Identify characteristics of small fruits and tree fruits.

UNIT OBJECTIVE

Students will demonstrate their knowledge of production requirements for fruits and vegetables by developing a calendar for cultivating and harvesting 10 fruits and vegetables.

REFERENCES AND MATERIALS

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Fruit and Vegetable Production Unit for Plant Science Core Curriculum - Competency Crosswalk

Duty Band & Task Statement	SHOW-ME STANDARDS		CURRICULUM FRAMEWORKS FOR GRADES 9-12					
	Knowledge (Content)	Performance (Goals)	Communication Arts	Fine Arts	Health/Physical Education	Math	Science	Social Studies
1	CA 4; MA 1, 3; SS 4	1.4, 1.7, 2.3, 2.7, 3.8, 4.1, 4.5	I.2.a, III.1.a, III.1.i			I.2.b, II.4.h, V.1.a, VII.4.a		IV.D.1.h, IV.D.1.k
2	CA 3, 4; MA 3;	1.1, 1.8, 2.1, 3.8, 4.1	I.2.a, I.2.c, I.2.d, I.3.a, IV.3.a, IV.2.b					
3	CA 1, 4; SC 4, 8; SS 5	1.10	IV.1.e				I.A.3.a, II.A.2.a, VI.A.1.a, VI.B.4.a	III.E.6.n, IV.E.4.g
4	SC 3, 5, 8; PE 5	1.3, 1.10, 2.1, 3.6, 3.8, 4.7	I.3.f, I.6.c		II.B.4.a, II.D.1.b, III.D.1.a, III.D.2.a		I.A.3.a, II.A.2.a, VIII.A.1.a, VIII.B.1.a	
5	CA 1, 4, 6; SC 5	1.5, 1.8, 2.1	I.2.a, I.2.c, I.2.d, I.3.a, III.1.c				VII.A.4.a	
6	CA 1, 4, 6; SC 5	1.5, 1.8, 2.1	I.2.a, I.2.c, I.2.d, I.3.a, III.1.c				VII.A.4.a	

Duty Band & Task Statement	SHOW-ME STANDARDS		CURRICULUM FRAMEWORKS FOR GRADES 9-12					
	Knowledge (Content)	Performance (Goals)	Communication Arts	Fine Arts	Health/Physical Education	Math	Science	Social Studies
Unit Activity	CA 3	1.2	I.2.a, I.2.c, I.2.d, I.3.b, II.2.c, III.1.d,IV.3.b				VI.A.1a, VI.B.4.a, VIII.A.1.a	III.E.6.n, IV.E.4.g

Fruit and Vegetable Production Unit for Plant Science Core Curriculum - Competency Crosswalk

Duty Band & Task Statement	Science 9-12 Grade Level Expectations							
	Strand 1 Matter & Energy	Strand 2 Force & Motion	Strand 3 Living Organisms	Strand 4 Ecology	Strand 5 Earth Systems	Strand 6 Universe	Strand 7 Scientific Inquiry	Strand 8 Science, Technology, & Human Activity
1							1.E.a	
2							1.B.a, 1.C.a, 1.E.a	1.B.a
3				1.C.b, 1.D.a, 3.C.a, 3C.c	1.D.b, 2.A.a, 2.A.b, 3.A.e		1.C.a	1.C.a
4				1.A.a, 1.A.b, 1.D.a, 3.C.a, 3.C.c			1.A.f, 1.C.a, 1.E.a	1.C.a
5							1.A.f, 1.C.a, 1.E.a	
6							1.A.f, 1.C.a, 1.E.a	
Unit Activity				1.A.a, 1.A.b, 3.C.a, 3.C.c	1.D.b, 3.A.e		1.C.a, 1.E.a	1.C.a

Name: _____ **Fruit and Vegetable Production Competency Profile**

Directions: **Evaluate the student by checking the appropriate number to indicate the degree of competency. The rating for each task should reflect** employability readiness **rather than the grades given in class.**	**Student Rating Scale:** **3 – Mastered** – can work independently with no supervision **2 – Requires Supervision** – can perform the job completely with limited supervision **1 – Not Mastered –** requires instruction and close supervision **N – No Exposure –** no experience or knowledge in this area

NOTE: All competencies involving safety require a Number 3 rating.

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Fruit and Vegetable Production

3	2	1	N		
				1.	Explain the importance of financial planning in fruit and vegetable production.
				2.	Describe approaches for the marketing of fresh fruits and vegetables.
				3.	Classify characteristics of selecting and planning for fruit and vegetable production.
				4.	Explain management practices for pest control.
				5.	Identify characteristics of cool season, long season, and warm season vegetable crops.
				6.	Identify characteristics of small fruits and tree fruits.
					Other: _____
				Unit Activity	Demonstrate knowledge of production requirements for fruits and vegetables by developing a calendar for cultivating and harvesting 10 fruits and vegetables.

Fruit and Vegetable Production Unit for Plant Science Core Curriculum

Student Names														

Fruit and Vegetable Production

1. Explain the importance of financial planning in fruit and vegetable production.
2. Describe approaches for the marketing of fresh fruits and vegetables.
3. Classify characteristics of selecting and planning for fruit and vegetable production.
4. Explain management practices for pest control.
5. Identify characteristics of cool season, long season, and warm season vegetable crops.
6. Identify characteristics of small fruits and tree fruits.

Unit Activity

Demonstrate knowledge of production requirements for fruits and vegetables by developing a calendar for cultivating and harvesting 10 fruits and vegetables.

Fruit and Vegetable Production Unit for Plant Science Core Curriculum

Teaching Calendar

	Length for Classroom Instruction / Activities (Hours)	Length for Activity Sheets (AS) (Minutes)	
Lesson 1	1	AS 1.1	40
Lesson 2	2	AS 2.1	80
Lesson 3	2	AS 3.1	120
Lesson 4	2	AS 4.1	60
Lesson 5	2	AS 5.1	90
Lesson 6	2	AS 6.1	90
Unit Activity			60

Fruit and Vegetable Production

Lesson 1: Managing Financial Resources

Competency/Objective

Explain the importance of financial planning in fruit and vegetable production.

Study Questions

1. **Why is financial planning important in fruit and vegetable production?**

2. **What is the importance of setting goals for financial planning?**

3. **What are the three steps in financial planning?**

References and Materials

1. *Fruit and Vegetable Production Unit for Plant Science Core Curriculum* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2006.

2. Figures / Transparency Masters

3. Activity Sheet

   AS 1.1 Distinguishing Between Receipts and Expenditures

4. Supplies

   Record book receipt and expenditure pages to accompany activity sheet

Teaching Procedures

A. Introduction

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

B. Motivation

Ask students if they have ever been to a farmers' market. Have them list items that are sold at farmers' markets. Ask the students if they have ever tried to start a business of their own. What are the rewards of having your own business? What are the drawbacks? When the students have compiled a list, ask what level of finances needs to be available and what they need to know to become a vendor at a farmers' market.

C. Assignment

The instructor should assign the unit-level performance-based assessment activity at the beginning of the unit. Students will work toward completing the activity as they progress through the unit lessons. The assessment activity will be due at the completion of the unit.

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students consider all the study questions before the discussion. Another option is to have students work in a cooperative learning environment by forming groups and assigning different study questions to each group.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. Why is financial planning important in fruit and vegetable production?

Financial planning should be done ahead of time to ensure adequate funds or secure additional finances, if needed.

a. Financial planning is the process of defining goals and developing and implementing a plan to finance the goals.
b. Financial planning is essential in fruit and vegetable production.
    i. There is a limited period of income because of the limited growing season.
    ii. Planning will help ensure finances will last throughout the year.
    iii. Planning promotes critical thinking regarding planting times and varieties of crops.

2. What is the importance of setting goals for financial planning?

Setting goals is an important step in determining where the grower wants to be at the end of the season or year.

a. A goal is a statement of what an individual wants to accomplish both personally and financially.
b. Goal setting is important in fruit and vegetable production.
    i. Because products are highly perishable, careful planning is needed to ensure that they are saleable.
    ii. Labor is a major expense, and labor requirements vary depending on the type of operation. Determining labor needs and costs is an important part of setting goals and making a financial plan.

3. What are the three steps in financial planning?

Each step in financial planning allows the grower to accurately assess the current situation and plan for the future.

a. Step one: Record a projection of income and expenses.
    i. Income is money the business will receive.
        1. Income (receipts) may be received weekly, every two weeks, monthly, or even once or twice a year.
        2. Use the receipts pages in a record book to show the income that is received, where it came from, and the date it was received.
        3. Gross income is the total amount of money the business takes in before any deductions are made.
        4. Net income is the money the business has after expenses and deductions, such as taxes and Social Security, have been taken out.
    ii. An expense is money that is spent to obtain a goal or purpose.
        1. Use the expenditures pages in a record book to keep track of how much money is spent and where it is going.
        2. Fixed (ownership) costs are paid regularly, regardless of the amount of sales the business makes.

3. The major areas of fixed costs are rent, insurance, depreciation, taxes, interest, and repair.
4. Examples of fixed costs in fruit and vegetable production are rent, land insurance, repair of structures, and interest on principal.
5. Variable (operating) costs change according to the production level and amount of use.
6. The major categories of variable costs include labor (salaries), fertilizer, chemicals, seeds / plants, gasoline and oil, inventory, supplies, advertising, utilities, telephone bills, and principal payment.
7. Examples of variable costs in fruit and vegetable production are labor (both seasonal and full-time), fertilizer, growing media and chemicals, water, electricity, and advertising.

b. Step two: Make a list of wants and needs.
   i. Needs are items and expenses that are necessary for the survival of the business.
   ii. Wants are items and expenses that are desired but not essential.
   iii. Making a list of wants and needs helps set short-, intermediate-, and long-term goals.
c. Step three: Implement the financial plan.
   i. Keep current and accurate records of all income and expenses.
   ii. Monitor progress toward reaching the business goals.
   iii. Adjust plans as needed to manage problems and reach goals.
   iv. Adapting to changes builds understanding and confidence.

F. Other Activities

1. Set goals for a fruit and / or vegetable production SAE.

2. Contact the local extension agent to find out about the average income generated from fruit and / or vegetable production.

G. Conclusion

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.

H. Answers to Activity Sheet

AS 1.1 Distinguishing Between Receipts and Expenditures

1. $37.50 Expenditure
2. $52.50 Receipt
3. $300.00 Expenditure
4. $600.00 Expenditure
5. $360.00 Receipt
6. $225.00 Receipt
7. $25.00 Expenditure

Answers will vary on record book pages.

I. Answers to Assessment

1. Financial planning is the process of defining goals and developing and implementing a plan to finance the goals.
2. Financial planning is very important in fruit and vegetable production because the products are highly perishable, which means marketing and selling time are limited. Students may also note that labor is a major expense that must be planned for, and planning promotes critical thinking about what crops to plant.
3. Gross income is the total amount of money the business takes in before any deductions are made.
4. Net income is the money the business has after expenses have been met and deductions, such as taxes and Social Security, have been taken out.
5. Students could list two of the following major areas of fixed expense.
   A. Rent
   B. Insurance
   C. Depreciation
   D. Taxes
   E. Interest
   F. Repair

   Students could also list two of the examples related to fruit and vegetable production.
   A. Rent
   B. Land insurance
   C. Repair of structures
   D. Interest on principal

6. Students could list two of the major categories of variable costs.
   A. Labor (salaries)
   B. Fertilizer
   C. Chemicals
   D. Seeds / plants
   E. Gasoline and oil
   F. Inventory
   G. Supplies
   H. Advertising
   I Utilities
   J. Telephone bills
   K. Principal payment

   Students could also list two of the examples related to fruit and vegetable production.
   A. Labor (both seasonal and full-time)
   B. Fertilizer
   C. Growing media and chemicals
   D. Water
   E. Electricity
   F Advertising
7. Wants are items and expenses that are desirable but not essential, and needs are items and expenses that are necessary for the survival of the business.
8. Implement the financial plan.

Unit I: Fruit and Vegetable Production Name: _____

Lesson 1: Managing Financial Resources Date: _____

ASSESSMENT

Short-Answer Questions: Write the answers in the space provided.

1. What is financial planning?

2. Why is financial planning important for fruit and vegetable production?

3. What is gross income?

4. What is net income?

5. List two fixed (ownership) expenses.

   A.

   B.

6. List two variable (operating) expenses.

   A.

   B.

7. What is the difference between wants and needs?

8. What is the final step in the financial planning process?

Unit I: Fruit and Vegetable Production **AS 1.1**

Lesson 1: Managing Financial Resources Name: _____

Distinguishing Between Receipts and Expenditures

Objective: Distinguish between receipts and expenditures in fruit and vegetable production.

Directions: Work in small groups. Figure the total amount for each item. Then separate the list below into receipts and expenditures. With the receipts and expenditures record book pages provided, place each item on the appropriate page and complete the receipts and expenditures pages.

Item	Description	Amount	Total Amount
1. Seeds	25 packets	$1.50 a packet	
2. Blueberries	15 lbs	$3.50 / lb	
3. Labor	2 students @ 30 hrs / each	$5.00 / hr	
4. Rent	3 months	$200 / month	
5. Corn	15 dozen ears	$2.00 / ear	
6. Cucumbers	450	$0.50 each	
7. Pruners	2 pair	$12.50	

Receipts	Expenditures

Fruit and Vegetable Production

Lesson 2: Developing a Marketing Plan

Competency/Objective

Describe approaches for the marketing of fresh fruits and vegetables.

Study Questions

1. **How does a business identify a customer base?**

2. **What are the different venues to sell products?**

3. **What are the different ways to advertise?**

References and Materials

1. *Fruit and Vegetable Production Unit for Plant Science Core Curriculum* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2006.

2. Figures / Transparency Masters

   Fig. 2.1 Identifying a Market
   Fig. 2.2 Characteristics of Many Successful Retail Produce Businesses

3. Activity Sheet

   AS 2.1 Advertising a Product

Teaching Procedures

A. Review

The first lesson discussed the importance of managing financial resources and the steps in financial planning. This lesson covers key factors in developing a marketing plan: identifying customers, considering venues for selling products, and choosing methods of advertising.

B. Motivation

Ask the students if they have ever seen a commercial or ad that made them want whatever was being advertised. Have them discuss the way the ad made them feel and the way it made them react.

C. Assignment

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students consider all the study questions before the discussion. Another option is to have students work in a cooperative learning environment by forming groups and assigning different study questions to each group.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. How does a business identify a customer base?

Refer to Figure 2.1 Identifying a Market. The first step in creating a marketing plan is identifying the market. It is essential that growers have their marketing plan in place before their produce is ready to sell.

a. A market is all the potential customers for a particular product or service.
   i. There are six steps in defining a business's market that move from the total population, in which no market is identified, to the penetrated market of customers who buy the product.

1. Total population: no market identified.
2. Potential market: all customers who might have interest in the product.
3. Available market: customers with the necessary interest, income, and access to the product.
4. Qualified available market: customers who can by a product based on age or other criteria.
5. Target market: customers the company will serve.
6. Penetrated market: customers already buying the product.

b. The first factor in identifying a customer base is deciding whether to sell to wholesale or retail customers.
   i. Selling wholesale means selling goods to a buyer who sells the goods again. Considerations include the following:
      1. Wholesalers sell in bulk.
      2. A few customers purchase the whole crop.
      3. Producers do not deal directly with the general public.
      4. Customers aren't interested in product displays and ads.
      5. Producers provide less customer assistance.
      6. Producers make less on each item sold.
   ii. Retailers sell relatively small amounts of products directly to the people who will use them. Considerations include the following:
      1. Producers can charge more per item.
      2. Displays and ads are important.
      3. Customers expect more service.

c. Producers should determine what customers exist in their market.
d. 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.
e. The local Chamber of Commerce, census bureau, university extensions, and trade associations are among the resources that may be used to obtain these statistics.

