Nutrient Management

AK-590HT

Conservation Practice Job Sheet Seasonal High Tunnel System

Definition
Nutrient management is managing the source, rate, form, timing, and placement of plant nutrients.

Purpose
Nutrient management effectively and efficiently uses scarce nutrient resources to adequately supply soils and plants to produce food, forage, fiber, and cover while minimizing environmental degradation.

Where Used
Nutrient management is applicable to all lands where plant nutrients and soil amendments are applied.

Conservation Management Systems
Nutrient management may be a component of a conservation management system. It is used in conjunction with crop rotation, residue management, pest management, irrigation water management, conservation buffer practices, and/or other practices needed on a site-specific basis to address natural resource concerns and the landowner's objectives. The major role of nutrient management is to minimize nutrient losses from areas where crops are grown, thus helping protect surface and ground water supplies.

Both nitrogen and phosphorus can be transported off site through leaching or surface runoff that may result in water quality impairment. Nitrogen is highly water soluble and therefore subject to leaching into shallow ground water. Nitrate contamination of wells has potential health impacts for humans and livestock. Young children and developing fetuses are especially susceptible to nitrate poisoning.

Phosphorus is less soluble than nitrogen but when phosphorus is repeatedly applied in excess of what the crop can use P builds up in the soil and can be leached or runoff as dissolved P. Phosphorus can also be transported off of fields with the soil when erosion occurs. Both nitrogen and phosphorus can cause increased plant growth in aquatic systems, reduced dissolved oxygen, fish kills, odors and reduction of water quality for drinking, recreation, and fish and wildlife.

Nutrient Management Planning
Nutrient management components of the conservation plan will include the following information:

- location map and soil map
- crops that will be grown
- soil test results
- If needed, results of water, plant, and organic material analyses
- expected yield
- sources of nutrients to be applied
- recommended nutrient rates, form, timing, and method of application
- location of designated sensitive areas
- guidelines for operation and maintenance

Nutrient management is most effective when used with other agronomic practices, such as residue management, irrigation water management, pest management, and crop rotation.

Nutrient Management Considerations

- Soil Test every year to obtain current nutrient levels. At a minimum one composite sample should be tested for each seasonal high tunnel.
- Apply nutrients based on soil test values and yield goals. Yields in a high tunnel can be 3 to 4 times the yield obtained in the field; therefore, generally more nutrients will be required to meet plant needs.
- If symptoms of nutrient deficiencies or toxicities are exhibited by plants, tissue tests may be used to help determine corrective actions.
- Optimum soil pH is between 6 and 7 for most vegetables. Increase soil pH by adding lime according to soil test results. Alkaline soils can be adjusted downward by adding elemental sulfur or fertilizers containing sulfur.
- Irrigation water testing can be helpful to determine if any potential problems (i.e. salts) could be caused by irrigation water application.
- Any organic material (compost, etc.) or animal waste that will be used as a source of nutrients should be tested to provide specific information on which to base application rates.
- Set realistic yield goals.
- Consider effects of irrigation on quantities of available nutrients.
- Use a water budget to guide timing of nutrient applications.
- Use split applications of nitrogen fertilizer for greater nutrient efficiency.
- Under fertilization can result in nutrient deficiencies and over application of nutrients can lead to salt build up and environmental degradation. Use plant symptoms (yellowing of leaves, interveinal chlorosis, etc.) to help identify specific nutrient deficiencies or toxicities. Many on-line references have excellent photo libraries of plants with nutrient deficiencies and toxicity symptoms.

Guidelines for Operation and Maintenance

- Review nutrient management component of the conservation plan annually and make adjustments when needed.
- Calibrate application equipment to ensure uniform distribution and accurate application rates.
- Protect nutrient storage areas from weather to minimize runoff and leakage.
- Avoid unnecessary exposure to fertilizer and organic waste, and wear protective clothing when necessary.
- Maintain records of nutrient application as required by state and local regulations.
- Clean up residual material from equipment and dispose of properly.

