NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

ALLEY CROPPING

(Ac.)

CODE 311

DEFINITION

Trees or shrubs planted in sets of single or multiple rows with agronomic, horticultural crops or forages produced in the alleys between the sets of woody plants that produce additional products.

PURPOSE

Alley Cropping is used to achieve one or more of the following purpose(s):

- Enhance microclimatic conditions to improve crop or forage quality and quantity.
- Reduce surface water runoff and erosion.
- Improve soil health by increasing utilization and cycling of soil nutrients.
- Alter subsurface water quantity or water table depths.
- Enhance wildlife and beneficial insect habitat.
- Increase crop diversity.
- Decrease offsite movement of nutrients or chemicals.
- Increase carbon storage in plant biomass and soils.
- Develop renewable energy systems.
- Improve air quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all cropland and hayland where trees, shrubs, crops and/or forages can be grown in combination.

CRITERIA

Use the following criteria in planning and applying this practice. The general criteria apply to all alley cropping, while additional listed criteria apply based on the intended purpose(s) of the practice.

General Criteria Applicable to All Purposes

Selecting Plant Species

Combinations of crops or forages and woody plants shall be compatible and complementary, and provide products and crops that meet landowner objectives.

Plants shall be adapted to the climatic region and the soil resource and suited to the landowner's equipment and management capabilities.

Crop or forage sequence and woody species selection shall be determined using an acceptable nutrient balance procedure. Select crops, forages and woody plants that maximize the utilization and cycling of soil nutrients and plant residues to maintain soil organic matter content.

Moisture conservation or supplemental watering shall be provided for plant establishment and growth where natural precipitation is too low for the selected species.

Select pest resistant plant varieties.

Avoid selecting tree/shrub species which will provide habitat to pests of the accompanying crop or forage.

Select crop, forage, and tree/shrub varieties based on their tolerance to agricultural chemicals that may be used in the alley cropping system.

Select crops or forages and woody plants that have complementary water requirements.

Select tree/shrub species that minimize adverse affects to alley crops or forage (e.g. shade, allelopathy, competing root systems/ sprouts, provide habitat to pests of the accompanying crop or forage).

Density and Spacing

Crops (woody and herbaceous) shall be grown in a planned conservation management system. The distance between the sets of trees or shrubs will be determined by the following tree or shrub management objectives:

- Tree and shrub management objectives
- Light requirements and growth period of the crops or forages in the alleys.
- Erosion control needs.
- Machinery widths and turning areas.

Site Preparation and Planting

Avoid planting trees or shrubs where they will interfere with structures and above or below ground utilities.

Planting dates, care in handling, and planting the seed, seedlings, or cuttings will be accomplished to assure acceptable plant survival.

Only viable and high quality planting stock or seed will be used for establishing the tree or shrub rows.

Site preparation shall be sufficient for establishment and growth of selected species and appropriate for the site.

Refer to TREE/SHRUB ESTABLISHMENT – NC Practice Standard 612 for further guidance on planting trees and shrubs.

Other General Criteria

Soil erosion will be controlled by vegetative or other means until the alley cropping design is fully functional.

Comply with applicable federal, state and local laws and regulations, during the installation, operation (including product harvesting), and maintenance of this practice.

Note: Specific pesticide recommendations will be obtained from personnel who are licensed by the NC Department of Agriculture and Consumer Services in specialty area Agricultural Pest Plant Category O (agricultural, plant) or G (forest) - in accordance with North Carolina Pesticide Laws and Regulations.
All pesticides must be registered for use by North Carolina and approved for use by the U. S. Environmental Protection Agency (EPA). Refer to the current issue of "North Carolina Agricultural Chemicals Manual" for guidelines, rules and regulations regarding use of pesticides. Users must **always** follow instructions and safety precautions on the container label when handling, applying, or storing pesticides.

Additional Criteria to Enhance Microclimatic Conditions to Improve Crop or Forage Quality and Quantity

Select tree/shrub set species that will provide a beneficial symbiotic environment for the target crop or forage species.

Select tree set density/width/orientation and crop set width/orientation that will maximize the required microenvironment for the target crop/forage.

Additional Criteria to Reduce Surface Water Runoff and Erosion

Tree or shrub rows will be oriented on or near the contour to reduce water erosion.

To reduce surface water runoff and erosion, herbaceous ground cover will be established in conjunction with the tree or shrub rows.

Selected species of trees and shrubs will be relatively deep rooted to encourage infiltration.

Use multiple rows of woody planting sets for enhanced reduction of surface water runoff and soil erosion where needed.

If wind erosion is a concern, align tree or shrub rows perpendicular to erosive winds as close as possible.

Additional Criteria to Improve Soil Quality by Increasing Utilization and Cycling of Nutrients

Select tree and crop species that have compatible soil biology and complementary nutrient needs.

Minimize soil disturbance in alley crops by using no-till planting methods.

Additional Criteria to Alter Subsurface Water Quantity or Water Table Depths

Alley Cropping is not normally used as a primary means for altering subsurface water table depth. When applicable, select tree/shrub species that are deep rooted and have high transpiration rates.