2. What are the different venues to sell products?

Fresh produce may be sold through a variety of outlets. Each has its own characteristics that should be considered when developing a marketing plan. Refer to Figure 2.2 Characteristics of Many Successful Retail Produce Businesses as a summary or for further discussion after covering retail venues.

a. Roadside stands
    i. Stands are a relatively easy way to sell directly to customers.
    ii. The grower sets the hours, prices, and products.
    iii. Sales provide immediate income.
    iv. Minimal setup cost is required for a small operation.
    v. Safe, adequate parking is needed.
    vi. Stands must comply with all zoning, licensing, and insurance requirements.
b. Farmers' markets
    i. Farmers' markets are a low-cost way to sell fresh produce to a large number of customers within a short period of time.
    ii. Producers have the opportunity to network with other growers, widen their customer base, and develop their marketing skills.
    iii. Producers also share the costs of advertising and promotion.
    iv. There is some loss of flexibility. Growers must adhere to rules and regulations regarding hours and days of operation, space availability, and products sold.
c. Community-supported agriculture (CSA)
    i. A CSA operation is a partnership between a grower and individuals who become members by purchasing shares of the season's harvest.
    ii. Members help pay for seeds, fertilizer, water, equipment maintenance, and labor in return for fresh produce throughout the season.
    iii. Growers benefit by receiving income as soon as work begins.
    iv. A financial plan is essential for determining share price.
    v. Since members are also the customers, growers should consider crops members want.
    vi. Growers can work together to provide a greater variety of crops.
d. Pick-your-own businesses
    i. Pick-your-owns need less harvesting labor than traditional operations.
    ii. However, pick-your-owns do require long work hours and additional liability insurance for the growers.
    iii. There must be room for customer parking and traffic.
    iv. The business must be accessible and close to a population that can support it.
    v. Growers and operators must be willing to work weekends.
    vi. Image is important.
    vii. Weather is a key factor; farmers rarely sell by pick-your-own alone.
e. Business and institutional markets
    i. Examples include restaurants, grocery stores, wholesale cooperatives, schools, hospitals, and nursing homes.
    ii. Sales are usually made by contract.
    iii. Produce is normally purchase on a weekly basis.
    iv. Buyers require prompt, regular delivery and consistent quality.

3. What are the different ways to advertise?

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.

a. Newspapers
   i. Advantages
      1. Local newspapers are available in most communities.
      2. Businesses can reach many potential customers for relatively little cost.
      3. Papers do research that can help businesses appeal to readers.
      4. Businesses can create or change ads quickly.
      5. Newspaper ads can generate sales in a relatively short period of time.
   ii. Disadvantages
      1. Circulation may be wider than the target market, meaning the business pays to reach people who aren't interested.
      2. Many ads compete for the reader's attention.
      3. The production quality and appearance of ads are frequently low.
b. Billboards
   i. Advantages
      1. Billboards are a relatively inexpensive way to advertise.
      2. Billboards can be seen by potential customers 24 hours a day.
   ii. Disadvantages
      1. Customers only have a short period of time to read the ads.
      2. Billboards are regulated in some areas.
c. Direct mailing
   i. Advantages
      1. Ads can be sent out selectively to the target audience.
      2. There are many options for how ads can appear.
      3. Ads are not competing with other ads on the page.
   ii. Disadvantages
      1. Mailing lists must be current. Ads can annoy people who aren't interested in the product and waste the business's ad budget.
d. Radio
   i. Advantages
      1. Radio ads are typically inexpensive.
      2. Stations can help businesses gear ads toward listeners.
      3. Ads can reach listeners at home, work, or on the go.
   ii. Disadvantages
      1. It is easy for listeners to become distracted or ignore the ad.
      2. There is no visual image to appeal to customers.

e. Internet
   i. Advantages
      1. Advertisers can reach millions of potential customer at relatively low cost.
      2. Ads can have creative audio and visual appeal.
      3. Customers have access 24 hours a day, 7 days a week.
   ii. Disadvantages
      1. The site must be maintained.
      2. It can be difficult for customers to find the site among all of the Web sites available.

F. Other Activities

Call local radio stations and have students compare and contrast prices for radio ads.

G. Conclusion

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.

H. Answers to Activity Sheet

AS 2.1 Advertising a Product

Answers will vary.

I. Answers to Assessment

1. The potential market is all of the customers who might have interest in a particular product.
2. The target market is the customer base the company will serve.
3. Students should list three of the following answers.
   A. Age
   B. Income level
   C. Population of surrounding areas
   D. Location of residential areas
   E. Influx of travelers
4. Students should list one of the following answers.
   A. It is a low-cost way to sell fresh produce to a large number of customers within a short period of time.
   B. Farmers' markets provide an opportunity to network with other growers, widen the business's customer base, and develop marketing skills.
   C. Producers share the cost of advertising and promotion.
5. Community-supported agriculture is a partnership between a grower and individuals who become members by purchasing shares of the season's harvest.
6. Students should list three of the following answers.
   A. Pick-your-owns need less harvesting labor than traditional operations
   B. Growers must work long hours.
   C. Growers need additional liability insurance.
   D. There must be room for customer parking and traffic.
   E. The business must be accessible and close to a population that can support it.
   F. Growers and operators must be willing to work weekends.
   G. Image is important.
   H. Weather is a key factor; farmers rarely sell by pick-your-own alone.
7. Students should list three of the following answers.
   A. Local newspapers are available in most communities.
   B. Businesses can reach many potential customers for relatively little cost.
   C. Papers do research that can help businesses appeal to readers.
   D. Businesses can create or change ads quickly.
   E. Newspaper ads can generate sales in a relatively short period of time.
8. Students should list the following answers.
   A. It is easy for listeners to become distracted or ignore the ad.
   B. There is no visual image to appeal to customers.

Unit I: Fruit and Vegetable Production Name: _____

Lesson 2: Developing a Marketing Plan Date: _____

ASSESSMENT

Short-Answer Questions: Write the answers in the space provided.

1. What is a potential market?

2. What is a target market?

3. List three characteristics that should be considered when conducting market research to determine a target market.

   A.

   B.

   C.

4. What is an advantage of selling produce at farmers' markets?

5. What is community-supported agriculture (CSA)?

6. What are three characteristics to consider before starting a pick-your-own business?

   A.

   B.

   C.

7. What are three advantages of using newspapers as a method of advertising?

   A.

   B.

   C.

8. What are two disadvantages of using radio as a method of advertising?

   A.

   B.

Figure 2.1

Identifying a Market

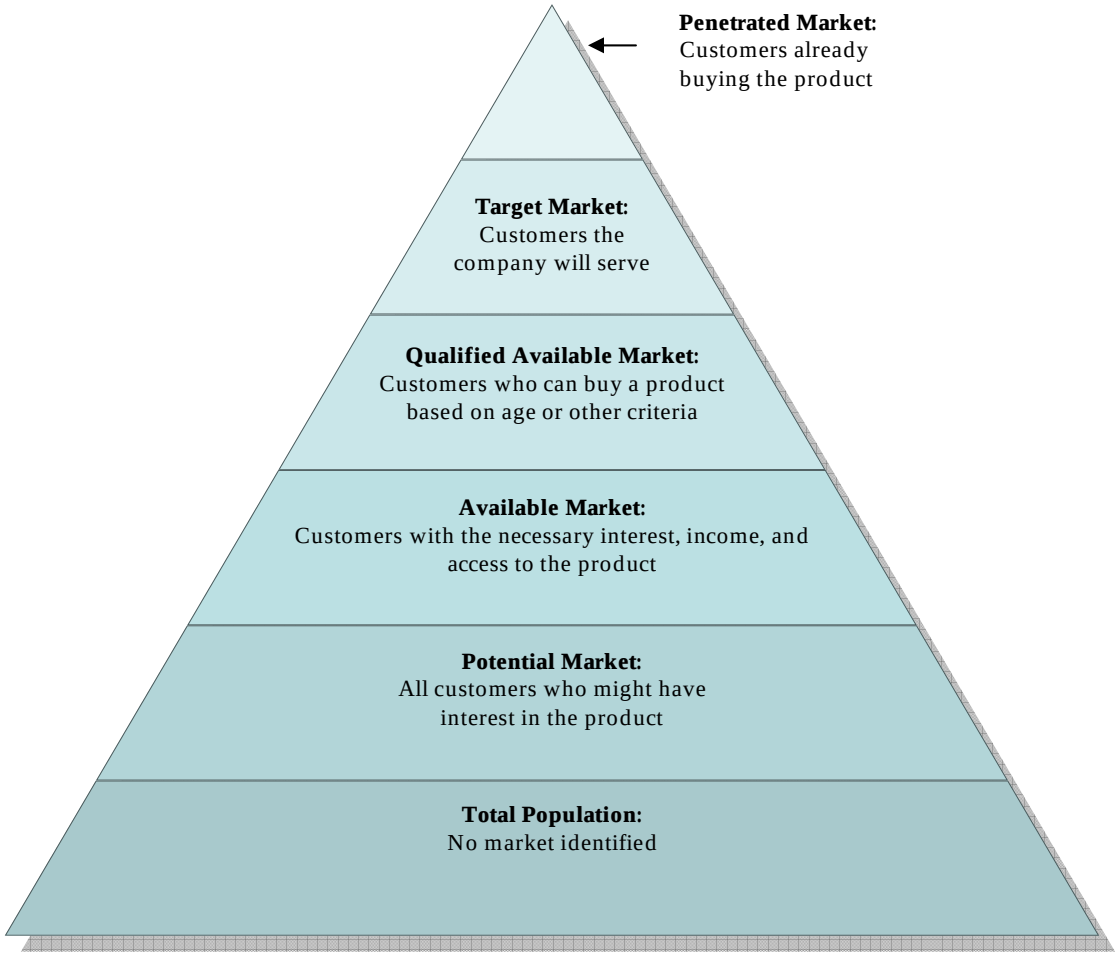


Figure 2.2

Characteristics of Many Successful Retail Produce Businesses

- 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.)

Unit I: Fruit and Vegetable Production **AS 2.1**

Lesson 2: Developing a Marketing Plan Name: _____

Advertising a Product

Objective: Advertise a product to create customer awareness.

Directions: Work individually. The maximum budget is $100.

1. Call three different newspapers in the area. Compare and contrast prices and sizes of ad space for each newspaper to get the most return for the amount spent. Use as much of the $100 as possible without exceeding the budget. Record findings in the space below.

2. Create a newspaper advertisement for a fruit or vegetable product using the information from question 1. Use the space below or a separate sheet of paper, as needed. Make sure to adhere to the size requirements of the newspaper. Remember to make the advertisement appealing to customers.

Fruit and Vegetable Production

Lesson 3: Site Evaluation

Competency/Objective

Classify characteristics of selecting and planning for fruit and vegetable production.

Study Questions

1. **What are soil considerations when evaluating a site?**

2. **What are topography considerations when evaluating a site?**

3. **What are accessibility considerations when evaluating a site?**

4. **What are climatic considerations when evaluating a site?**

5. **How do utilities affect evaluation of a site?**

6. **How does zoning affect evaluation of a site?**

7. **How does labor affect evaluation of a site?**

References and Materials

1. *Fruit and Vegetable Production Unit for Plant Science Core Curriculum* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2006.

2. Figures/Transparency Masters

   Fig. 3.1 Soil Texture Triangle
   Fig. 3.2 pH Scale
   Fig. 3.3 Essential Plant Nutrients
   Fig. 3.4 Spring Frost Dates
   Fig. 3.5 Fall Frost Dates

3. Activity Sheet

   AS 3.1 Evaluating a Possible Production Site

Teaching Procedures

A. Review

Lessons one and two outlined the importance of financial and market planning to fruit and vegetable operations. Lesson three looks at how to evaluate a site to determine if it is suitable for production. There are environmental and nonenvironmental factors to consider. Environmental factors include soil, topography, accessibility, and climate. Nonenvironmental factors include utilities, zoning, and labor.

B. Motivation

Ask students to think about building a house. What things should be considered before construction begins? Some examples would be land, location, zoning, electricity, water, and workers to build it. Then discuss how some of these concerns must also be evaluated before selecting a site for fruit and vegetable production.

C. Assignment

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students consider all the study questions before the discussion. Another option is to have students work in a cooperative learning environment by forming groups and assigning different study questions to each group.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. What are soil considerations when evaluating a site?

Ask students what they know about soil. During the discussion, help students relate what they know about soil to how it affects fruit and vegetable production. Refer to Figure 3.1 Soil Texture Triangle, Figure 3.2 pH Scale, and Figure 3.3 Essential Plant Nutrients.

a. Soil is a living, naturally occurring, dynamic system at the interface of air and rock.
    i. Soil forms when climate and organisms act on organic and geologic material in a specific landscape over time.
b. Soil texture refers to the percentage by weight of sand, silt, and clay in a soil.
    i. Ease of tilling and root development are influenced by soil texture.
    ii. Soil texture affects the amount of air and water the soil will hold and the rate of water movement through the soil.
    iii. Nutrient supplies are also affected by soil texture.
c. Soil pH measures the acidity and alkalinity of the soil.
    i. The pH scale ranges from 0 to 14, with 0 being the most acidic and 14 being the most alkaline or basic.
    ii. The pH value gives an estimate of the balance between the plant nutrient elements in the soil and other non-nutrient elements.
    iii. Soil pH affects available nutrient levels and should be monitored to reduce the likelihood of nutrient deficiencies.
d. There are nine essential macronutrients and eight essential micronutrients needed for plant growth.
    i. Macronutrients:
        1. Calcium (Ca)
        2. Magnesium (Mg)
        3. Potassium (K)
        4. Phosphorus (P)
        5. Sulfur (S)
        6. Nitrogen (N)
        7. Carbon (C)
        8. Hydrogen (H)
        9. Oxygen (O)
    ii. Micronutrients:
        1. Boron (B)
        2. Chlorine (Cl)
        3. Cobalt (Co)
        4. Iron (Fe)
        5. Manganese (Mn)
        6. Molybdenum (Mo)
        7. Zinc (Zn)
        8. Copper (Cu)

e. Fertile soil produces high-yielding, healthy crops. Soil fertility depends on the following:
   i. Nutrient balance and quantity
   ii. Soil texture
   iii. Soil structure
   iv. Rooting depth
   v. Organic matter content
   vi. Available water capacity
   vii. Aeration (porosity)
   viii. Length of growing season
   ix. Physical support
      1. Erosion control
      2. Good plant residue management
f. Soil testing is one of the best ways to evaluate soil.
   i. Soil testing can reveal the percentage of organic matter, pH, and available nutrients in soil.
   ii. Test results can be used to guide the application of fertilizer and soil amendments.
   iii. Soil testing can be used to monitor conditions and diagnose problems, which helps save time and money in the long run.

2. What are topography considerations when evaluating a site?

Ask students to explain what topography is. Why is topography an element considered in fruit and vegetable production?

a. Topography refers to the relative positions and elevations of the natural and fabricated features that describe the surface of an area. Topography affects the following:
   i. Soil condition
   ii. Types of plants that can grow well in the area
   iii. How accessible the area is for machinery
b. Topography determines how wind and water move toward, over, and away from the area. The interaction between topography, wind, and water influences the following:
   i. Soil erosion
   ii. Soil drainage
   iii. Water-holding capacity

3. What are accessibility considerations when evaluating a site?

Ask students what it means for an area to be accessible. Why would a production site need to be accessible? What are the different types of elements that might need to be present for a planting site?

a. Accessibility refers to how readily a site can be reached and used. Considerations include the following:
   i. Ease of getting into and out of the area with equipment and supplies to plant, maintain, and harvest the crop
   ii. Utilities, such as water and electricity
   iii. Existing roads
   iv. Roads that will need to be built
b. Pick-your-own and CSA farms must also be accessible to the public. Producers evaluating a site for these operations must plan on additional factors.
   i. Sufficient parking
   ii. Clear roads and trails
   iii. Barrier-free access to all services and facilities

4. What are climatic considerations when evaluating a site?

Ask students what type of climate zone they live in. Why is it important to know about the climate of an area? Can there be more than one climate in the same area? Refer to Figure 3.4 Spring Frost Dates and Figure 3.5 Fall Frost Dates.

a. 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. Principal atmospheric influences include the following:
   i. Temperature
   ii. Moisture
   iii. Wind
   iv. Pressure
   v. Evaporation
b. The climate helps determine what plants will thrive during the growing season.

c. Climate and region determine an area's frost dates.
    i. Frost dates are the estimated dates of the last frost in spring and the first frost in fall.
    ii. The time between frost dates is the growing season in which plants can reach maturity and produce fruits and vegetables that are ready to harvest.
    iii. Frost dates are based on historical data compiled by the USDA.
    iv. Frost dates are estimates only—earlier and later frosts can occur.
d. A microclimate is an area in which the climate is different from the area around it.
    i. Microclimates may be large or small.
    ii. They may be natural or caused by human construction or activity.
    iii. Producers can take advantage of microclimatic differences by the varieties of plants they choose and how they position their crops.

5. How do utilities affect evaluation of a site?

Ask students what utilities are. How are they used in everyday life? What possible uses would they have in fruit and vegetable production?

a. Utilities and services should be easily accessible.
    i. The distance from utilities will affect the cost of bringing them to the site.
    ii. Water should be available and plentiful, and water quality should also be considered.
    iii. Electricity may be needed, depending on the equipment used.