Making Specific Fertilizer Recommendations for Crops Grown Under High Tunnels

General fertilizer recommendations have been provided below and rates should be adjusted for individual high tunnel sites according to soil test results and the formulation and nutrient content of fertilizer to be used. Refer to AK Agronomy Technical Note 16 *Making Fertilizer Recommendations from Soil Test Reports*.

After the area under the seasonal high tunnel has been tilled, **broadcast** the specific fertilizer blend at the rate recommended by soil test or if a soil test is not available, broadcast a complete fertilizer (such as 8-32-16, 10-20-10, 16-16-16) at a rate of two to three pounds per 100 square feet, working it into the top two inches of soil. With broadcast applications consider applying half the amount at planting and half at mid-season to increase fertilizer efficiency and reduce the potential for leaching. To eliminate guesswork, remember that 2 cups of fertilizer is approximately 1 pound by weight. Both nitrogen and potash will injure seed and the roots of plants on contact, so thoroughly mix the fertilizer into the seedbed.

For equal results using approximately one-half the fertilizer, **band** the fertilizer. Place a **band** of the specific fertilizer blend recommended from soil test two to three inches away from and parallel to the row and one-inch below the seed using one-half the recommended fertilizer rate per 30 feet of row. If a soil test is not available, place a **band** of complete fertilizer two to three inches away from and parallel to the row and one-inch below the seed at a rate of one pound per 30 feet of row.

Fertilizers are also available in **water-soluble** form and are promoted to “feed” by applying to the foliage. Remember that leaves do not absorb much water; it’s the function of the roots to absorb. The following are the most commonly available water-soluble fertilizers: 5-10-5, 10-52-17; 8-32-16, 12-24-14, 15-30-15, and 13-26-13. Use these fertilizers at the rate specified by

the soil test and according to manufacturers mixing and application procedures or if a soil test is not available at a rate of 1-2 level tablespoons per gallon of water.

Remember when excess nitrogen is applied to crops such as tomatoes and squash, it is common to have all vines and no fruit or in root crops, such as turnips or carrots, you may end up with many leaves and small roots.

Alaska's short, cool growing season makes it important that transplants get a good start that can be aided by using a fertilizer starter solution. Starter solutions are available at most lawn and garden centers and are highly concentrated water soluble fertilizers with an analysis like 10-52-17. These fertilizers should be mixed according to directions on the label. Pour ½ cup of starter solution in each hole **before** the transplant is set into the ground. This will allow the soil in the transplant hole to settle providing maximum soil to root contact. After setting transplants, apply 1-2 cups of this solution around the roots of each plant to water in the transplant.

A recommendation for maintaining soil fertility is to add 2-4 inches of organic matter per year and maintain the proper pH by adding lime based on soil test results. Information about types of liming materials and calculating rates can be found in AK Agronomy Technical Note 15-*Liming Alaska Soils*. Good sources of organic matter include composted manure, yard or home compost and plant residues. Avoid using manures that have not been composted because untreated manure contains viable weed seed. In Alaska, chickweed seed is particularly prevalent in horse manure.

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

- periodic plan review to determine if adjustments or modifications to the plan are needed. As a minimum, plans will be reviewed and revised with each soil test cycle,

- protection of fertilizer and organic byproduct storage facilities from weather and accidental leakage or spillage,

- calibration of application equipment to ensure uniform distribution of material at planned rates,

- documentation of the actual rate at which nutrients were applied. When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.

- maintaining records to document plan implementation. As applicable, records include:
  - soil test results and recommendations for nutrient application,
  - quantities, analyses and sources of nutrients applied,
  - dates and method of nutrient applications,
  - crops planted, planting and harvest dates, yields, and crop residues removed,
  - results of water, plant, and organic byproduct tests or analyses, and
  - date of the last nutrient management plan review and person performing the review, and recommendations that resulted from the review.

