North Dakota Agriculture Education

PLANT SYSTEMS

Develop and implement a crop management plan for a given production goal that accounts for environmental factors.

1 **Determine the influence of environmental factors on plant growth.** 9.1

1 Describe the three measurements of light – color, intensity, and duration – that affect plant growth. 9.1.1

2 Identify the effects of environmental conditions (e.g., air movement, temperature, humidity, etc.) on plant growth. 9.1.2

3 Describe the effects of water quality on plant growth, (e.g., pH, dissolved solids, etc.). 9.1.3

4 Analyze plant responses to light color, intensity, and duration. 9.1.4

5 Determine the optimal environmental conditions for plant growth. 9.1.5

6 Analyze plant responses to water quality and quantity. 9.1.6

7 Recommend modifications to light for desired plant growth. 9.1.7

8 Evaluate a plan to maintain optimal environmental conditions for plant growth (e.g., day length, light, humidity, moisture, temperature, etc.). 9.1.8

9 Recommend modifications to water for desired plant growth. 9.1.9

2 **Prepare and adjust growing media for use in plant systems.** 9.2

1 Describe the major forms of growing media (e.g., hydroponics, soil, greenhouse potting mix, rockwool, etc.). 9.2.1

2 Identify the physical characteristics of soil water (e.g., water holding capacity, plant available water, permanent wilting point, gravitational water, etc.) and soil texture (e.g., sand, silt, clay, etc.). 9.2.2

3 Describe the physical and chemical characteristics of growing media and explain the influence they have on plant growth. 9.2.3

4 Discuss how differences in growing media can affect drainage (e.g., drain tile, surface drainage, tillage, porosity, irrigation, etc.). 9.2.4

5 Recommend a plan for managing crop growth in different growing media. 9.2.5

6 Determine the electroconductivity and pH for soil and how the results influence practices (e.g., irrigation, etc.). 9.2.6

3 **Demonstrate planting techniques and create the conditions needed for seed germination.** 9.3

Describe the steps to growing crops including crop selection, land preparation, seed selection, seed sowing, irrigation, fertilizing, and harvesting. 9.3.1

2 Plant a crop using the appropriate steps. 9.3.2

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3 Recommend a crop to plant given a geographic region. 9.3.3

4 **Develop and implement a nutrient management and/or fertilizer plan for specific plants or crops.** 9.4

1 Explain the role of macronutrients and micronutrients for plant growth and development and their major functions (e.g., nitrogen, phosphorus, potassium, iron, sulfur, etc.). 9.4.1

2 Explain the influence of electric conductivity (EC, soluble salts), pH, and cation exchange capacity on the availability of plant nutrients and crop growth. 9.4.2

3 Collect soil and plant tissue samples using industry accepted procedures and explain how incorrect sample collection will affect the results of a laboratory analysis. 9.4.3

4 Explain the formulations of both organic and inorganic fertilizers. 9.4.4

5 Summarize production methods focused on sustainable soil management (e.g., crop rotation, companion planting, cover crops, etc.). 9.4.5

6 Identify nutrient deficiencies in plants. 9.4.6

7 Contrast pH and cation exchange capacity between mineral soil and soilless growing media. 9.4.7

8 Interpret laboratory analyses of soil and tissue samples 9.4.8

9 Calculate the amount of fertilizer to be applied based on nutrient recommendation and fertilizer analysis. 9.4.9

10 Assess the short-and long-term effects of production methods focused on sustainable soil management. 9.4.10

11 Prepare a scouting report to correct elements negatively affecting plant growth in a field or greenhouse. 9.4.11

12 Recommend a plan of action to adjust the electric conductivity (EC, soluble salts) and pH of growing media given soil tests for specific plants or crops. 9.4.12

13 Prescribe fertilizer applications based on the results of a laboratory analysis of soil and plant tissue samples. 9.4.13

14 Recommend a fertilizer application method (e.g., liquid, dry, variable rate, manure, etc.). 9.4.14

15 Devise a plan for sustainable soil management for a selected cropping system. 9.4.15

Apply principles of classification, plant anatomy, and plant physiology to plant production and management