6. How does zoning affect evaluation of a site?

Ask students what they know about zoning issues. Does zoning change between communities? How do you find out about zoning regulations in your area?

a. Zoning controls the physical development of land and dictates the kinds of uses allowed on individual properties.
    i. Zoning laws determine where residential, industrial, recreational, and commercial activities can occur.
    ii. Local governments usually control zoning.
b. Check with the local zoning board about the regulations concerning the specific site before starting production.

7. How does labor affect evaluation of a site?

Ask students if they were going to start a fruit or vegetable production site how they would do it. How would they set out the plants? How would they gather the products? How would they maintain the production site? Will they need help?

a. Labor needs depend on the type, size, and scale of production.
   i. The producer should determine the availability of a labor force in the area.
   ii. Labor may be automated or done by hand.
      1. Hand labor is done by people working manually with crops.
      2. Automated labor is done by people operating machines.

F. Other Activities

1. Have students contact the local zoning board and find out about regulations in the area.

2. Ask a local producer to explain to the students what factors he or she considered before selecting a fruit or vegetable production site.

G. Conclusion

When considering a site for fruit and vegetable production, a number of environmental and nonenvironmental 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.

H. Answers to Activity Sheet

AS 3.1 Evaluating a Possible Production Site

Answers will vary.

I. Answers to Assessment

1. Students should list the following answers.
   A. Silt
   B. Clay
   C. Sand
2. The pH scale measures the acidity and alkalinity of the soil.
3. Students should list three of the following answers.
   A. Temperature
   B. Moisture
   C. Wind
   D. Pressure
   E. Evaporation
4. Producers can take advantage of microclimatic differences by the varieties of plants they choose and how they position their crops.
5. Zoning controls the physical development of land and dictates the kinds of uses allowed on individual properties. Zoning determines where residential, industrial, recreational, and commercial activities can occur.
6. Topography refers to the relative positions and elevations of the natural and fabricated features that describe the surface of an area.
7. Students should list three of the following answers.
   A. Soil condition
   B. Types of plants that can grow well in the area
   C. How accessible the area is for machinery
   D. Soil erosion
   E. Soil drainage
   F. Water-holding capacity

Unit I: Fruit and Vegetable Production Name: _____

Lesson 3: Site Evaluation Date: _____

ASSESSMENT

Short-Answer Questions: Write the answers in the space provided.

1. Soil texture refers to a soil's percentage by weight of what three components?

   A.

   B.

   C.

2. What does the pH scale measure?

3. What are three atmospheric influences that help determine climate?

   A.

   B.

   C.

4. How can producers use microclimates to their advantage?

5. Why is zoning a consideration in selecting a production site?

6. What is the definition of topography?

7. What are three things that topography can affect in a production site?

   A.

   B.

   C.

Figure 3.1

Soil Texture Triangle

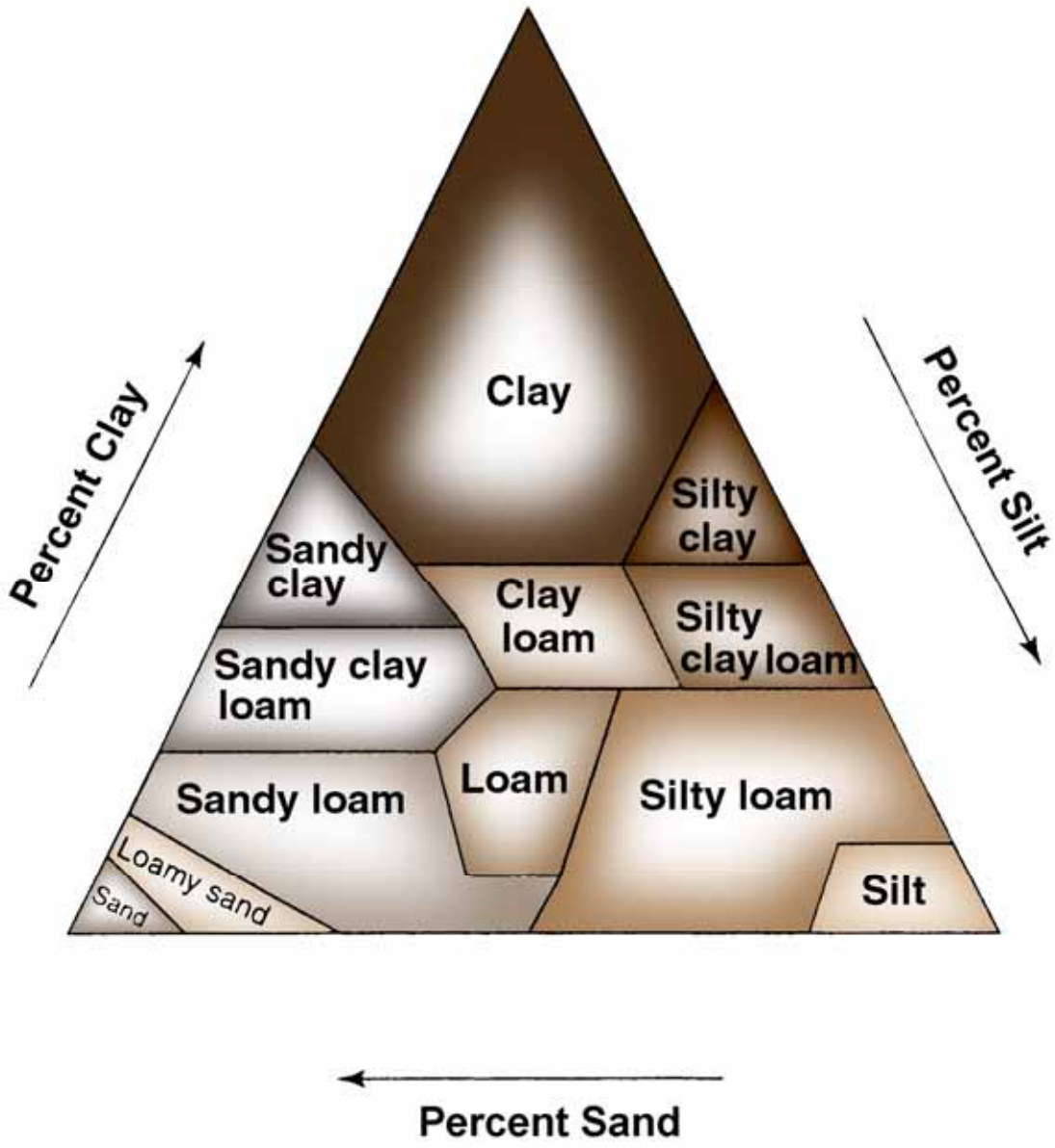


Figure 3.2

pH Scale

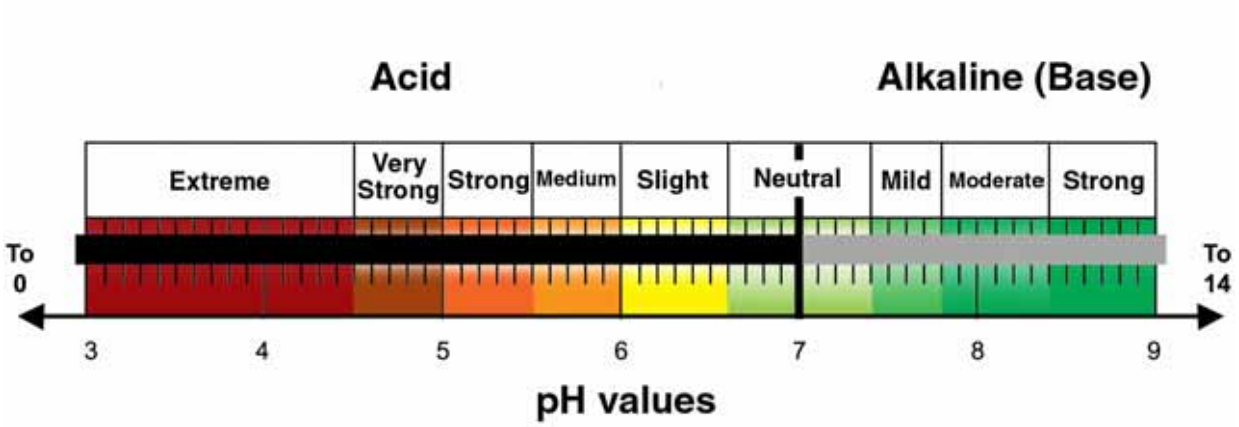


Figure 3.3

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

Figure 3.4

Spring Frost Dates

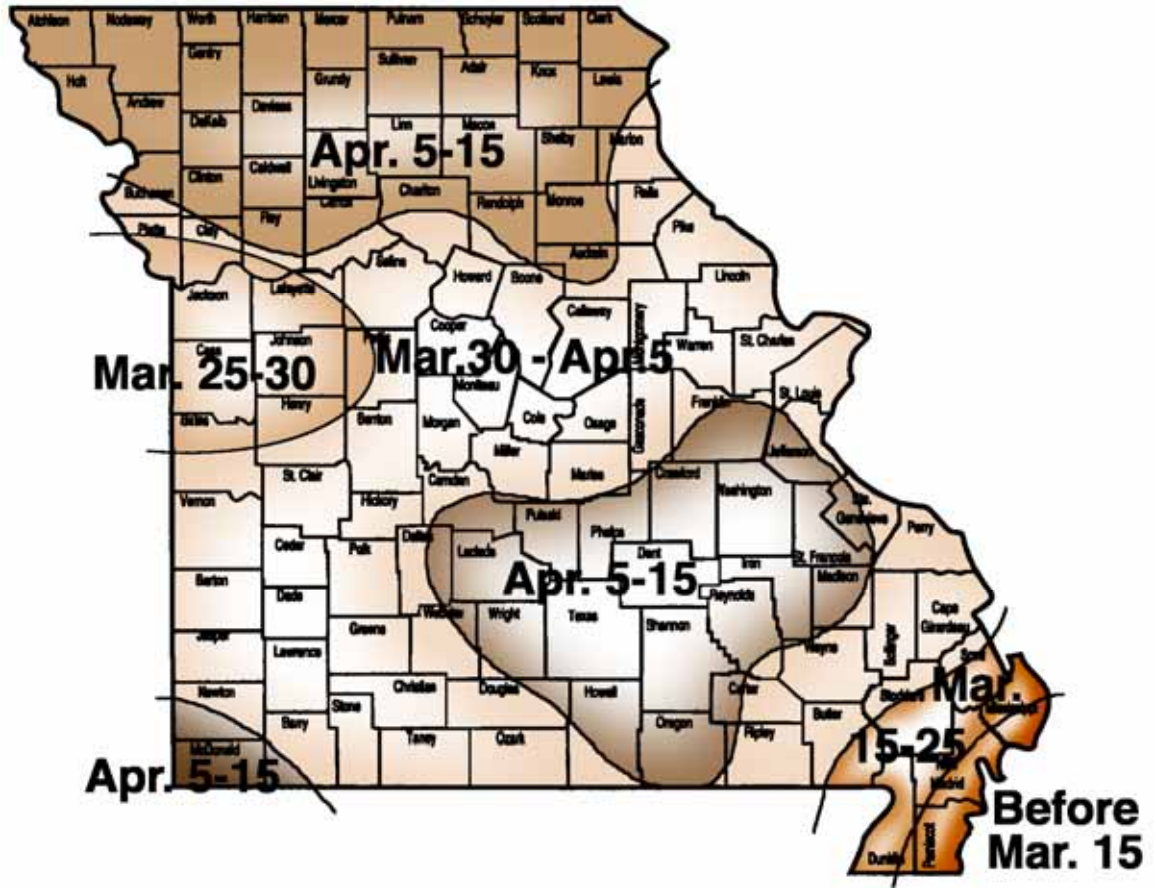
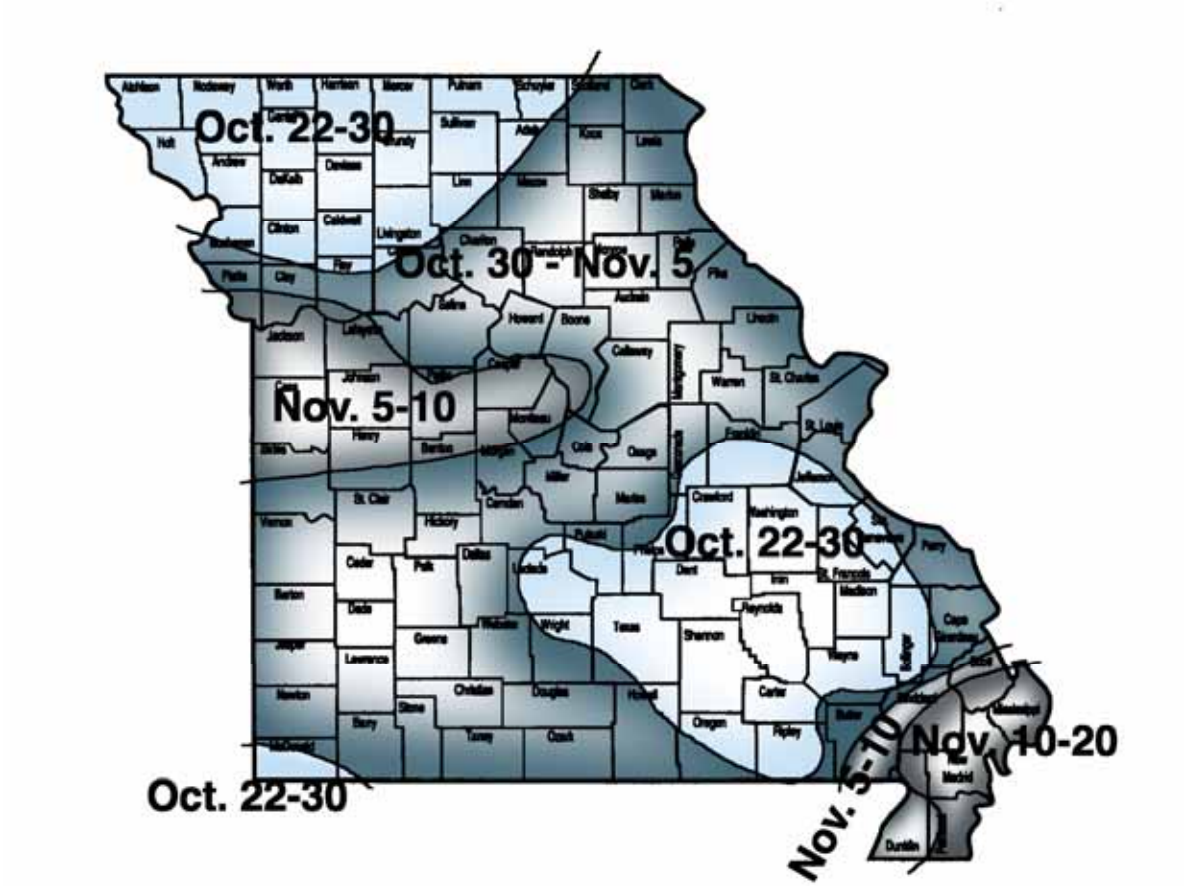


Figure 3.5

Fall Frost Dates



Unit I: Fruit and Vegetable Production **AS 3.1**

Lesson 3: Site Evaluation Name: _____

Evaluating a Possible Production Site

Objective: Identify a possible production site and evaluate it.

Directions: Work in small groups. Select a site for a possible fruit or vegetable production area. Evaluate the site based on the information discussed in the lesson. Answer the following questions about the site.

1. Where is the site located?

2. What are the dimensions of the site?

3. What crops would be best suited for the site?

4. Describe the appearance and texture of the soil.

5. Describe the topography of the area.

6. Is the area easily accessible? If so, how can the area be accessed? If not, what changes would be needed to provide better access to the site?

7. What is the climate of the area? Are there any microclimates in the site?

8. What utilities are available at the site? What additional utilities are needed?

9. Would this area be a good production site? Why or why not?

Fruit and Vegetable Production

Lesson 4: Integrated Pest Management

Competency/Objective

Explain management practices for pest control.

Study Questions

1. **What are the basic considerations of pest control?**

2. **What are biological pest management methods?**

3. **What are chemical pest management methods?**

4. **What are cultural pest management methods?**

5. **What are physical and mechanical pest management methods?**

6. **What is integrated pest management?**

References and Materials

1. *Fruit and Vegetable Production Unit for Plant Science Core Curriculum* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2006.

2. Figures / Transparency Masters

   Fig. 4.1 Pesticides for Specific Pests
   Fig. 4.2 Steps of Integrated Pest Management

3. Activity Sheet

   AS 4.1 Designing an IPM Strategy

Teaching Procedures

A. Review

Lesson three discussed evaluating a site. 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. This lesson covers systems of pest management.