Select tree set density/width and crop set width that will provide the minimum to optimum water table for the target crop/forage.

Additional Criteria to Enhance Wildlife and Beneficial Insect Habitat

Woody species selection shall benefit targeted wildlife or insect species. Design dimensions of the woody planting shall be adequate for targeted wildlife species.

Plan and use crop and forage management techniques (residue management, timing of mowing/harvest, etc.) in the alleys that will benefit target wildlife and insect species.

Additional Criteria to Increase Crop Diversity

Alley cropping by default is biologically more diverse than standard monoculture and allows opportunity for more diverse and marketable crops. To further increase crop diversity select multiple crops for the crop sets and/or select multiple nut/fruit trees for the shrub/tree sets.

Additional Criteria to Decrease the Offsite Movement of Nutrients or Chemicals

Follow the additional criteria to reduce surface water runoff and erosion.

Additional Criteria to Increase Carbon Storage in Biomass and Soils

Carbon sequestration is generally a secondary criterion for alley cropping. For optimal carbon sequestration both above and below ground, select woody plants (or mixtures of plants) that are adapted to the site to assure strong health, vigor and rapid growth. Plant the appropriate FULL stocking rate for the site and maximize the size (width and length) of the tree/shrub sets to fit the site. Some plants may fix carbon in biomass and soils more efficiently than others; consult current research on adapted plants that may sequester carbon more efficiently.

Minimize soil disturbance in alley crops by using no-till planting methods.

Prediction of carbon sequestration rates shall be made using current, approved carbon sequestration modeling technology.

Additional Criteria to Develop Renewable Energy Systems

Select plants that can provide adequate kinds and amounts of plant biomass to supply identified bioenergy needs.

Intensity and frequency of energy biomass removals will be managed to prevent long-term negative impacts on the system.

Harvesting of energy biomass shall be done in a manner that will not compromise other intended purpose(s) and functions.

Additional Criteria to Improve Air Quality

Use plant species (crop, forage) in the alley that provide full ground coverage during establishment and harvest operations.

Residue from the alley-crop shall be left on the surface.

Select and maintain tree/shrub species with foliar and structural characteristics that optimize interception, adsorption and absorption of particulates.

Tree or shrub rows will be oriented as close to perpendicular as possible to prevailing wind direction during critical air quality period(s).

CONSIDERATIONS

Species diversity including use of native species should be considered to avoid loss of function due to species-specific pests or enhance wildlife needs.

Consider invasive potential when selecting plant species.

Select crops, forages and woody plants for water requirements not to exceed available soil water.

Consider plant characteristics (rooting depths, growth pattern, etc.) of woody plantings and alley crops; where possible, choose planting sets that compliment each other (i.e. one growing while one dormant, one deep and one shallow rooted, etc.).

Crown expansion of woody plantings may eventually begin to shade alley areas and more shade resistant alley corps or forages may be required. If light demanding crops/forages are desired for more than 15 years, widen alleys to 40 feet or more.

Consider cultural resources when planning this practice.

High value trees or shrubs should be selected to maximize economic returns.

Coppice ability of selected species of trees and shrubs should be considered when they are to be pruned periodically.

Consider modifying microclimate conditions and habitat to enhance biological pest management.

PLANS AND SPECIFICATIONS

Plans and Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

Minimum documentation for this practice includes:

- Plant materials or species to be planted.
- Plant spacing and arrangement/width of crop/forage alleys and woody set plantings.
- Site preparation and planting method(s) for woody planting rows.
- Site specific needs for soil amendments, cultural, pest management or other practices.
- Time or season of year to plant.
- Statement requiring compliance with all federal, state and local laws.
- Operation and maintenance requirements.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

- Replacement of dead trees or shrubs will be continued until the woody set is established. As a guide:
  - first 2 years: replace any dead plants found
  - after 2 years: replace plants to maintain at least 85% survival, and not leave two adjacent dead plants.
- All other specified maintenance measures and techniques of tree/shrub establishment will continue until plant survival and establishment are assured. This includes pruning of dead or damaged branches for safety reasons, periodic pruning of selected branches for control of product quality, and control of undesirable competing vegetation
- Inspect trees/shrub sets, crops, and/or forages periodically and protect from adverse impacts including insects, diseases or competing vegetation. Tree/shrub sets will be protected from fire and damage from livestock or wildlife.
- Removal of tree/shrub products, use of agricultural chemicals, and maintenance operations shall be consistent with the intended purpose of the practice. Avoid damaging the site and soil.
- Comply with applicable federal, state and local regulations pertaining to on-site and off-site effects.

REFERENECES

National Agroforestry Center, Lincoln NE. *Alley Cropping: An Agroforestry Practice.* Agroforestry Note # 12.

Buck, L.E. and Lassoie, J.P. 1998. *Agroforestry in Sustainable Agriculture Systems*.

Gordon, A.M. and Newman, S.M. 1997. *Temperate Agroforestry System.*

Kimble, J.M., Heath, Linda S., Birdsey, Richard A., Lal, R. editors. 2003. *The Potential of U.S. Forest Soils to Sequester Carbon and Mitigate the Greenhouse Effect.*