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5 **Classify plants according to taxonomic systems.** 9.5

1 Identify plants based on visual characteristics (e.g., seedling stages, fully grown, etc.). 9.5.1

2 Classify the morphological characteristics and systems used to identify agricultural and herbaceous plants (e.g., life cycles, growth habit, plant use and as monocotyledons, or dicotyledons, woody, herbaceous, etc.) by common and scientific names. 9.5.2

3 Assess the importance of plants to agricultural and ornamental plant systems by scientific names. 9.5.3

6 **Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.** 9.6

1 Identify structures in a typical plant cell and explain the function of plant cell organelles. 9.6.1

2 Identify the components, the types, and the functions of plant roots. 9.6.2

3 Identify the components and the functions of plant stems. 9.6.3

4 Identify morphological features found in leaves, how they contribute to plant identification, and how they relate to overall plant growth. 9.6.4

5 Describe the components of a flower, the functions of a flower, and the functions of flower components. 9.6.5

6 Identify the functions and components of seeds and fruits. 9.6.6

7 Apply the knowledge of cell differentiation and the functions of the major types of cells to plant systems. 9.6.7

8 Analyze root tissues and explain the pathway of water and nutrients into and through root tissues. 9.6.8

9 Contrast the difference in arrangement of vascular tissue between monocot and dicot plant stems. 9.6.9

10 Analyze how leaves capture light energy and exchange gasses. 9.6.10

11 Differentiate between the types of flowers and flower inflorescence (e.g., complete, incomplete, perfect, imperfect). 9.6.11

12 Categorize the major types of seeds and fruits. 9.6.12

13 Compare and contrast mitosis and meiosis. 9.6.13

14 Evaluate the active and passive transport of minerals into and through the root system to plant nutrition. 9.6.14

15 Evaluate the function of the xylem, phloem, and cambium tissues and their impact on plant systems. 9.6.15

16 Devise a plan for agronomic management practices that takes into account leaf structure, function, and environmental factors (e.g., drought vs. humid conditions, adding adjuvants to spray solutions for successful pesticide applications, etc.). 9.6.16

17 Evaluate the impact of plant and flower structure on plant breeding, production, and use. 9.6.17

18 Evaluate the impact of different seed and fruit structures to plant culture and use. 9.6.18

7 **Apply knowledge of plant physiology and energy conversion to plant systems.** 9.7

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1 Describe the photosynthesis pathway and its reactants and products. 9.7.1

2 Explain the stages of cellular respiration including their products and reactants. 9.7.2

3 Explain primary growth and the role of the apical meristem. 9.7.3

4 Categorize the five groups of naturally occurring plant hormones and synthetic plant growth regulators. 9.7.4

5 Compare and contrast the effects of transpiration, translocation, and assimilation on plants. 9.7.5

6 Differentiate between the types of photosynthesis (e.g., c3, c4, Cam) and its stages (e.g., light dependent and light independent reactions). 9.7.6

7 Analyze factors that affect the rate of cellular respiration in a given crop production setting. 9.7.7

8 Analyze plant growth and the process of secondary plant growth. 9.7.8

9 Analyze the plant responses to plant growth regulators and different forms of tropism. 9.7.9

10 Analyze the factors affecting the rate and products of transpiration, translocation, and assimilation. 9.7.10

11 Evaluate the factors that affect photosynthesis and the impact those factors have on plant management and production problems. 9.7.11

12 Evaluate the impact of plant respiration on plant growth, crop management, and post-harvest handling decisions. 9.7.12

13 Relate the principles of primary and secondary growth to plant systems. 9.7.13

14 Recommend the use of specific plant growth regulators to produce desired responses from plants (e.g., adding PGRs to a spray solution, etc.). 9.7.14

15 Recommend plant management strategies that apply knowledge of transpiration, translocation, and assimilation on plant growth. 9.7.15

Propagate, culture, and harvest plants and plant products based on current industry standards.