B. Motivation

Show students a plant that has been damaged by pests. Have students discuss possible pest problems the plant might have and ways to prevent and treat the problems. Keep the plant for section F. Other Activity and discuss it again after students have completed the lesson.

C. Assignment

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students consider all the study questions before the discussion. Another option is to have students work in a cooperative learning environment by forming groups and assigning different study questions to each group.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. What are the basic considerations of pest control?

Introduce the topic of pest control and ask students to give examples of pest control strategies. Could a plant or insect be a pest in one situation and not in another?

a. Pests are plants, animals, or other organisms that occur where they are not wanted or where they can cause damage.

b. A pest control program should do the following:
   i. Protect crops from pests
   ii. Increase plant resistance to pests
   iii. Reduce or eliminate pest populations
c. There are four basic methods of pest control:
   i. Biological
   ii. Chemical
   iii. Cultural
   iv. Physical and mechanical

2. What are biological pest management methods?

a. Biological pest management is the use of living organisms to control pests. Examples include the following:
   i. Trap plants used to lure pests from crops
   ii. Natural predators and parasites used to reduce pests
b. Biological pest management is usually done in one or more of three ways:
   i. Conserving or encouraging species in the area that control the pests
   ii. Supplementing existing predator populations with additional members of the same species
   iii. Introducing new species to the environment specifically to control pests
c. Biological methods tend to take longer than other management methods and do not completely eliminate pests.

3. What are chemical pest management methods?

Refer to Figure 4.1 Pesticides for Specific Pests.

a. Chemical pest management is the use of chemicals to protect and treat plants and to repel or destroy pests.
b. Pesticides are the most common form of chemical pest management.
c. Pesticides can be a very useful tool in managing pest populations, but they do pose potential risks.
   i. Can present health risks to humans
   ii. Can cause damage to the environment
d. Pesticide use is monitored and regulated by various agencies, including the U. S. Environmental Protection Agency, which evaluates new pesticides and reviews old ones to determine that they can be used safely.
e. Growers should follow all directions and regulations regarding the proper use, handling, and storage of any pesticides they use.
f. Pests can develop resistance to chemicals over time, so using pesticides alone should not be the only method for treating pests.

g. Pesticides should be used only when necessary and at the lowest rate of application that will effectively control the pests. This is done for the following reasons:
   i. Reduce expense
   ii. Help prevent pests from becoming resistant
   iii. Lower health and environmental risks

4. What are cultural pest management methods?

a. Cultural pest management is controlling pests through the use of proper planting and growing techniques.
b. Cultural pest management works by optimizing conditions for crops while minimizing opportunities for pests.
c. Cultural management strategies have the advantage that many of them can be implemented before pests appear.
d. Examples of cultural pest management practices include the following:
   i. Choosing crop varieties suited to the area
   ii. Planting crops to optimize growing conditions and reduce plant stress
   iii. Providing adequate water and nutrients so plants resist disease and pests and outgrow weeds
   iv. Rotating crops
   v. Disposing of plant residue
   vi. Planting and harvesting to avoid coinciding with pests

5. What are physical and mechanical pest management methods?

a. Physical and mechanical pest management strategies use physical barriers and labor to prevent or limit pest damage. Examples of barriers and techniques include the following:
   i. Fencing
   ii. Traps
   iii. Row covers
   iv. Trenches
   v. Mowing
   vi. Plowing
   vii. Hand-picking insects off plants
   viii. Holding produce in cold storage to kill pests or slow or stop their development
b. Some physical and mechanical strategies, such as removing insects by hand, can require too much time and labor to be practical for larger operations.
c. The size of the operation and the availability of a labor force should be considered before using physical and mechanical management strategies.

6. What is integrated pest management?

Refer to Figure 4.2 Steps of Integrated Pest Management.

a. Integrated pest management (IPM) combines biological, chemical, cultural, and physical and mechanical strategies into a comprehensive system of pest control.
b. Integrated pest management programs have the following goals:
    i. Limit pests to acceptable levels
    ii. Promote healthy crops and good land management
    iii. Reduce reliance on pesticides
    iv. Promote long-term management strategies
    v. Improve health and safety for farm workers and consumers
    vi. Limit damage to the environment
c. Integrated pest management plans don't try to eliminate all pests—small pest populations are left to support predators and parasites utilized for biological control.
d. The key to IPM is knowing the action threshold (also called the economic threshold)—the point at which the cost of damage is greater than the cost of controlling the pests.
e. There are a number of factors that should be considered when determining the action threshold:
    i. Level of damage and infestation
    ii. Market price
    iii. Stage of crop growth
    iv. Cost of pesticides
f. A successful IPM strategy requires a thorough understanding of the following factors:
    i. Crops to be grown
    ii. Potential pests and their enemies
    iii. Surrounding environment
    iv. How these elements interact
g. Monitoring the site for pest activity is critical for the IPM strategy to succeed.
h. By utilizing a variety of control methods, IPM reduces the likelihood that pests will adapt to one particular strategy.

F. Other Activities

Revisit the motivation activity in which students examined a plant damaged by pests. Have students separate into small groups and discuss ways to prevent or treat the problem using an integrated pest management strategy. Have the groups present their strategies to the class.

G. Conclusion

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.

H. Answers to Activity Sheet

AS 4.1 Designing an IPM Strategy

Answers will vary.

I. Answers to Assessment

1. Biological pest management is the use of living organisms to control pests.
2. Students should list four of the following answers.
   A. Fencing
   B. Traps
   C. Row covers
   D. Trenches
   E. Mowing
   F. Plowing
   G. Hand-picking insects off plants
   H. Holding produce in cold storage to kill pests or slow or stop their development
3. Integrated pest management (IPM) combines biological, chemical, cultural, and physical and mechanical strategies into a comprehensive system of pest control.
4. Students should list three of the following answers.
   A. Limit pests to acceptable levels
   B. Promote healthy crops and good land management
   C. Reduce reliance on pesticides
   D. Promote long-term management strategies
   E. Improve health and safety for farm workers and consumers
   F. Limit damage to the environment
5. Students should list three of the following answers.
   A. Level of damage and infestation
   B. Market price
   C. Stage of crop growth
   D. Cost of pesticides

Unit I: Fruit and Vegetable Production Name: _____

Lesson 4: Integrated Pest Management Date: _____

ASSESSMENT

Short-Answer Questions: Write the answers in the space provided.

1. What is biological pest management?

2. List four examples of physical or mechanical pest management strategies.

   A.

   B.

   C.

   D.

3. What is integrated pest management (IPM)?

4. Identify three goals of integrated pest management.

   A.

   B.

   C.

5. Identify three factors to consider when determining the action threshold in an integrated pest management strategy.

   A.

   B.

   C.

Figure 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

Figure 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.

Unit I: Fruit and Vegetable Production **AS 4.1**

Lesson 4: Integrated Pest Management Name: _____

Designing an IPM Strategy

Objective: Design an IPM strategy for a garden.

Directions: Work in small groups to create an integrated pest management strategy for a 10 ft x 10 ft tomato garden using all four methods of pest control: biological, chemical, cultural, and physical and mechanical. Use Table 4.2 Steps of Integrated Pest Management in lesson four to guide your plan. Choose one of the 10 pests below to help focus your plan.

- Birds
- Cutworms
- Flea beetles
- Hornworms
- Leaf miners
- Spider mites
- Stalk borers
- Stink bugs
- Tomato fruit worms
- Turtles

Fruit and Vegetable Production

Lesson 5: Vegetable Production

Competency/Objective

Identify characteristics of cool season, long season, and warm season vegetable crops.

Study Questions

1. **What are plant considerations in vegetable production?**
2. **What are cool season crops?**
3. **What are warm season crops?**
4. **What are long season crops?**
5. **What are the components of the vegetable charts and what do they mean?**
6. **What are the important production characteristics of individual vegetable crops?**

References and Materials

1. *Fruit and Vegetable Production Unit for Plant Science Core Curriculum* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2006.
2. Figures / Transparency Masters

   Fig. 5.1 Sample Vegetable Chart
3. Activity Sheet

   AS 5.1 Exploring a Vegetable Crop

Teaching Procedures

A. Review

Lesson four discussed the basic methods of pest management and the general steps and benefits of an integrated pest management strategy. This lesson covers cool, warm, and long season crops and important aspects of vegetable production.

B. Motivation

Ask students to picture a grocery store produce aisle. What do they see? How are the various crops produced? How do the plants grow?

C. Assignment

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students consider all the study questions before the discussion. Another option is to have students work in a cooperative learning environment by forming groups and assigning different study questions to each group.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. What are plant considerations in vegetable production?

Ask students what they know about vegetable production. What are some things that need to be considered? Why are these things important?

a. The term vegetable is generally used to refer to the edible portion of herbaceous (nonwoody) plants—the roots, stems, leaves, flowers, or fruit.
b. Different varieties and hybrids of vegetables offer certain desirable characteristics, such as good size, flavor, and appearance and resistance to certain pests and diseases.

i. Variety: plant that occurs naturally or through cultivation and differs from other members of its species by one or more characteristics
ii. Hybrid: plant that results from interbreeding two distinct cultivars, varieties, or species

2. What are cool season crops?

Ask students to explain what cool season crops are. Why is it important to know about cool season crops?

a. A cool season crop is a crop that grows best during the cool temperatures of fall and spring.
   i. Cool season crops prefer temperature between 50°F and 70°F.
   ii. They are very tolerant of cold weather and can usually stand a light frost.
   iii. Examples: beets, carrots, potatoes, cabbage, and cauliflower
   iv. Two primary types of cool season crops are root crops and surface crops.
      1. Root crops: vegetables that are primarily cultivated for their edible roots, tubers, or modified stems, which grow below ground
      2. Surface crops: vegetables that are grown for edible parts—leaves, flowers, and "fruits"—that grow above ground

3. What are warm season crops?

Ask students what vegetables are considered warm season crops. Why are these crops considered warm season crops?

a. 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.
   i. Warm season crops should only be planted when soil temperature is warm enough to induce sprouting.
   ii. Examples: tomatoes, eggplants, and corn

4. What are long season crops?

Ask students what vegetables are considered long season crops. Why are these crops considered long season crops?

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

5. What are the components of the vegetable charts and what do they mean?

Ask students what they would need to know about a specific crop if they were going to grow it. How could knowing this information help them with production? Refer to Figure 5.1 Sample Vegetable Chart.

a. Different types of vegetables will be discussed in this lesson using a chart format. Vegetable chart components are discussed below.
   i. **Days to Germination:** The days to germination is an estimated number of days before a plant will begin to grow and sprout.
   ii. **Days to Maturity:** The days to maturity is the estimated number of days from planting until a usable or salable product can be harvested.
   iii. **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.
   iv. **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.
   v. **Harvest:** The harvest section provides general guidelines to help determine when the crop is ready to be harvested and how to harvest the crop.
   vi. **Postharvest:** Proper storage and handling procedures are listed in the postharvest portion of the chart.
   vii. **Production Concerns:** Crop-specific information to facilitate proper growth and production is supplied in the production concerns section.
   viii. **Pests and Diseases:** This section lists common pests and diseases that affect the specific crop.
   ix. **Other Considerations:** This heading provides a place to include crop-specific concerns that are not associated with other areas of the chart.

6. What are the important production characteristics of individual vegetable crops?

Ask students what vegetable crops grow in the area. What types of vegetable crops have students grown?

a. The instructor should choose vegetable charts to discuss in class from those provided or use blank charts to develop charts for other crops as needed.
b. The instructor should distribute blank charts to students to fill out during class discussion or as part of their assigned work.
c. Charts for the following vegetables are included with this unit. A blank chart for student charts and other vegetables is included with each group.

i. Cool season root crops
    1. Beets
    2. Carrots
    3. Potatoes
    4. Radishes
    5. Turnips
    6. Others
ii. Cool season surface crops
    1. Asparagus
    2. Cabbage
    3. Cauliflower
    4. Lettuce
    5. Spinach
    6. Others
iii. Warm season crops
    1. Cucumbers
    2. Eggplants
    3. Green beans
    4. Okra
    5. Peppers
    6. Summer squash
    7. Sweet corn
    8. Tomatoes
    9. Others
iv. Long season crops
    1. Cantaloupes
    2. Gourds
    3. Pumpkins
    4. Watermelons
    5. Winter squash
    6. Others

F. Other Activities

1. Have students plant 10 vegetable seeds each and monitor them. Have students record the days the seeds germinate and the germination rate.

2. Start a production site where students can watch and identify the different types of vegetables as they mature.

3. Have samples of each of the different crops studied in class for the students to see and taste.

G. Conclusion

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.

H. Answers to Activity Sheet

AS 5.1 Exploring a Vegetable Crop

Answers will vary.

I. Answers to Assessment

1. Students should provide the following answers.
   A. Days to Germination: The days to germination is an estimated number of days before a plant will begin to grow and sprout.
   B. Days to Maturity: The days to maturity is the estimated number of days from planting until a usable or salable product can be harvested.
   C. 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.
   D. 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.
   E. Harvest: The harvest section provides general guidelines to help determine when the crop is ready to be harvested and how to harvest the crop.
   F. Postharvest: Proper storage and handling procedures are listed in the postharvest portion of the chart.
   G. Production Concerns: Crop-specific information to facilitate proper growth and production is supplied in the production concerns section.
   H. Pests and Diseases: This section lists common pests and diseases that affect the specific crop.
   I. Other Considerations: This heading provides a place to include crop-specific concerns that are not associated with other areas of the chart.

2. Students should provide two of the following answers.
   A. Good size
   B. Good flavor
   C. Good appearance
   D. Resistance to certain pests
   E. Resistance to certain diseases
3. A cool season crop is a crop that grows best during the cool temperatures of fall and spring.
4. Students should provide two of the following answers.
   A. Beets
   B. Carrots
   C. Potatoes
   D. Radishes
   E. Turnips
   F. Asparagus
   G. Cabbage
   H. Cauliflower
   I. Lettuce
   J. Spinach
5. Long season crops are vegetables that require a relatively long growing season to mature compared to other plants.
6. Students should provide two of the following answers.
   A. Cantaloupes
   B. Gourds
   C. Pumpkins
   D. Watermelons
   E. Winter squash
7. 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.
8. Students should provide two of the following answers.
   A. Cucumbers
   B. Eggplants
   C. Green beans
   D. Okra
   E. Peppers
   F. Summer squash
   G. Sweet corn
   H. Tomatoes

Unit I: Fruit and Vegetable Production Name: _____

Lesson 5: Vegetable Production Date: _____

ASSESSMENT

Short-Answer Questions: Write the answers in the space provided.

1. Explain what information would be found under each heading of the vegetable chart.

   A. Days to Germination:

   B. Days to Maturity:

   C. Soil:

   D. Spacing:

   E. Harvest:

   F. Postharvest:

G. Production Concerns:

H. Pests and Diseases:

I. Other Considerations:

2. What are two advantages that a variety or hybrid can offer?

   A.

   B.

3. What is a cool season crop?

4. What are two examples of cool season crops?

   A.

   B.

5. What is a long season crop?

6. What are two examples of long season crops?

   A.

   B.

7. What is a warm season crop?

8. What are two examples of warm season crops?

   A.

   B.

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	

Unit I: Fruit and Vegetable Production **AS 5.1**

Lesson 5: Vegetable Production Name: _____

Exploring a Vegetable Crop

Objective: Identify key growing elements for a vegetable crop.

Directions: Each student will receive a blank vegetable chart. The instructor will assign each student a vegetable to research. Students will complete the chart for their assigned vegetable. Textbooks, seed catalogs, magazines, the Internet, and other sources may be used as references. After the chart is completed, students will present their findings to the class. Students will turn in their completed chart and a bibliography of their sources following their presentations.

Fruit and Vegetable Production

Lesson 6: Fruit Production

Competency/Objective

Identify characteristics of small fruits and tree fruits.

Study Questions

1. **What are plant considerations in fruit production?**
2. **What are small fruits?**
3. **What are tree fruits?**
4. **How are fruit trees produced?**
5. **What are the types of fruit trees?**
6. **What are the components of the fruit charts and what do they mean?**
7. **What are the important production characteristics of individual fruit crops?**

References and Materials

1. *Fruit and Vegetable Production Unit for Plant Science Core Curriculum* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2006.

2. Figures / Transparency Masters

   Fig. 6.1 Whip Grafting
   Fig. 6.2 Sample Fruit Chart

3. Activity Sheet

   AS 6.1 Exploring a Fruit Crop

Teaching Procedures

A. Review

Lesson five discussed cool, warm, and long season crops and key aspects of vegetable production. Lesson six will introduce students to small fruits, tree fruits, and various elements of fruit production.