Records should be maintained for two years; or for a longer period if required by other Federal, state, or local ordinances, or program or contract requirements.

Workers should be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated by the cleaning of nutrient application equipment should be accomplished properly. Excess material should be collected and stored or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.

HIGH TUNNEL NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Landuser: Field:
Assisted by: Date:

PURPOSE (check all that apply)	
■ Budget and supply nutrients for plant production	☐ Utilize manure/organic materials as a nutrient source
☐ Minimize agricultural non-point source pollution	☐ Maintain or improve soil condition
☐ Other	☐ Improve Plant Health

Table 1. Field Conditions and Recommendations

CROPS TO BE GROWN	EXPECTED YIELD
mixed veggies	
SIZE OF HIGH TUNNEL	**SOIL TYPE**

CURRENT SOIL TEST LEVELS (PPM or LB/ac)					
N	P	K	pH	O.M%	EC

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD BASED ON SOIL TEST					
Person Making Recommendation: UAF/CES, via tech. Note 16, interpreted by Jim Hazlett					
N	P_2O_5	K_2O	LIME	Other	Other

NUTRIENT MANAGEMENT SPECIFICATIONS			
Amount to be Applied (LB/ac)	***N:***	***P_2O_5:***	***K_2O***

Recommendation from Soil Test: **N-P205-K20**
Fertilizer Ratio Needed: **N-P205-K20**

Assessing different available fertilizer blends:

Participation in this practice requires the sampling of soil and or amendments, then providing the laboratory analysis to a Nutrient Management Specialist who was certified by NRCS. You will be provided a Nutrient Management Plan for your high tunnel crops based on UAF Extension recommendations. You will be required to apply the recommended amount of nutrients. It is the producer's choice on the Source of these nutrient amounts using commercial or organic nutrient sources. Please inform the Nutrient Management Specialist of your choice in this regard. And to seek advice to follow the recommendation.

Record keeping is an integral part of this practice. You will be required to provide records prior to practice certification and payment that identify: the type or blend of nutrients used (Source), including receipts, product labels, or amendment analysis; amount in pounds per how many Square Feet (Rate); date the nutrients were applied (Time); the method of application (Place); and crop production amounts (Yields).

This job sheet is informational and is provided as part of the contract folder to clarify practice requirements.

Fertilizer Types:

The three key nutrients for plant growth are nitrogen (N), phosphorus (P), and potassium (K). These nutrients are contained in most commercial fertilizer mixes. There are a number of commercially bagged fertilizers made from either organic or inorganic materials. Opinions vary concerning the merits of manures or other organic fertilizers versus “chemical” fertilizers. Excellent gardens may be grown using either method. Plants do not differentiate between nutrients from organic and chemical fertilizers; the form absorbed by plant roots from both sources is identical.

All commercially available fertilizers contain known amounts of nitrogen, phosphorus, and potassium. Each package bears a label specifying its contents in percent, example10-20-10. This number tells the amount of each element nitrogen (N), phosphate (P), and potash (potassium) (K), always in this order contained in the bag. For example, each 100 pounds of 10-20-10 fertilizer contains 10 pounds of nitrogen (N), 20 pounds of phosphorus (P), and 10 pounds of potash (K).

Non-commercial organic fertilizers include manure and compost. Soil bacteria and fungi must act on most organic nutrient sources to change them into a usable form. Thus, if you use mostly organic fertilizers, you may need to add a small amount of a source of more readily available nitrogen early in the season to ensure adequate plant nutrition until the organic sources become available to plants. Options include liquid fish, blood meal, and chemical fertilizer.

Application Methods:

Three ways to apply fertilizer are described below. Regardless of the method you use, keep the following facts in mind:

- The nitrogen in chemical fertilizers is highly water-soluble and is carried to the roots by irrigation and rain. Thus, you don't need to mix these materials into the soil, but you do need to water the plants under your high tunnel if rain doesn't fall within a day after you apply them.
- Organic sources of nitrogen are most accessible to plants if mixed into the top 2–3 inches of soil.
- Phosphate moves slowly in the soil. You'll obtain best results by banding phosphate containing fertilizer 2 inches below the seed when you plant or by tilling it into the soil during spring preparation.
- Work potassium fertilizers into the soil using the banding or broadcast methods. Do not allow potassium fertilizers to contact plant roots.