8 **Demonstrate plant propagation techniques in plant system activities.** 9.8

1 Describe pollination, cross-pollination, and self-pollination of flowering plants. 9.8.1

2 Identify sowing techniques used to create favorable conditions for seed germination. 9.8.2

3 Summarize optimal conditions for asexual propagation. 9.8.3

4 Explain the main stages of micropropagation. 9.8.4

5 Explain the principles of recombinant DNA technology and the basic steps in the process. 9.8.5

6 Apply the process of plant pollination and/or fertilization. 9.8.6

7 Examine factors that affect seed viability, vigor, and germination rates. 9.8.7

Demonstrate plant propagation techniques (e.g., cuttings, division, separation, layering, budding and grafting, etc.). 9.8.8

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9 Examine aseptic micropropagation techniques. 9.8.9

10 Compare and contrast the potential risks and advantages associated with genetically modified agricultural and ornamental plants. 9.8.10

11 Justify the use of pollination methods and practices used to maximize crop pollination (e.g., honey bee, leaf cutter bee, wind, ratio of males to females planted, etc.). 9.8.11

12 Conduct tests associated with seed germination rates, viability, and vigor. 9.8.12

13 Evaluate asexual propagation practices comparing productivity, efficiency, and cost. 9.8.13

14 Recommend micropropagation techniques in a given scenario. 9.8.14

15 Evaluate the impact of using genetically modified agricultural and ornamental crops on other production practices. 9.8.15

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9 Develop and implement a management plan for plant production. 9.9

1 Explain the importance of starting with pest- and disease-free propagation material. 9.9.1

2 Explain the reasons for preparing growing media before planting. 9.9.2

3 Determine seeding rate needed for specified plant populations or desired quantity of finished plants. 9.9.3

4 Describe environmental conditions during the germination, growth, and development of a crop. 9.9.4

5 Explain the stages of plant growth and the methods and reasons for controlling plant growth. 9.9.5

6 Describe structures and technologies used for controlled atmosphere production of plants. 9.9.6

7 Describe the use of hydroponic and aquaponic systems for plant production. 9.9.7

8 Inspect propagation material for evidence of pests or disease. 9.9.8

9 Prepare soil and growing media for planting with the addition of amendments. 9.9.9

10 Assess how pre-plant treatments are used on seeds and plants. 9.9.10

11 Adjust environmental conditions based on the progress of plantings. 9.9.11

12 Demonstrate proper techniques to control and manage plant growth through mechanical, cultural, or chemical means. 9.9.12

13 Compare and contrast the types of technologies used for controlled atmosphere production. 9.9.13

14 Compare and contrast the types of systems used in hydroponic and aquaponic plant production. 9.9.14

15 Demonstrate ways to produce pest- and disease-free propagation material. 9.9.15

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16 Assess how mechanical planting equipment performs soil preparation and seed placement. 9.9.16

17 Recommend the calibration for mechanized seeding and/or planting equipment for a desired seed application rate. 9.9.17

18 Prepare a plant production schedule based on predicted environmental conditions and desired market target (e.g., having plants ready to market on a specific day such as Mother's Day, organic production, low maintenance landscape plants, etc.). 9.9.18

19 Prepare plant production schedules utilizing plant growth knowledge to get plants to their optimal growth stage at a given time. 9.9.19

20 Recommend technology for use in controlled atmosphere production. 9.9.20

21 Recommend the use of a hydroponic or aquaponic plant system. 9.9.21

10 Develop and implement a plan for integrated pest management for plant production. 9.10

1 Identify plant pests, diseases, and disorders. 9.10.1

2 Diagram the life cycles of major plant pests and diseases. 9.10.2

3 Describe pest control strategies associated with integrated pest management and the importance of determining economic threshold. 9.10.3

4 Summarize risks and benefits associated with the materials and methods used in plant pest management. 9.10.4

5 Categorize common local weeds, insect pests, fungal, viral, bacterial, and infectious and noninfectious plant diseases. 9.10.5

6 Predict pest and disease problems based on environmental conditions and life cycles. 9.10.6

7 Calculate pesticide formulations including organic and synthetic active ingredients and selection of pesticides to control specific pests. 9.10.7

8 Apply procedures for the safe handling, use, and storage of pesticides including personal protective equipment and Restricted Entry Interval. 9.10.8