B. Motivation

Ask students to use a phone book to identify fruit producers in the area. Ask them what types of fruit are produced in the area. Where are these fruits sold?

C. Assignment

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students consider all the study questions before the discussion. Another option is to have students work in a cooperative learning environment by forming groups and assigning different study questions to each group.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. What are plant considerations in fruit production?

Ask students what they know about fruit production. What are some things that need to be considered? Why are those things important?

a. Fruits are the matured ovaries of flowering plants that contain the seeds of the plant.
b. A fruit crop is a perennial crop that produces true (botanical) fruit that is edible and of economic value.

c. Different varieties and hybrids of fruits offer certain desirable characteristics, such as good size, flavor, and appearance and resistance to certain pests and diseases.
   i. Variety: a plant that occurs naturally or through cultivation and differs from other members of its species by one or more characteristics
   ii. Hybrid: a plant that results from interbreeding two distinct cultivars, varieties, or species
d. Qualities such as size, flavor, and appearance are especially important when choosing fruit crops because these traits play a large role in appealing to customers.

2. What are small fruits?

Ask students to explain what small fruits are. Why are small fruits important in fruit production?

a. Small fruit crops produce small, soft fruit, usually on vines, plants, or shrubs.
   i. Small fruits are not all in the same botanical family.
   ii. They require little space relative to the amount of fruit they produce.
   iii. Small fruit crops typically bear fruit one or two years after planting.
   iv. Pests are generally easier to control than on tree fruits.
   v. Examples: blackberries, blueberries, grapes, raspberries, strawberries

3. What are tree fruits?

Ask students what fruit trees they have seen in the area. Why would someone grow fruit trees?

a. Tree fruits are edible fruit crops that grow on trees.
   i. Trees are woody plants that usually have a single main trunk and produce new growth in the branches of their canopy.
      1. Trees are distinct from shrubs, which typically have several stems instead of a single trunk and produce new growth from the ground.
      2. The growth pattern of trees makes them well suited to grafting.

4. How are fruit trees produced?

Ask students if they know how most fruit trees are produced. What is grafting? Why is grafting important? Refer to Figure 6.1 Whip Grafting.

a. 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.
    i. 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.
    ii. Grafting allows the grower to combine the best traits of multiple plants and produce a better product.

5. What are the types of fruit trees?

Ask students if they know what the different types of fruit trees are. What are pome fruit trees? What are stone fruit trees? What are nut trees? Why is a nut considered a fruit?

a. Pome fruits
    i. Pome fruits are members of the Pomoideae subfamily of the family Rosaceae.
    ii. The fruit, a pome, forms from a flower with an inferior, compound ovary.
    iii. The edible portion that surrounds the seeds is formed by the nonovarian parts of the flower.
    iv. Pome fruits are generally well adapted to cool, temperate climates.
    v. They typically have a long storage life if proper conditions are provided.
    vi. Examples: apples and pears
b. Stone fruits
    i. Stone fruits are members of the subfamily Prunoideae of the family Rosaceae.
    ii. The fruit, a drupe, forms from a flower with a superior, simple ovary.
    iii. The common name comes from the hard pit or “stone” in the center of the fruit.
    iv. The stone is a specialized layer of ovary tissue called an endocarp that surrounds the seed.
    v. Most stone fruits are native to warmer climates.
        1. They are very susceptible to injury from low winter temperatures.
        2. Stone fruits bloom early in the spring, which makes their flowers vulnerable to damage from spring frosts.
    vi. Stone fruits are extremely perishable and have a very limited storage life.
    vii. Examples: cherries, peaches, and plums

c. Nuts
   i. 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.
   ii. Indehiscent means that the fruit does not open when it ripens.
   iii. Nut crops are not all in the same botanical family, but they do have similar processing requirements, such as hulling and drying.
   iv. They are typically high in protein and low in saturated fats.
   v. 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.
   vi. Examples: black walnuts, Chinese chestnuts, and northern pecans

6. What are the components of the fruit charts and what do they mean?

Ask students what they would need to know about a specific crop if they were going to grow it. How could knowing this information help them with production? Refer to Figure 6.2 Sample Fruit Chart.

a. Different types of fruits will be discussed in this lesson using a chart format. Fruit chart components are discussed below.
   i. **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.
   ii. **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.
   iii. **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.
   iv. **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.
   v. **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.
   vi. **Postharvest:** Proper storage and handling procedures are listed in the postharvest portion of the chart.
   vii. **Production Concerns:** Crop-specific information to facilitate proper growth and production is supplied in the production concerns section.
   viii. **Pests and Diseases:** This section lists common pests and diseases that affect the specific crop.

ix. **Structures and Equipment:** This section provides a guide to what structures and equipment are needed for proper growth and production.
x. **Other Considerations:** This heading provides a place to include crop-specific concerns that are not associated with other areas of the chart.

7. What are the important production characteristics of individual fruit crops?

Ask students what fruit crops grow in the area. What types of fruit crops have students grown?

a. The instructor should choose fruit charts to discuss in class from those provided or use blank charts to develop charts for other crops as needed.
b. The instructor should distribute blank charts to students to fill out during class discussion or as part of their assigned work.
c. Charts for the following fruits are included with this unit. A blank chart for student charts and other fruits is included with each group.
    i. Small fruits
        1. Blackberries
        2. Blueberries
        3. Grapes
        4. Raspberries
        5. Strawberries
        6. Others
    ii. Pome fruit trees
        1. Apples
        2. Pears
        3. Others
    iii. Stone fruit trees
        1. Cherries
        2. Peaches
        3. Plums
        4. Others
    iv. Nut trees
        1. Black walnuts
        2. Chinese chestnuts
        3. Northern pecans
        4. Others

F. Other Activities

1. Have samples of each of the different crops studied in class for the students to see and taste.

2. Have examples of different fruits and ask the students to identify them as pome or stone fruits.

G. Conclusion

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.

H. Answers to Activity Sheet

AS 6.1 Exploring a Fruit Crop

Answers will vary.

I. Answers to Assessment

1. Fruits are the matured ovaries of flowering plants that contain the seeds of the plant.
2. Students should list the following types of tree fruits. Examples of each type will vary.
   A. Pome fruits
      1. Apples
      2. Pears
   B. Stone fruits
      1. Cherries
      2. Peaches
      3. Plums
   C. Nuts
      1. Black walnuts
      2. Chinese chestnuts
      3. Northern pecans

3. Students should provide three of the following answers.
   A. Blackberries
   B. Blueberries
   C. Grapes
   D. Raspberries
   E. Strawberries
4. Students should provide two of the following answers.
   A. Small fruits require little space relative to the amount of fruit they produce.
   B. Crops typically bear fruit one or two years after planting.
   C. Pests are generally easier to control on small fruits than they are on most tree fruits.
5. Size and appearance are especially important when choosing fruit crops because these qualities play a large role in appealing to customers.
6. 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.

Unit I: Fruit and Vegetable Production Name: _____

Lesson 6: Fruit Production Date: _____

ASSESSMENT

Short-Answer Questions: Write the answers in the space provided.

1. What is a fruit?

2. List the three types of tree fruits and an example of each.

   A.

   B.

   C.

3. List three different small fruits.

   A.

   B.

   C.

4. What are two advantages of producing small fruits compared to tree fruits?

   A.

   B.

5. Why are qualities such as size and appearance especially important when choosing fruit crops?

6. What is grafting?

Figure 6.1

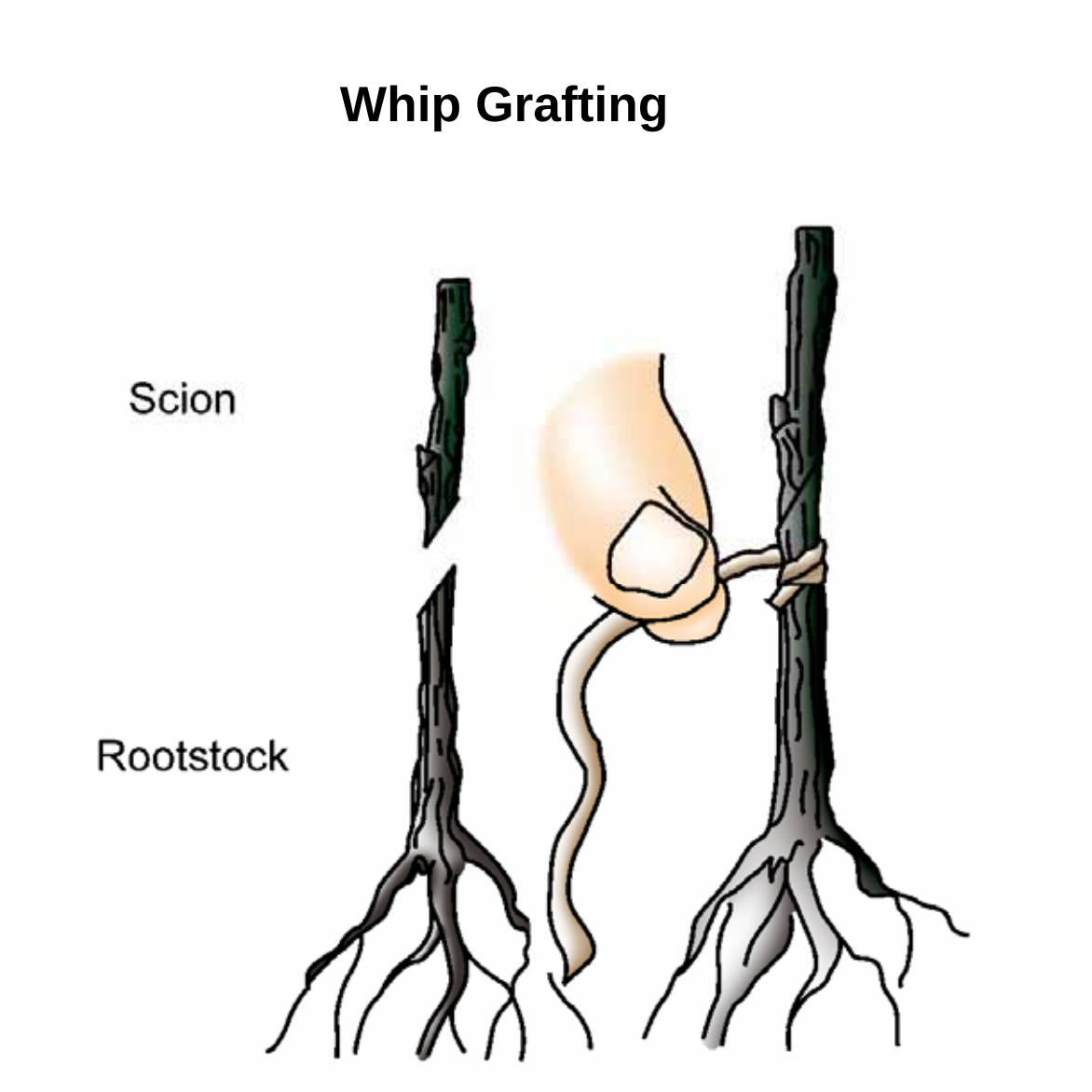


Figure 6.2

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	

Unit I: Fruit and Vegetable Production **AS 6.1**

Lesson 6: Fruit Production Name: _____

Exploring a Fruit Crop

Objective: Identify key growing elements for a fruit crop.

Directions: Each student will receive a blank fruit chart. The instructor will assign each student a fruit to research. Students will complete the chart for the assigned fruit. Textbooks, seed catalogs, magazines, the Internet, and other sources may be used as references. After the chart is completed, students will present their findings to the class. Students will turn in their completed chart and a bibliography of their sources following their presentations.

Fruit and Vegetable Production

Unit Activity: Developing a production calendar

Unit Objective:

Students will demonstrate their knowledge of production requirements for fruits and vegetables by developing a calendar for cultivating and harvesting 10 fruits and vegetables.

Show-Me Standards: 1.2, CA 3

Reference:

Fruit and Vegetable Production Unit for Plant Science Core Curriculum. University of Missouri-Columbia: Instructional Materials Laboratory, 2006.

Students may use additional outside sources to complete this activity (e.g., seed catalogs or gardening magazines).

Instructional Strategies/Activities:

- Students will engage in study questions in lessons 1 through 6.
- Students will complete AS 1.1, Distinguishing Between Receipts and Expenditures; AS 3.1, Evaluating a Possible Production Site; AS 4.1, Designing an IPM Strategy; AS 5.1, Exploring a Vegetable Crop; and AS 6.1, Exploring a Fruit Crop.
- Additional activities that relate to the unit objective can be found under the heading "Other Activities" in the following locations: p. 4, p. 33, p. 53, and p. 67.

Performance-Based Assessment:

Students will develop a yearlong calendar for establishing, maintaining, and harvesting 10 different fruits and vegetables. A real calendar or a different format, determined by the student, may be used for this activity. The calendar should include a combination of both fruits and vegetables.

Students will be assessed based on the overall presentation and content of their calendar.

Instructor Guide

The instructor should assign the unit-level performance-based assessment activity at the beginning of the unit. Students will work toward completing the activity as they progress through the unit lessons. The assessment activity will be due at the completion of the unit.

1. Assign each student to develop a yearlong calendar for establishing, maintaining, and harvesting 10 different fruits and vegetables.
   a. Students may use the information in their student reference or other reliable information they might acquire. They may not use the source information word for word and must provide a complete bibliography of their sources along with their calendar.
   b. The calendar must include a combination of 10 different fruits and vegetables.
   c. Special consideration should be given to certain crops because they may not be ready for harvest during that calendar year (e.g., seedling asparagus plants).

2. The students may be creative in the layout of their project as long as it is useful and easy to follow. An actual calendar may be used or a chart or diagram.

3. The calendar must include the following information and dates for each fruit or vegetable.
   - ❑ When and how to establish the ground prior to planting
   - ❑ When the plants should be planted
   - ❑ When and how to maintain the plants and soil prior to planting, during growth, and after harvesting
   - ❑ When and how to harvest the fruits and vegetables
   - ❑ Any other necessary practices that should be noted

4. Students will be assessed on the overall content and presentation of their calendar.

Student Handout

1. Develop a yearlong calendar for establishing, maintaining, and harvesting 10 different fruits and vegetables.
   a. You may use the information in the student reference or other reliable information you might acquire. You may not use the source information word for word and must provide a complete bibliography of the sources along with your calendar.
   b. The calendar must include a combination of 10 different fruits and vegetables.
   c. Special consideration should be given to certain crops because they may not be ready for harvest during that calendar year (e.g., seedling asparagus plants).

2. You may be creative in the layout of the project as long as it is useful and easy to follow. An actual calendar may be used or a chart or diagram.

3. The calendar must include the following information and dates for each fruit or vegetable.
   - ❑ When and how to establish the ground prior to planting
   - ❑ When the plants should be planted
   - ❑ When and how to maintain the plants and soil prior to planting, during growth, and after harvesting
   - ❑ When and how to harvest the fruits and vegetables
   - ❑ Any other necessary practices that should be noted

4. Students will be assessed on the overall content and presentation of their calendar.

Fruit and Vegetable Production

Scoring Guide **Name** _____

Assessment Area	Criteria	0 Points	1 Point	2 Points	3 Points	4 Points	Weight	Total
Information and Content of Calendar	❑ All facts are accurate ❑ Practices are sound ❑ Addresses all key topics ❑ Facts or practices are listed in proper order	0 criteria met	1 criterion met	2 criteria met	3 criteria met	All 4 criteria met	X 20	
Presentation	❑ Well organized ❑ Useful format ❑ Neat ❑ No spelling or punctuation errors	0 criteria met	1 criterion met	2 criteria met	3 criteria met	All 4 criteria met	X 5	
TOTAL								

Final Assessment Total _____/100 pts.

Comments:

Nut Trees

Black Walnuts

Interval From Planting to Fruiting	• Grafted trees: 5 years to first nut production; 10 years to commercial production • Seedling trees: 10 years to first nut production; up to 20 years for commercial production
Season of Ripening	• Mid September to late October, depending on cultivar
Soil	• pH: 6.5 to 7.5 • Well-drained soil
Spacing	• Between trees: 30 ft • Between rows: 30 ft
Harvest	• Harvest walnuts when the hull is green and can be indented with the thumb.
Postharvest	• Hull and wash walnuts immediately upon harvest. Dry hulled nuts at ambient temperature for 4 to 6 weeks before cracking. • After cracking, allow nuts to dry for a day or two before refrigerating. • Frozen nuts can last up to two years.
Production Concerns	• Hull and clean walnuts while husks are still green. • Allowing nuts to remain in the husk degrades nut quality.
Pests and Diseases	• Pests: weevil, nut casebearer • Diseases: anthracnose leaf disease
Structures and Equipment	• Stake grafted trees when young. Protect young trees from deer browse and deer rub. • Tree shakers and hullers are used in commercial production.
Other Considerations	• Use space between rows for grasses, winter wheat, vegetables, blackberries, blueberries, or raspberries.