☐ **Broadcast**
Scatter the material uniformly over the surface manually or by using a drop or spin type fertilizer spreader. If an application method is not mentioned, broadcasting is implied.
☐ **Band**
Place the fertilizer in a trench about 3 inches deep. The corner of a hoe works well to make the trench. Sow seeds or plant seedlings 1 1⁄2 to 2 inches above and to the side of the fertilizer. The plant roots quickly absorb the nutrients and grow rapidly.
☐ **Sidedress**
Scatter the fertilizer material close to growing plants. Keep fertilizer granules off leaves to prevent burning. Nitrogen is very soluble and need not be mixed with the soil. A fertilizer blend containing nitrogen, phosphate, and potash should be lightly scratched in, but take care to avoid damaging plant roots. Apply irrigation so the plants can absorb the nutrients.

Fertilizer Timing:

☐ Apply a complete fertilizer in the spring when the soil is tilled.

☐ An additional application of nitrogen may be required as the plants start fruiting and/or making considerable growth*. Sidedress 1 lb urea per 100 feet of row OR Broadcast 1 lb urea per 100 square feet, OR apply a similar amount using a soluble fertilizer solution

*Note that crops such as carrots, beets, turnips, parsnips and lettuce do not need additional nitrogen and application of excess nitrogen can result in reduced yields and/or lower quality produce. Crops that can benefit from additional nitrogen include cabbage, cauliflower, broccoli, cucumber, peas, beans, peppers, egg plant, spinach, kale, greens and tomatoes.

Record Keeping

- Documentation of the actual rate at which nutrients were applied. When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.
- Maintaining records to document plan implementation. As applicable, records include:
  - soil test results and recommendations for nutrient application,
  - quantities, analyses and sources of nutrients applied,
  - dates and method of nutrient applications,
  - crops planted, planting and harvest dates, yields, and crop residues removed,
  - results of water, plant, and organic byproduct analyses, and
  - date of last review and person performing the review, and recommendations that resulted from the review.

Records should be maintained for five years; or for a period longer than five years if required by other Federal, state, or local ordinances, or program or contract requirements.

Nutrient Management – Job Sketch

Draw or sketch the field, showing any sensitive areas and required setback zones. Inside each sketched field, enter total field acres and net application acres. Other relevant information, such as complementary practices or adjacent field or tract conditions may be included.

Scale 1"= ft. (NA indicates sketch not to scale: grid size=1/2" by 1/2")

Perform the following operations and maintenance:	
Review this nutrient management plan every year.	
Maintain field records for at least 2 years or if under an EQIP contract, for the life of the contact.	
Calibrate application equipment.	
Handle all nutrient material with caution. Wear appropriate protective clothing.	
Clean up residual material from equipment and dispose of properly.	
Additional specifications and notes:	

This plan was developed based on the requirements of the current NRCS standard and any applicable Federal, state, or local regulations or policies. Changes in any of these regulations may necessitate a revision of the plan.

Seasonal High Tunnel System – Operation and Maintenance Plan

Operation and Maintenance

An operation and maintenance (O&M) plan shall be prepared and reviewed with the landowner or operator.

The following items are required for the operation and maintenance of the high tunnel.

- The high tunnel structure will be installed and maintained per manufacturer's instructions.
- Duration of operation of the high tunnel is 4 years. Any disruption in operation due to damage to the structure is in violation of the EQIP contract. It is the responsibility of the participant to repair damage or replace irreparable material to continue high tunnel operation.
- Maintain proper drainage around and away from the high tunnel structure.
- If plastic cover is removed for winter storage, place the material where it will not be handled, moved, or disturbed when cold.