9 Devise solutions for plant pests, diseases, and disorders. 9.10.9

10 Design a crop scouting program. 9.10.10

11 Employ pest management strategies to manage pest populations, assess the effectiveness of the plan, and adjust the plan as needed. 9.10.11

12 Evaluate environmental and consumer concerns regarding pest management strategies. 9.10.12

11 Apply principles and practices of sustainable agriculture to plant production. 9.11

1 Compare and contrast different production systems (conventional and organic). 9.11.1

2 Describe national/international and local/regional food production systems. 9.11.2

3 Explain the impacts of environmental conditions on plant production. 9.11.3

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4 Analyze the alignment of modern technologies used in production systems (e.g., precision agriculture, GE crops, etc.) with USDA sustainable practices criteria. 9.11.4

5 Examine the environmental impacts (e.g., carbon footprint, greenhouse gas, sustainability, food security, etc.) of the national/international production system on local/regional production system markets. 9.11.5

6 Examine differing research conclusions related to environmental factors and their effect on plant production. 9.11.6

7 Design plans for a plant systems enterprise that aligns with USDA sustainable practices criteria. 9.11.7

8 Recommend the use of nationally/internationally grown or locally/regionally grown for a production operation system. 9.11.8

9 Evaluate evidence supporting claims on how environmental conditions affect plant production. 9.11.9

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12 Harvest crops according to industry standards. 9.12

1 Identify harvesting methods and equipment. 9.12.1

2 Explain the reasons for calculating crop loss and or damage. 9.12.2

3 Assess the stage of growth to determine crop maturity or marketability. 9.12.3

4 Analyze crop yield and loss data. 9.12.4

5 Demonstrate mechanical harvesting practices used to process plant crops. 9.12.5

6 Recommend strategies to reduce crop loss given specific crop yield and loss data. 9.12.6

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13 Haul and store crops according to industry standards. 9.13

1 Describe how safety is ensured at each stage of harvesting, hauling, and storing. 9.13.1

2 Identify plant preparation methods for storing and shipping plants and plant products. 9.13.2

3 Describe the techniques used to prepare plants and plant products for distribution. 9.13.3

4 Analyze practices used to maintain a safe product through harvest, processing, storage, and shipment (e.g., Food Safety Modernization Act, Good Agricultural Practices, etc.). 9.13.4

5 Analyze the proper conditions required to maintain the quality of plants and plant products held in storage and during shipping. 9.13.5

6 Demonstrate techniques for grading, handling, and packaging plants and plant products for distribution. 9.13.6

7 Demonstrate practices that govern safe plant production, distribution, and use/consumption. 9.13.7

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8 Evaluate environmental conditions in storage facilities for plants and plant products. 9.13.8

9 Evaluate techniques for grading, handling, and packaging plants and plant products. 9.13.9

Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).

14 Evaluate, identify, and prepare plants to enhance an environment. 9.14

1 Identify plants by their purpose (e.g., floral plants, landscape plants, house plants, etc.). 9.14.1

2 Demonstrate proper use of plants in their environment (e.g., focal and filler plants in floriculture, heat tolerant and shade plants in a landscape design, etc.). 9.14.2

3 Create a design plan by selecting plants based on design elements and environmental conditions. 9.14.3

15 Create designs using plants. 9.15

1 Explain the applications of design in agriculture and ornamental plant systems. 9.15.1

2 Classify tools used for design (e.g., computer landscape software, drawing tools, florist tools, turf management, etc.). 9.15.2

3 Explain the concept of landscape ecology and summarize factors that shape the ecology of a landscape (e.g., composition, structure, function, etc.). 9.15.3

4 Create an aesthetically pleasing design utilizing plants in their proper environments. 9.15.4

5 Demonstrate the use of tools used for creating designs. 9.15.5

6 Provide examples of ecological factors incorporated into landscape designs or turfgrass management. 9.15.6

7 Propose suggestions for improvement of a design (e.g., a floral arrangement, a landscape or a landscape plan, turfgrass management, etc.). 9.15.7

8 Recommend appropriate tools to create a desired design. 9.15.8

9 Utilize green technologies and sustainable practices that prevent or limit negative environmental impacts. 9.15.9