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Nut Trees

Chinese Chestnuts

Interval From Planting to Fruiting	• Grafted trees: 3 years to first nut production; 6 to 9 years to commercial production • Seedling trees: 5 years to first nut production; 8 to 12 years for commercial production
Season of Ripening	• Mid September to mid October, depending on cultivar
Soil	• pH: 5.5 to 6.5 • Well-drained, loamy to sandy loam soils
Spacing	• Between trees: 35 ft • Between rows: 35 ft
Harvest	• Chestnuts are gathered from the ground after they have fallen naturally off the tree. • Harvest nuts every day to prevent molding and decay.
Postharvest	• Store chestnuts at 32°F in sealed plastic bags to retard molding. • If weevils are present, harvest chestnuts promptly, follow with hot water treatment (122°F for 30 minutes), and refrigerate immediately to kill immature larvae and prevent weevil emergence.
Production Concerns	• Train trees using a modified central leader system. • Ensuring that trees have adequate water promotes growth and reduces stress, particularly in the first year.
Pests and Diseases	• Pests: rabbits, voles, deer, yellowneck caterpillars, weevils, nut curculios • Diseases: chestnut blight, Phytophthora root rot
Structures and Equipment	• Stake grafted trees when young. • Protect young trees from deer browse and deer rub.
Other Considerations	• Young trees must be protected from sunscald.

Chinese Chestnuts. University of Kentucky Cooperative Extension Service. http://www.uky.edu/Ag/NewCrops/introsheets/chestnuts.pdf (accessed December 20, 2005).

Hunt, K., M. Gold, W. Reid, and M. Warmund. *Growing Chinese Chestnuts in Missouri.* University of Missouri Center for Agroforestry. http://extension.missouri.edu/explorepdf/agguides/agroforestry/af1007.pdf (accessed December 20, 2005).

"Pests and Disease." Empire Chestnut Company. http://www.empirechestnut.com/faqpests.htm (accessed December 20, 2005).

Rieger, M. "Chestnuts." Mark Rieger's Fruit Crop Home Page. University of Georgia Department of Horticulture. http://www.uga.edu/fruit/chestnut.htm (accessed May 3, 2006).

Nut Trees

Northern Pecans

Interval From Planting to Fruiting	• Grafted cultivars require 10 to 13 years to produce 5 pounds of nuts per tree, or approximately 250 pounds per acre.
Season of Ripening	• Mid September to late October, depending on cultivar
Soil	• pH: 6.0 to 7.5 • Deep, well-drained soil
Spacing	• Between trees: 40 ft • Between rows: 40 ft
Harvest	• As pecans dry, their shuck turns brownish black and curls away from the shell. • Pecans are fully dry and ready to harvest when they fall from the trees. When the first pecans begin falling, the trees or limbs can be shaken to speed harvesting. More than one shaking may be required.
Postharvest	• Pecans can be stored at room temperature for approximately four months before becoming rancid. • For best results, shell pecans and store the kernels in the freezer. Frozen pecan kernels can remain fresh for 2 years or more.
Production Concerns	• Pecan trees will grow without irrigation in most parts of Missouri but must have an adequate water supply. Even mild drought conditions will reduce pecan size and quality.
Pests and Diseases	• Pests: weevils, nut casebearers • Diseases: scab, downy spots
Structures and Equipment	• Tree shakers and nut harvesters are used in commercial production.
Other Considerations	• Train trees using a central leader system. Prune trees up eight feet to allow equipment to travel underneath. • Trees become quite large and must be thinned out once limbs are about to touch between trees. • Nitrogen is needed (100 lb / acre) for higher yields.

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Nut Trees

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

Pome Fruit Trees

Apples

Interval From Planting to Fruiting	• 2 to 6 years
Season of Ripening	• July through October
Soil	• pH: 6.0 to 6.5 • Well-drained, light-textured soil
Spacing	• Depends on scion and rootstock
Harvest	• Fruit softens as it matures. Harvest apples based on intended length of storage. • In Missouri, most apples are harvested from mid September through October.
Postharvest	• Can be stored several months at 32°F and 80% to 90% relative humidity, depending on variety
Production Concerns	• Spring frosts and winter freezes are the main limiting factors.
Pests and Diseases	• Pests: European red mites, codling moths, San Jose scale, plum curculios • Diseases: cedar apple rust, fire blight, powdery mildew, scab
Structures and Equipment	• Stakes
Other Considerations	• Liberty, Red Delicious, and Golden Delicious are varieties that can be grown with success in Missouri.

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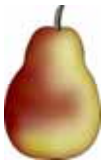

Pome Fruit Trees

Pears

Interval From Planting to Fruiting	• 5 to 8 years
Season of Ripening	• Mid July through mid October
Soil	• pH: 6.0 to 6.5
Spacing	• Between trees: 20 ft • Between rows: 26 ft
Harvest	• Pears should be firm and not fully ripe at harvest. • Seeds turn from white to dark brown when the fruit reaches maturity.
Postharvest	• Pears can be stored for 2 to 4 months at 32°F and 90% to 95% relative humidity. • Ripen pears at 60°F to 70°F before using or selling.
Production Concerns	• Warm, wet springs increase the likelihood of fire blight.
Pests and Diseases	• Pests: scale, stinkbugs, pear psylla • Diseases: fire blight, bot canker, flyspeck
Structures and Equipment	
Other Considerations	• Trees are usually pruned using a central leader system. • Pear trees are generally not pruned as much after the third year.

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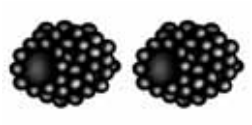
Pome Fruit Trees

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



Small Fruits
Blackberries

Interval From Planting to Fruiting	• 1 year
Season of Ripening	• Early June through late July
Soil	• pH: 5.5 to 6.5 • Well-drained soil
Spacing	• Between plants: 2 ft to 8 ft • Between rows: 8 ft to 12 ft
Harvest	• Harvest blackberries when fruit is sweet but still firm. • Blackberries are typically harvested by hand in Missouri, either by pickers or pick-your-own customers. Mechanical harvesters are generally used in larger operations.
Postharvest	• Can be held for 2 to 3 days at 31°F to 32°F and 90% to 95% relative humidity • Highly perishable
Production Concerns	• Pruning is key to production. • Blackberries are very sensitive to water stress.
Pests and Diseases	• Pests: aphids, rednecked cane borers, raspberry crown borers, raspberry cane borers, strawberry weevils, psyllids, white grubs • Diseases: anthracnose, Botrytis blossom, Septoria cane and leaf spot, fruit rot, orange rust, spur blight, root rot, powdery mildew
Structures and Equipment	• Trellis for some varieties
Other Considerations	• There are thorny and thornless blackberry cultivars.

Ames, G. K. *Growing Blackberries in Missouri*. State Fruit Experiment Station. Missouri State University-Mountain Grove. http://mtngrv.missouristate.edu/Publications/b39.pdf (accessed January 3, 2006).

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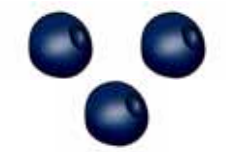

Small Fruits

Blueberries

Interval From Planting to Fruiting	• 2 to 3 years
Season of Ripening	• Late May to mid July
Soil	• pH: 4.3 to 4.9 • Sandy loam soil with high organic matter content
Spacing	• Between plants: 4 ft to 8 ft • Between rows: 8 ft to 14 ft
Harvest	• Berries are harvested in June, July, and early August. • Berries turn blue 3 to 4 days before reaching peak flavor and sweetness. Berries that have a reddish tinge are not yet ripe.
Postharvest	• Blueberries can be stored 14 days at 32°F and 90% to 95% relative humidity. • Cellophane covers reduce water loss from fruit.
Production Concerns	• Plants are very sensitive to too much water and too little water because of their shallow root systems. Good drainage is essential, and plants should be mulched and watered regularly.
Pests and Diseases	• Pests: blueberry maggots, blueberry tip borers, cherry fruitworms, cranberry fruitworms, plum curculios, birds • Diseases: cane gall, mummy berry, Botrytis blossom blight, powdery mildew, twig blights, leaf spots
Structures and Equipment	
Other Considerations	• Plants usually do not need to be pruned for the first three years. Prune dormant plants during the fourth year.

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Small Fruits

Grapes

Interval From Planting to Fruiting	• 3 years
Season of Ripening	• Mid August through early October
Soil	• pH: 5.5 to 6.5 • Adequate soil drainage is important
Spacing	• Between plants: 8 ft • Between rows: 10 ft
Harvest	• Size and color are two indicators of maturity. • Grapes harvested for table use can be picked when they taste good. Grapes for wine have specific ranges for sugar content, pH, and acidity that determine quality and acceptability.
Postharvest	• With forced-air cooling, can be stored up to 6 months at 32°F and 85% relative humidity, depending on variety
Production Concerns	• Grapes require more significant and regular pruning than any other fruit crop.
Pests and Diseases	• Pests: grape berry moths, mealybugs, leafhoppers, flea beetles • Diseases: black rot, powdery mildew, downy mildew, crown gall
Structures and Equipment	• Some type of trellising system is needed and plants must be trained to it.
Other Considerations	• Grapes can do well in a variety of soil conditions. • Grapes are pruned when they are dormant. Late winter is the preferred season for pruning.

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Small Fruits
Raspberries

Interval From Planting to Fruiting	• 5 months to 1 year
Season of Ripening	• June through early July for summer bearing varieties • August through October for fall bearing varieties
Soil	• pH: 5.5 to 6.5 • Well-drained soil with high organic matter content
Spacing	• Between plants: 2 ft to 6 ft • Between rows: 8 ft to 12 ft
Harvest	• Harvest raspberries when fruit is firm, has good color, and separates easily from the plant. • Raspberries are typically harvested by hand in Missouri, either by pickers or pick-your-own customers. Berries should be harvested directly into shallow sale containers to minimize handling and damage.
Postharvest	• Can be held for 2 to 3 days at 32°F and 90% to 95% relative humidity • Highly perishable
Production Concerns	• Black and purple varieties grow more heartily and require more pruning than red varieties. • Raspberries are very sensitive to water stress, and well-drained soil is necessary to avoid root rot. • Pruning essential to production.
Pests and Diseases	• Pests: raspberry crown borers, rednecked cane borers, strawberry bud weevils • Diseases: anthracnose, Septoria cane and leaf spot, rust, blight, powdery mildew, fruit rot
Structures and Equipment	• Trellis in “T”, “I”, or “V” formation
Other Considerations	• Training and pruning are usually the most expensive and time-consuming production concerns. The trellis system and training strategy must be matched to the variety of raspberry being grown.

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Small Fruits
Strawberries

Interval From Planting to Fruiting	• 2 months to 1 year
Season of Ripening	• May through mid October
Soil	• pH: 5.5 to 6.5 • Well-drained soil
Spacing	• Between plants: 30 in. to 36 in. • Between rows: 42 in. to 48 in.
Harvest	• Strawberries are ripe when they are fully red. • Harvest ripe strawberries daily and dispose of moldy berries to prevent rot from spreading. • Harvest berries directly into sale containers to minimize handling and damage.
Postharvest	• Can be held 5 to 7 days at 32°F and 95% relative humidity • Highly perishable
Production Concerns	• Strawberries need to be planted in a location that provides full sun.
Pests and Diseases	• Pests: tarnished plant bugs, leaf rollers, mites, strawberry weevils or clippers, nematodes, slugs • Diseases: black root rot, red stele root rot, leaf spot, leaf scorch, Verticillium wilt, gray mold, leather rot
Structures and Equipment	
Other Considerations	• Strawberries should receive at least 1 in. of water per week during the growing season. • Weed control is particularly important in strawberry production. Weeds reduce plant establishment, plant density, budding, and fruit size, as well as make harvesting difficult.

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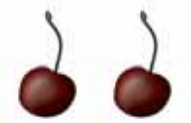
Small Fruits

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



Stone Fruit Trees

Cherries

Interval From Planting to Fruiting	• 3 to 5 years
Season of Ripening	• June through July
Soil	• pH: 5.5 to 7.5
Spacing	• Between trees: 20 ft • Between rows: 20 ft
Harvest	• Trees are usually picked only once per season, except Rainier cherry trees, which are picked at least three times in a season. • Cherries that are overripe, immature, or too small are used for processing or discarded.
Postharvest	• Sweet cherries can be held for 2 to 3 weeks at 30°F to 31°F and 90% to 95% relative humidity. • Sour cherries can be held for 3 to 7 days at 32°F and 90% to 95% relative humidity.
Production Concerns	• Sweet and sour varieties both have relatively high chilling requirements that prevent production in warmer climates. • Excessive rain and high humidity can contribute to fungal disease, rot, and cause some varieties of fruit to crack.
Pests and Diseases	• Pests: plum curculios, fruit flies, birds • Diseases: brown rot, crown gall, cherry leaf spot, black knot
Structures and Equipment	
Other Considerations	• Trees are usually pruned using the central leader or open center pruning method. • The best time to prune is in late winter though early spring.

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Stone Fruit Trees

Peaches

Interval From Planting to Fruiting	• 2 to 3 years
Season of Ripening	• Early July to mid September
Soil	• pH: 6.0 to 6.5 • Well-drained soil
Spacing	• Between trees: 20 ft • Between rows: 20 ft
Harvest	• Trees are usually picked 3 or 4 times at intervals of 2 or 3 days. • Peaches are harvested when the background color turns from green to yellow and the fruit are mature but firm.
Postharvest	• Can be stored up to 2 weeks at 31°F to 32°F and 90% to 95% relative humidity
Production Concerns	• Most peach varieties overbear fruit. Natural or hand thinning, depending on the variety, is necessary to prevent small peaches and broken branches.
Pests and Diseases	• Pests: borers, oriental fruit moths, plum curculios, tarnished plant bugs, stink bugs • Diseases: bacterial leaf spot, brown rot, peach leaf curl, canker
Structures and Equipment	
Other Considerations	• Peach cultivars are either freestone or semifreestone. • Peach trees can be readily pruned into an open vase form.

Avery, J., P. Byers, M. Kaps, L. Kovacs, and M. Odneal. *Growing Fruit for Home Use*. State Fruit Experiment Station. Missouri State University-Mountain Grove. http://mtngrv.missouristate.edu/Publications/GFFHUweb.pdf (accessed January 30, 2006).

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Stone Fruit Trees

Plums

Interval From Planting to Fruiting	• 3 to 5 years
Season of Ripening	• August through September
Soil	• pH: 5.5 to 6.5 • Well-drained soil
Spacing	• Between trees: 20 ft • Between rows: 20 ft
Harvest	• Plums harvested for fresh market sale should have good color and be firm but not hard. • Plums harvested for drying can be more mature than fresh market plums.
Postharvest	• Can be stored 2 to 4 weeks at 31°F to 32°F and 90% to 95% relative humidity • Hydrocool for best storage life
Production Concerns	• Fertilize trees annually in early spring. • Thinning is necessary for some varieties to ensure that the remaining fruit reaches the proper size.
Pests and Diseases	• Pests: European red mites, plum curculios • Diseases: black knot, leaf spot, brown rot
Structures and Equipment	
Other Considerations	• Can be pruned with a modified central leader or open center system

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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	

Cool Season Root Crop

Beets

Days to Germination	• 5 to 16
Days to Maturity	• 40 to 50
Soil	• pH: 6.0 to 7.5 • Sensitive to acidic soil • Well-drained, loose, sandy loam soil
Spacing	• Between plants: 2 in. to 4 in. • Between rows: 12 in. to 18 in.
Harvest	• Beet greens are best at 4 in. to 6 in. • A full-grown beet is roughly the size of a tennis ball, depending on the variety.
Postharvest	• Hydrocool by spraying or immersing vegetables in chilled water • Can be stored for 4 to 6 months at 32°F and 100% relative humidity
Production Concerns	• Provide beets with consistent moisture, particularly during early development, but avoid overwatering.
Pests and Diseases	• Pests: Mexican bean beetles, leafhoppers, leaf miners, wireworms, mice, rabbits • Diseases: Alternaria, Cercospora, Ramularia, damping-off
Other Considerations	• Rotate crops to avoid Cercospora.