PLAN CERTIFICATION

This practice is designed and planned according to NRCS AK Standards and Specifications.

_____ _____

Signature of person preparing plan Date

_____ _____

Signature of Certified Specialist in Nutrient Management. Date

I agree to install this practice as designed and planned.

Client: _____ **Date:** _____

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Practice Name(Code):

Owner _____

Operator _____

Location _____

Field #s _____

Tract # _____ Farm # _____

Program_____ Contract # _____ Acres Planned_____

Acres Applied_____

PRACTICE CERTIFICATION

This practice was installed and maintained in accordance with the accompanying Nutrient Management job sheet and will meet the intended function and purpose as described in the design specification.

☐ **YES** ☐ **No**

Recommendations and Comments:

_____
_____
_____
_____
_____
_____
_____

Operation & Maintenance

Periodic monitoring of this practice is essential to determine 1) if production and ecological goals are being met, 2) if facilitating practices are installed, maintained, and adequate, and 3) if modifications are needed.

Completed by: _____ **Date:** _____

ORGANIC SOURCES OF NUTRIENTS When manure, compost, or other organic sources of nutrients are land applied there is a potential for buildup of phosphorus, heavy metals or other elements in the soil. Some of these elements can reach environmentally harmful levels over time and may accumulate to concentrations that are toxic to plants.

Micronutrient levels tend to be higher in organic nutrient sources than in commercial fertilizers. Micronutrients are essential for plant growth in small amounts but can become toxic to plants at higher levels. Consistent use of manufactured fertilizers that do not contain micronutrients combined with intensive cropping systems can also deplete soil micronutrients over time. Therefore, soil tests should include micronutrients when these conditions exist

Phosphorus can be transported off of fields through erosion and runoff. At very high levels of soil phosphorus, leaching can move P into groundwater. When phosphorus is transported in runoff it can lead to eutrophication of the receiving waters. Since phosphorus is an essential element for plant and animal growth it can cause excess growth when it accumulates in surface water. This growth causes changes in the aquatic plant community, increased growth of algae and depletion of the oxygen in the water from decomposition of the excess plant growth. The end result can be fish kills, loss of recreation opportunities and contamination of drinking water.

Growing and harvesting crops and providing vegetative filters may be all that is needed to reduce the phosphorus level of the soil and prevent P transport into surface water.

When growing "fresh edible crops for produce market, such as vegetables, root, or tuber crops" and using compost, animal manure or other organic materials as sources of plant nutrients, applications should be in accordance with applicable Federal, State, and/or local laws or policies.

Sewage sludge or other products containing human wastes should NOT be used on food crops for human consumption.

MANURE

Use the Alaska Phosphorus Index to assess the risk for phosphorus pollution from a field or management unit. If the risk is low or medium manure can be applied based on nitrogen needs of the crop, however, applying manure based on nitrogen will usually result in an accumulation of soil phosphorus over a period of several years. It is common for the fields closest to the manure storage to have the highest levels of accumulated phosphorus because it is easy and quick to apply manure to these fields.

As phosphorus builds up in the soil it will show up in soil tests. Long term record keeping and monitoring of trends will indicate if phosphorus is reaching an environmentally harmful level. Periodic use of the Phosphorus Index will indicate when land applications of manure should switch to a phosphorus based instead of a nitrogen based rate.

When manure is applied to agricultural crops based on phosphorus content, the amount of nitrogen supplied by the manure is less than that required by the crop. Supplemental applications of nitrogen (N) fertilizer may be required for optimum crop yield.

The farm manager may choose to reduce the amount of manure applied annually to fields *before* a critical level of soil phosphorus is reached. Soil test records can be used to determine if a buildup is occurring or if practices are maintaining a steady level of soil phosphorus.

Other option for managing phosphorus include feeding low phosphorus feeds and applying amendments to stored manure to reduce volatilization of nitrogen. These practices maintain a better balance between nitrogen and phosphorus in the manure.