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Cool Season Root Crop

Carrots

Days to Germination	• 6 to 18
Days to Maturity	• 70 to 85
Soil	• pH: 6.5 to 7.0 • Well-drained, sandy loam soils
Spacing	• Between plants: 3 in. • Between rows: 18 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Baby carrots: 4 in. to 5 in. long • Mature carrots: 3/4 in. to 1 1/2 in. in diameter
Postharvest	• Can be stored for 7 to 9 months at 32°F to 34°F and 98% to 100% relative humidity
Production Concerns	• Provide 1 in. of water per week during growing season.
Pests and Diseases	• Pests: carrot rust fly larvae, wireworms, leafhoppers • Diseases: leaf spot, soft rot, aster yellow
Other Considerations	

Banse, G. *Growing Carrots.* Farm and Garden. http://www.farm-garden.com/growing-vegetables/carrots.

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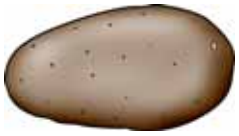

Cool Season Root Crop

Potatoes

Days to Germination	• 10 to 14
Days to Maturity	• 100 to 120
Soil	• pH: 5.0 to 5.5 • Good drainage • High phosphorus, nitrogen, and potassium content
Spacing	• Between plants: 6 in. to 12 in. • Between rows: 30 in. to 36 in.
Harvest	• New potatoes: Check when plants are blossoming and harvest when potatoes reach the desired size. • Mature potatoes: Harvest when leaves die back. • Lighter, well-drained soils make harvesting easier.
Postharvest	• Brush off the soil, but do not wash potatoes. • Cure potatoes in a dry, dark, cool place prior to prolonged storage. • Mature potatoes can be stored for 5 to 10 months at 40°F to 50°F and 90% relative humidity.
Production Concerns	• Provide uniform moisture throughout growing season.
Pests and Diseases	• Pests: Colorado potato beetles, pocket gophers • Diseases: speckle leaf, black leg, potato blight, early blight, late blight, ring rot
Other Considerations	• Potatoes can also be grown in trenches, hills, mulch, and structures such as vertical boxes and wire cages. • Growing potatoes in mulch works well in areas with rocky or compact soil. • Soil can dry out quickly when more surface area is exposed to the air, as in hills or wire cages. Monitor moisture levels closely.

Banse, G. *Growing Potatoes.* Farm and Garden. http://www.farm-garden.com/growing-vegetables/potatoes.

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Cool Season Root Crop

Radishes

Days to Germination	• 4 to 12
Days to Maturity	• 25 to 35
Soil	• pH: 6.5 to 7.0 • Cool, moist soil • Maintain soil pH at 6.8 or higher to manage club root.
Spacing	• Between plants: 1 in. to 2 in. for smaller varieties; 6 in. for larger varieties • Between rows: 18 in.
Harvest	• To harvest, grasp radishes by the top and pull them from the ground. • Harvest radishes when they are 1/2 in. to 1 in. in diameter.
Postharvest	• Wash and dry radishes thoroughly. • Hydrocooling improves shelf life and helps maintain crispness. • Washing with chlorinated water helps reduce black spot. • Radishes can be stored for 1 to 2 weeks at 32°F and 95% to 100% relative humidity.
Production Concerns	• Keep soil consistently moist to prevent radishes from becoming bitter and mealy.
Pests and Diseases	• Pests: cabbage maggots, flea beetles, aphids • Diseases: generally free of disease
Other Considerations	• Can be grown within other crops

Banse, G. *Growing Radishes.* Farm and Garden. http://www.farm-garden.com/growing-vegetables/radishes.

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Jett, L. W. *Vegetable Planting and Planning Calendar.* University of Missouri Extension. http://muextension.missouri.edu/explore/agguides/hort/g06201radish.htm.

Schrock, D. *Vegetable Harvest and Storage.* University of Missouri Extension. http://muextension.missouri.edu/explore/agguides/hort/g06226.htm.

Sources accessed November 14, 2005.

Cool Season Root Crop

Turnips

Days to Germination	• 3 to 7
Days to Maturity	• 35 to 70
Soil	• pH: 6.0 to 6.8
Spacing	• Between plants: Sow seeds 1 in. apart; thin plants to 2 in. to 6 in. apart • Between rows: 12 in.
Harvest	• Turnips can be harvested from the time they reach 1 in. in diameter. Once they are roughly the size of a tennis ball, they tend to become woody and tough. • Harvest turnip greens when they are 4 in. to 6 in.
Postharvest	• Can be stored for 4 to 5 months at 32°F and 90% to 95% relative humidity
Production Concerns	• Provide plenty of water to help prevent woody stems.
Pests and Diseases	• Pests: aphids, beetles, slugs, snails, cutworms, root maggots • Diseases: mildew, white blister disease
Other Considerations	• Turnips can withstand several light freezes.

Ed Hume Seeds. "Soil pH That Vegetables Prefer." http://www.humeseeds.com/soilph.htm.

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Cool Season Root Crop

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

Cool Season Surface Crop

Asparagus

Days to Germination	• 21
Days to Maturity	• 3 years from first planting
Soil	• pH: 6.5 to 7.5
Spacing	• Between plants: 18 in. • Between rows: 48 in. if cultivated by hand or field implements
Harvest	• Harvest spears when they are approximately 6 in. to 8 in. tall. • Spears should be dark green and firm with tightly closed tips. • Harvest spears by hand by snapping or cutting them just above the ground.
Postharvest	• With good ventilation, can be stored for 3 weeks at 35°F and 95% to 100% relative humidity
Production Concerns	• Provide adequate moisture during the fern stage to avoid significant reductions in next spring's crop. • Avoid light, frequent irrigation during the fern stage to prevent foliage disease development.
Pests and Diseases	• Pests: asparagus aphids, asparagus beetles, spotted asparagus beetles • Diseases: Fusarium, needle blight, purple spot, asparagus rust
Other Considerations	• Because asparagus occupies a site for a number of years, soil preparation and fertilization are particularly important. • Asparagus grows more rapidly as the temperature increases.

Banse, G. *Growing Asparagus*. Farm and Garden. http://www.farm-garden.com/growing-vegetables/asparagus.

Jett, L. W. *Vegetable Planting and Planning Calendar*. University of Missouri Extension. http://muextension.missouri.edu/xplor/agguides/hort/g06201asparagus.htm.

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Sources accessed November 9, 2005.

Cool Season Surface Crop

Cabbage

Days to Germination	• 4 to 14
Days to Maturity	• 70 to 80
Soil	• pH: 6.5 to 7.0 • Well-drained loam soil with high organic matter content
Spacing	• Between plants: 12 in. • Between rows: 24 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Harvest when heads are firm and before they split or burst. • Leave 4 to 6 wrapper leaves attached to heads harvested for fresh market display.
Postharvest	• Can be stored for 5 to 6 months at 32°F and 98% to 100% relative humidity
Production Concerns	• Provide an even supply of moisture but avoid overwatering transplants.
Pests and Diseases	• Pests: flea beetles, cabbage loopers, aphids, cutworms, imported cabbageworms, diamondback moths • Diseases: Alternaria leaf spot, black rot, black leg, club root, wire stem, downy mildew
Other Considerations	• Cooler temperatures improve cabbage flavor because plant cells convert starches to sugars to protect the plant from the cold.

Banse, G. *Growing Cabbage.* Farm and Garden. http://www.farm-garden.com/growing-vegetables/cabbage.

Commercial Vegetable Production Guides. "Cabbage." Oregon State University. http://oregonstate.edu/dept/NWREC/cabb.html.

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Sources accessed November 9, 2005.

Cool Season Surface Crop

Cauliflower

Days to Germination	• 5 to 10
Days to Maturity	• 65 to 75
Soil	• pH: 6.4 to 7.4 • Well-drained loamy soil
Spacing	• Between plants: 24 in. • Between rows: 24 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Harvest cauliflower when the heads are 5 in. to 6 in. in diameter. • Cut cauliflower off the stalk just below the head. • For heads harvested for fresh market display, leave at least two leaves on heads for protection and presentation.
Postharvest	• Can be held for 3 to 4 weeks at 32°F and 95% relative humidity • Highly perishable
Production Concerns	• Cauliflower is blanched to maintain white heads. To blanche cauliflower, tie the outer leaves over the heads when the heads become visible. • Self-blanching varieties are also available.
Pests and Diseases	• Pests: aphids, cutworms, flea beetles, cabbage loopers, imported cabbageworms, diamondback moths • Diseases: Alternaria leaf spot, black leg, black rot, club root, wire stem, downy mildew
Other Considerations	• Cauliflower heads are easily damaged and require care when handling.

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Cool Season Surface Crop

Lettuce

Days to Germination	• 7 to 14
Days to Maturity	• 55 to 80
Soil	• pH: 6.5 to 6.8 • Good moisture retention
Spacing	• Between plants: 3 in. to 6 in. • Between rows: 18 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Harvest lettuce before flower stalks appear. • To harvest by the leaf, wait until removing 3 or 4 outside leaves will not harm the plant's growth. • To harvest by the head, wait until heads are bigger than a fist, well-formed, and solid.
Postharvest	• Clean and cool lettuce by hydrocooling. • Head lettuce can be stored 2 to 3 weeks at 32°F and 98% to 100% relative humidity.
Production Concerns	• Provide continuous moisture to promote vigorous growth and keep lettuce from becoming bitter. • Grow lettuce in semi-shade to shade.
Pests and Diseases	• Pests: aphids, armyworms, imported cabbageworms, loopers, slugs • Diseases: damping-off, downy mildew, big vein, mosaic virus, nematodes, Sclerotinia drop, soft rot, tip burn
Other Considerations	• Very sensitive to ethylene gas

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Cool Season Surface Crop

Spinach

Days to Germination	• 7 to 14
Days to Maturity	• 40 to 50
Soil	• pH: 6.2 to 6.9
Spacing	• Between plants: 3 in. • Between rows: 18 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Harvest spinach when leaves reach an edible size and before seed stalks develop. • To harvest, cut leaves from the plant or pull the whole plant from the ground.
Postharvest	• Can be stored for 10 to 14 days at 32°F and 95% to 100% relative humidity.
Production Concerns	• Provide uniform moisture throughout the growing season. • Straw mulch can be used to retain moisture.
Pests and Diseases	• Pests: armyworms, aphids, crown maggots, flea beetles, leafhoppers, loopers, leaf miners, slugs • Diseases: spinach blight, anthracnose, damping-off, downy mildew
Other Considerations	• Spinach is highly perishable and is usually marketed or eaten soon after harvest. • Spinach is sensitive to ethylene gas.

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Cool Season Surface Crop

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

Long Season Crop

Cantaloupes

Days to Germination	• 7 to 14
Days to Maturity	• 80 to 90
Soil	• pH: 6.0 to 6.5 • Well-drained sandy or silt loam soil
Spacing	• Between plants: 60 in. • Between rows: 48 in. if cultivated by hand; 60 in. if field implements are used
Harvest	• Cantaloupes are ripe when they separate easily from the vine and the skin takes on a slightly yellowish appearance. • Cantaloupes that will be shipped long distances can be picked just prior to ripening.
Postharvest	• Ripe cantaloupes can be held for 5 to 14 days at 32°F to 36°F. • Cantaloupes are highly perishable.
Production Concerns	• Cantaloupes are frequently planted in hills, but this is not necessary and may not be practical when growing large quantities.
Pests and Diseases	• Pests: aphids, cucumber beetles, squash bugs • Diseases: Fusarium wilt, anthracnose, Alternaria leaf spot, bacterial wilt, powdery mildew, gummy stem blight, damping-off, root rot / vine decline, root knot
Other Considerations	

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Sources accessed November 28, 2005.

Long Season Crop

Gourds

Days to Germinations	• 10 to 15
Days to Maturity	• 100 to 180
Soil	• pH: 6.5 to 6.8 • Sunny, well-drained site
Spacing	• Between plants: 24 in. • Between rows: 60 in. • Hills: 48 in. to 60 in. apart with rows 84 in. apart
Harvest	• Harvest gourds when the stems are dry and brown and before frost.
Postharvest	• Clean gourds with soap and water, dry, and apply rubbing alcohol to the surface. • Curing Cucurbita and Lagenaria gourds is a two-step process. The first step, surface drying, takes approximately a week. This is followed by internal drying, which can take from 4 weeks to several months, depending on the variety. • Luffa sponges are prepared by removing the seeds, soaking and removing the skin, and bleaching the sponge to achieve the desired appearance.
Production Concerns	• Because of their long growing season, gourds should be started indoors 4 weeks before planting outdoors. • Gourds are often grown on a trellis or arbor. Gourds vary greatly in weight and size. Be sure the structure will support the weight of the gourds.
Pests and Diseases	• Pests: aphids, cucumber beetles, squash bugs, squash vine borers • Diseases: angular leaf spot, bacterial wilt, mosaic viruses, powdery mildew
Other Considerations	There are three main types of gourds: • Cucurbita: ornamental gourds • Lagenaria: large, utilitarian gourds • Luffa: vegetable sponges

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Long Season Crop

Pumpkins

Days to Germination	• 6 to 10
Days to Maturity	• 95 to 120
Soil	• pH: 5.5 to 6.5 • Moderate potassium and phosphorus and high nitrogen content
Spacing	• Between plants: 12 in. to 18 in. • Between rows: 72 in.
Harvest	• Pumpkins are ready to harvest when they are a deep solid color and the vine has begun to shrivel. • Harvest pumpkins before the first hard frost. • Leave 3 in. to 4 in. of stem attached to the pumpkin.
Postharvest	• Can be held for 2 to 3 months at 50°F to 55°F and 50% to 75% relative humidity
Production Concerns	• Water pumpkins regularly throughout growing season and keep plants evenly moist. • Watering plants early in the day and keeping water off foliage helps prevent mildew.
Pests and Diseases	• Pests: squash vine borers, cucumber beetles • Diseases: bacterial wilt, anthracnose, downy mildew, powdery mildew
Other Considerations	• Do not plant pumpkins until the danger of frost has passed and the soil has warmed.

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Long Season Crop

Watermelons

Days to Germination	• 7 to 14
Days to Maturity	• 85 to 95
Soil	• pH: 5.0 to 8.0 • Well-drained sandy or sandy loam soil
Spacing	• Between plants: 96 in. • Between rows: 96 in. if hand cultivated; 120 in. if field implements are used
Harvest	Timing is important because sweetness does not increase after harvest. Indications of ripeness include the following: • Ground spot (the portion of the melon in contact with the soil) turns from white to yellow • Tendrils near the fruit become brown and dry • Rind has a shiny appearance • Thumping produces a hollow sound—less effective on varieties with firmer flesh
Postharvest	• Can be stored for 2 weeks at 52°F to 60°F and 85% to 90% relative humidity • Not suited for long storage • Will lose flavor and color if stored below 50°F
Production Concerns	• Adequate water early in the season improves vine growth and yield.
Pests and Diseases	• Pests: aphids, cucumber beetles • Diseases: Alternaria leaf spot, anthracnose, downy mildew, Fusarium wilt
Other Considerations	• Fruit disorders: misshapen melons, blossom-end rot, bursting, white heart, hollow heart, sunburn, rind necrosis

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Long Season Crop

Winter Squash

Days to Germination	• 6 to 10
Days to Maturity	• 80 to 120
Soil	• pH: 5.5 to 6.5 • Fertile, well-drained soil
Spacing	• Between plants: 60 in. • Between rows: 48 in. if cultivated by hand; 60 in. if field implements are used
Harvest	• Winter squash are ready to harvest when their stems begin to shrivel. • Cut squash off the plant and leave 2 in. of stem attached to the fruit.
Postharvest	• Curing is often recommended for many types of winter squash to harden the skin and extend storage life. To cure, store squash for 10 to 20 days at 75°F to 80°F. • Fully cured squash can be held 84 to 150 days at 50°F to 55°F and 50% to 70% relative humidity. • Do not cure acorn squash. Acorn squash can be held 5 to 8 weeks at 50°F.
Production Concerns	• Keep squash evenly moist throughout the growing season. • Monthly application of a complete organic fertilizer is recommended to improve plant health and yield.
Pests and Diseases	• Pests: aphids, cucumber beetles, squash vine borers, squash bugs • Diseases: bacterial wilt, anthracnose, downy mildew, powdery mildew
Other Considerations	• Squash plants are not hardy and are susceptible to frost in the spring and fall.

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Long Season Crop

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

Warm Season Crop

Cucumbers

Days to Germination	• 7 to 10
Days to Maturity	• 50 to 70
Soil	• pH: 5.0 to 6.0 • Warm, moist soil • Hate “wet feet”
Spacing	• Between plants: 12 in. • Between rows: 48 in. • For hills, space hills 4 ft apart, sow 3 to 5 seeds per hill, and thin to 2 to 3 plants per hill.
Harvest	• Skin should be completely dark green, and cucumbers should be large enough to use. • Harvest cucumbers before they mature completely to keep the vine producing.
Postharvest	• Wash and dry thoroughly • Can be stored for 2 to 4 weeks at 50°F to 55°F • Very sensitive to ethylene gas
Production Concerns	• Cucumbers need plenty of water to stay crisp and juicy. • Water in the morning so that leaves can dry during the day.
Pests and Diseases	• Pests: cucumber beetles • Diseases: bacterial wilt, mildew, leaf spot
Other Considerations	• Frost sensitive

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Warm Season Crop

Eggplants

Days to Germination	• 10 to 14
Days to Maturity	• 80 to 90
Soil	• pH: 6.0 to 6.8
Spacing	• Between plants: 24 in. • Between rows: 24 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Skin should be shiny and eggplants should be 4 in. to 5 in. long. Dull skin indicates overripening. • Cut eggplants off the plant with a sharp knife; leave at least 1 in. of stem attached to the fruit.
Postharvest	• Market immediately after harvest • Can be stored for 7 to 10 days at 45°F to 50°F and 90% to 95% relative humidity
Production Concerns	• At least 2 in. of water per week is required during the growing season.
Pests and Diseases	• Pests: cutworms, flea beetles, aphids, corn earworms, European corn borers, hornworms, cabbage loopers, Colorado potato beetles, spider mites, fruit flies, picnic beetles, whiteflies • Diseases: Phytophthora blight, Verticillium wilt, Phomopsis blight, Alternaria leaf spot, Cercospora leaf spot, anthracnose
Other Considerations	

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Warm Season Crop
Green Beans

Days to Germination	• 5 to 8
Days to Maturity	• Bush: 50 to 60 • Pole: 60 to 70
Soil	• pH: 6.0 to 6.8 • Well-drained, loose-textured soil • Moderately high organic matter content
Spacing	Bush: • Between plants: 3 in. • Between rows: 24 in. if cultivated by hand; 42 in. if field implements are used Pole: • Between plants: 36 in. • Between rows: 30 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Beans should be thin, bright green, and snap easily when bent. • Beans can over-mature quickly, particularly when temperatures are high. Over-mature beans lose color and become tough.
Postharvest	• Can be stored for 8 to 12 days at 41°F to 46°F and 95% to 100% relative humidity
Production Concerns	• Sensitive to moisture stress
Pests and Diseases	• Pests: beetles, thrips, corn earworms, leafhoppers, aphids • Diseases: anthracnose, common blight, rust, damping-off, mosaic
Other Considerations	• Bush beans require less space and produce more beans at one time, but pole beans provide a more constant supply. • Equipment considerations include poles for pole beans.

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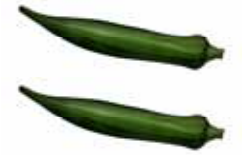

Warm Season Crop

Okra

Days to Germination	• 5 to 14
Days to Maturity	• 55 to 60
Soil	• pH: 6.5 to 7.5 • Fertile, loamy soil
Spacing	• Between plants: 12 in. • Between rows: 30 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Okra pods are usually ready to harvest 4 to 7 days after their flowers open. Plants will bear until frost if pods are picked regularly. • Cut or gently pull okra pods from the plant while they are tender and free of fiber—2 in. to 4 in. long for most varieties.
Postharvest	• Can be stored for 7 to 10 days at 45°F to 50°F and 90% to 95% relative humidity • Very sensitive to ethylene gas
Production Concerns	• Provide even moisture throughout the growing season. • Monthly side dressings of manure and monthly applications of a complete organic fertilizer are beneficial.
Pests and Diseases	• Pests: corn earworms, stink bugs, Japanese beetles, leaffooted bugs, European corn borers, vegetable leaf miners, aphids • Diseases: Fusarium wilt, root knot nematode, leaf spot, blossom and fruit blight, Southern blight, seedling disease, cotton root rot, charcoal rot
Other Considerations	• Okra pods develop twice as fast with every 18°F rise in temperature. Harvest every other day in hot weather.

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Warm Season Crop

Peppers

Days to Germination	• 10 to 14
Days to Maturity	• 70 to 80
Soil	• pH: 6.0 to 6.8
Spacing	• Between plants: 18 in. • Between rows: 30 in. if cultivated by hand; 42 in. if field implements are used
Harvest	• Peppers turn from green to the color that they will be at maturity. • Harvest peppers by cutting (not pulling) the mature fruit from the plant.
Postharvest	• Store peppers at 45°F to 55°F and 90% to 95% relative humidity.
Production Concerns	• Peppers are shallow-rooted, so mulch can be used to prevent moisture loss.
Pests and Diseases	• Pests: European corn borers, corn earworms, aphids, flea beetles, whiteflies, mites • Diseases: pepper tobamovirus, pepper mottle virus, bacterial spot, bacterial leaf spot, tobacco mosaic virus
Other Considerations	

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Warm Season Crop

Summer Squash

Days to Germination	• 6 to 10
Days to Maturity	• 80 to 90
Soil	• pH: 5.5 to 6.5 • Provide moderate potassium and phosphorus and high nitrogen.
Spacing	• Between plants: 48 in. • Between rows: 48 in. if cultivated by hand; 60 in. if field implements are used
Harvest	• Summer squash are ready to harvest when they turn their mature color. • Harvest zucchini and straightneck and crookneck squash at 1 1/2 in. to 2 in. in diameter. • Harvest scallop summer squash at 3 in. to 4 in. in diameter.
Postharvest	• Can be stored for 7 to 14 days at 41°F to 50°F and 90% to 95% relative humidity
Production Concerns	• Water evenly throughout the growing season. • Monthly applications of a complete organic fertilizer are beneficial.
Pests and Diseases	• Pests: cucumber beetles, squash vine borers, squash bugs • Diseases: anthracnose, downy mildew, bacterial wilt
Other Considerations	• Water in the early morning to help avoid mildew. • Plants are very prolific.

Banse, G. *Growing Summer Squash*. Farm and Garden. http://www.farm-garden.com/growing-vegetables/summersquash.

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Warm Season Crop

Sweet Corn

Days to Germination	• 7 to 10
Days to Maturity	• Mature 22 to 24 days after silking • Maturity dates depend on the variety used.
Soil	• pH: 6.0 to 6.8 • Medium textured soil, sandy loam soil • Good drainage
Spacing	• Between plants: 8 in. for early and short varieties; 12 in. for tall and late-maturing varieties • Between rows: 36 in. to 38 in.
Harvest	• Harvest sweet corn when the ears are full at the tip, husks are tight, and the silks have dried. • Kernels should be full and produce a milky liquid when punctured.
Postharvest	• At 86°F, traditional types of sweet corn will lose half of their sugar within 24 hours. • Super sweet and ultra sweet varieties retain their sweetness much longer.
Production Concerns	• 1 in. to 1 1/2 in. of water per week during June • 2 in. to 2 1/2 in. of water per week during July and early August
Pests and Diseases	• Pests: flea beetles, corn borers, corn earworms, cutworms, seed corn maggots, white grubs, wireworms • Diseases: Stewart's wilt, common smut, maize dwarf mosaic, wheat streak mosaic
Other Considerations	• Cross pollination can adversely affect sweet corn appearance and taste. To avoid cross pollination, plant noncompatible types of sweet corn 250 ft apart or separate plantings by 14 days.

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Warm Season Crop

Tomatoes

Days to Germination	• 7 to 14
Days to Maturity	• 70 to 75 staked; 75 to 90 not staked
Soil	• pH: 6.5 to 7.0 • Apply lime in late fall or early spring.
Spacing	• Between plants: 2 ft staked; 2 ft to 4 ft not staked • Between rows: 3 ft to 5 ft staked; 4 ft to 6 ft not staked
Harvest	• Tomato color and flavor is best when daily temperatures are an average of 75°F.
Postharvest	• Wrap tomatoes in paper and store at 60°F to 65°F.
Production Concerns	• At least 1 in. of water per week May through June • At least 2 in. of water per week July through September
Pests and Diseases	• Pests: cutworms, flea beetles, hornworms, leaf miners, stalk borers, stink bugs, tomato fruit worms, spider mites • Diseases: wilt, mosaic, leaf spot, anthracnose
Other Considerations	• Structure and equipment considerations include stakes, cages, and high tunnels.

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Warm Season Crop

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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

Student Reference

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First Edition: June 1984
Revised: June 2006

The activity that is the subject of this report was supported in whole or in part by funds from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. However, the opinions expressed therein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education or the Division of Vocational and Adult Education, and no official endorsement should be inferred.

Acknowledgments

Fruit and Vegetable Production Unit for Plant Science Core Curriculum is a curriculum designed to provide instruction about the production of fruit and vegetable crops for tenth grade students. Funding for the curriculum development project was provided through a grant from the Missouri Department of Elementary and Secondary Education (MDESE).

Recognition is given to advisory committee members for providing their valuable time and suggestions in developing the outline for this curriculum. The committee consisted of the following members:

Pat Bellrose, Fahr Greenhouse
Ron Dickens, Liberal R-II High School
Jeanne Holmes, Mineral Area College
Deanna Thies, Boonslick Technical Education Center
Jim Thies, Howard County High School
Tracy Vedder, Gasconade County R-I High School
Michele Warmund, College of Agriculture, Food, and Natural Resources, University of Missouri-Columbia

A special thank-you is extended to Terry Heiman, Director of Agricultural Education Division of Career Education, and Nancy Alford, Supervisor of the Southeast & South Central Districts of Agricultural Education for the Department of Elementary and Secondary Education.

Special recognition is extended to Michael A. Gold, Associate Director, University of Missouri Center for Agroforestry, for providing technical expertise.

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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.

Terry Heiman, Director
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Department of Elementary and
Secondary Education

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

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Fruit and Vegetable Production

Lesson 2: Developing a Marketing Plan

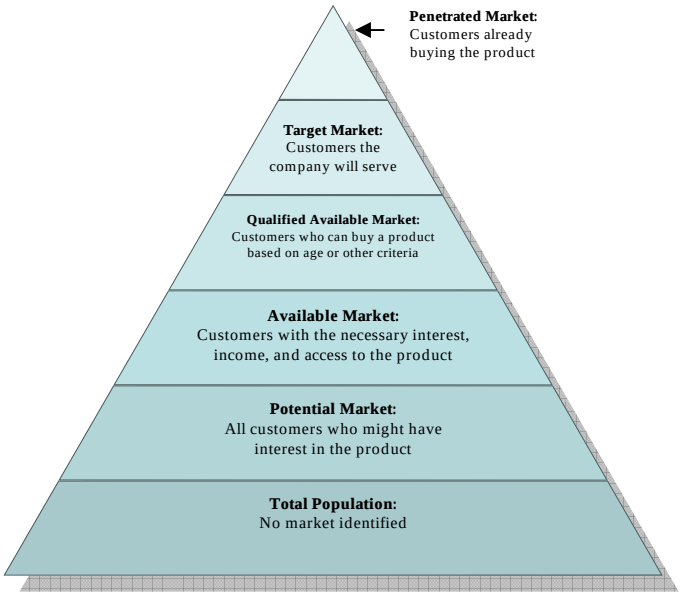
Producers must have a strategy for selling the fruits and vegetables they grow. This strategy is called a marketing plan. It is essential that growers have their marketing plan in place before their produce is ready to sell. The purpose of the plan is to identify potential customers and determine how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

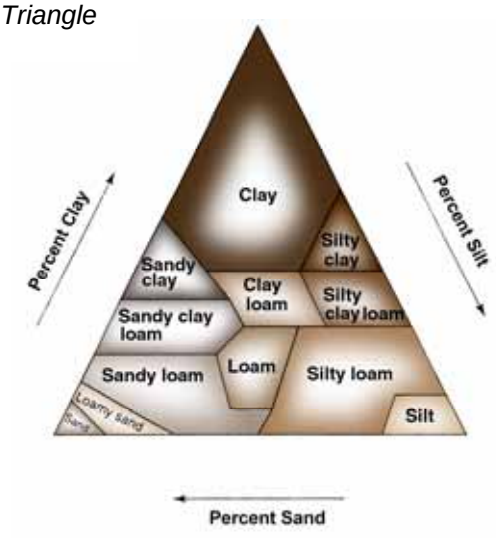
Environmental Evaluation Concerns

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.

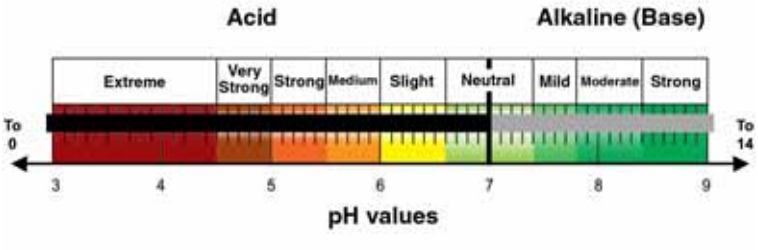
Texture is an important soil property because it is closely related to many aspects of soil behavior. Soil texture refers to the percentage by weight of sand, silt, and clay in a soil. The ease of tilling and plant root development within the soil are both influenced by soil texture. Texture affects 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.

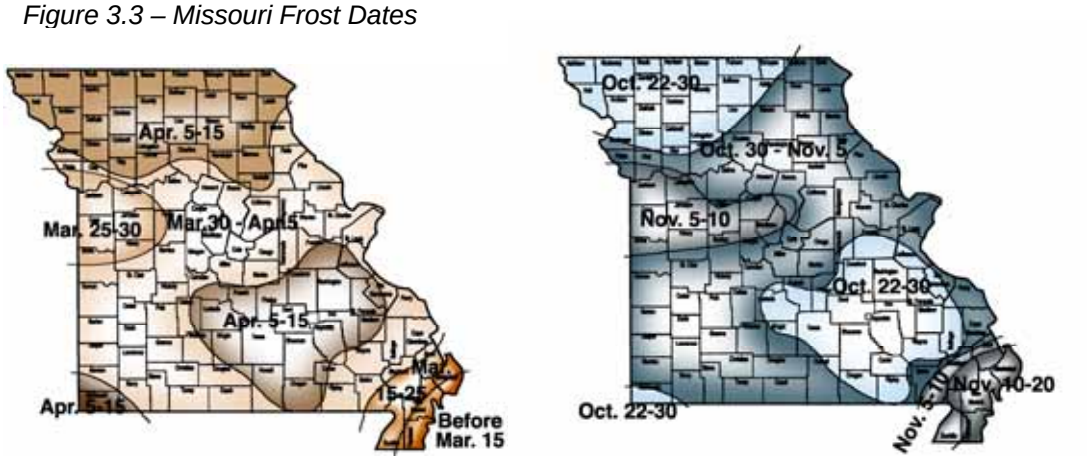
Traditionally, it was primarily the owners, operators, and workers who needed access to the farm. However, producers who are considering an operation such as a pick-your-own or CSA farm must also determine whether the site is accessible to the public. If consumers will be frequenting the farm, it is 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

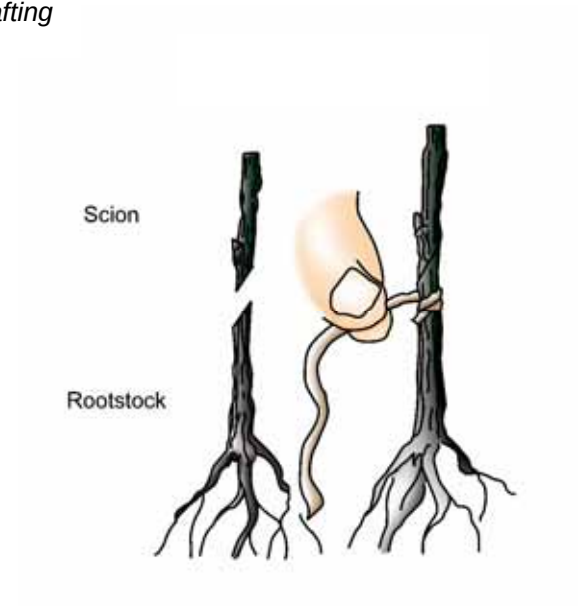
Small fruit crops are grouped together because they produce small, soft fruit, usually on vines, plants, or shrubs; however, not all small fruit crops are in the same botanical family. Examples include blackberries, blueberries, grapes, raspberries, and strawberries.

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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