TECHNICAL NOTES

AGRONOMY NO. 23 **August 28, 2003**

SUBJECT: Mulching Information

BACKGROUND: Mulch is a non-living material placed on the soil surface to protect the soil from wind and water erosion, facilitate infiltration, reduce evaporation, and moderate soil temperatures. It is the application of plant residues, by-products or other suitable materials produced off site, to the land surface.

PURPOSE: To conserve soil moisture; moderate soil temperature; provide erosion control on critical areas; suppress weed growth; assist in the establishment of vegetative cover; and to improve soil condition and soil fertility.

CONSERVATION MANAGEMENT SYSTEMS: Mulching may be a component of a conservation management system. It is used in conjunction with Critical Area Planting, grass seeding, tree and shrub plantings, conservation buffer practices, grassed waterways, and other practices on a site-specific basis to address natural resource concerns and the producer's objectives. The major role of mulching is to conserve soil moisture and control erosion on sites lacking adequate protection. Mulching generally can improve overall germination and seedling establishment and protect the soil resource.

MULCHING PLANNING: The need for mulching is based on the potential for erosion and the potential benefits mulch can provide toward the establishment of grass and other more permanent cover. On shallow sites where soils are not highly erodible, soil moisture and organic matter is present, high winds are not a problem and no soil crusting is expected to occur, mulching may not be necessary.

Mulch components of the conservation plan will include the following information:

- Type of mulch material used
- Percent cover and/or thickness of mulch material
- Timing of application
- Site preparation
- Listing of netting, tackifiers, methods of anchoring
- Operation and maintenance
- Plan map of managed fields
- Results of the Soil Conditioning Index and the Nutrient Management Budget

When mulching is applied to reduce soil moisture evaporation on a grass planting, seeding must be completed prior to mulching. At least 60 percent cover is required to reduce evaporation. When mulching is completed to moderate soil temperature, 100 percent coverage over the area is required. When mulching is completed to protect against soil and water erosion, at least 70 percent ground cover is required. To suppress weeds, 100 percent ground cover is required.

PLANNING GUIDELINES: Straw mulches consisting of wheat, barley, and/or oats are the most common mulches. Application rates can vary, but average two tons per acre. Care must be taken to use certified weed-free straw to prevent the introduction of noxious weeds onto the site. Stems need to be as long as possible to increase its life expectancy as mulch. Straw can be placed on the site by hand or with a blower for large areas. Straw mulch often needs to be anchored to prevent being blown away or washed away by overland water flow. The use of tackifiers, plastic, or biodegradable netting is an effective way to retain the straw on the site. Mechanical crimpers have also been used to push the straw into the soil surface on sites where the use of heavy equipment is feasible.

Hydromulching with wood fiber or paper in water slurry is another form of mulching. This requires the use of a machine called a hydromulcher or hydroseeder, and equipment access to the site. Wood fiber mulches are usually more effective than paper mulches because the longer wood fibers adhere to the soil and are more resistant to wind and water erosion. Hydromulch is often applied at average rates of 1,500 lbs. to the acre and a tackifier can be used to help it stay on the

Perennial native or introduced grass should have at least 50 percent of the stems and leaves, by weight, 10 inches long or longer, before being applied to the site. Hay containing mature seed may be used if it is the same species and/or variety as the species used in planting. Native hay mulches often contain high levels of noxious weed seed or other non-desirable plant species. Great care must be exercised when using native hay; if the introduced species are desirable, then native hay can result in increased diversity of the resulting plant community. Therefore, native and introduced hay mulch should be free of noxious weed seed and mold.

Small grain straw shall consist of wheat, oats, barley, or rye straw from which the grain has been removed. At least 50 percent of the stems, by weight, should exceed 6 inches in length before being applied to the site if anchored by resin, netting, tackifiers, etc. When anchored mechanically, 50 percent of the stems, by weight shall exceed 10 inches in length.

Woodchips. sawdust, and bark can also be used as mulch. These can be quite inexpensive if local sources are present. Wood residues are very long lasting compared to other mulches. However, nutrients like nitrogen can get tied up and immobilized in the wood during the decay process. The addition of fertilizer can help offset nitrogen deficiencies during decomposition.

Wood fiber mulch should be cut from green timber. The timber should be cut for maximum fiber length and at slight angle to the wood grain to promote splintering while weathering. As a guide, 50 percent of the fibers, by weight, need to be 6 inches in length.

Spread mulch uniformly by hand or mechanically at the rates shown in TABLE 1. When spread by hand, the bales of hay must be torn apart, "fluffed up" and spread uniformly over the area. For uniform distribution of hand spread mulch, divide the area into 1000-square foot sections and spread the mulch at the rate shown in TABLE 1 in each section. Mechanically applied mulches should not be applied when wind velocities exceed 15 miles per hour.

The use of pre-made erosion control mats are also effective for revegetation and rehabilitation projects. These mats come in a variety of types, sizes, and strengths and can be expensive. Mats made from straw and/or coconut fiber with biodegradable netting are rolled onto the site and secured with metal staples. Stronger mats, either pure coconut fiber or synthetic fibers need to be used on sites with high erosion hazards, high velocity overland flow rates, or steep slopes.
Mulching after seeding can improve the success of the revegetation by keeping the seed in contact with soil, moderating temperatures, and reducing water loss necessary for germination. Mulching around planted seedlings can also improve water availability and provide protection from the environment.

If soil crusting has occurred on the surface of the soil prior to seeding, the crust must be broken up and the application of a mulch and tackifier should be utilized. If rainfall has occurred on disturbed areas prior to seeding, crusting has probably occurred. Stockpiling the organic layer and topsoil while building roads or other activities for redistribution later is a very good idea. One of the biggest problems in poor revegetation success is the lack of organic matter and nutrients needed by the plants. Sampling soil pH, bulk densities, and nutrient levels present on and in the seedbed will provide information to help decide if soil amendments, mulches, fertilizers, or other cultural treatments are necessary.

See TABLE 5 for various mulch types and descriptions, and considerations.

Anchoring

Hay, straw, or wood fiber mulches should be anchored using one of the following **hand methods:**

Using stake and twine anchor immediately after spreading mulch. Drive 8-10 inch wooden stakes to within 2 or 3 inches of the soil surface every 4 feet in all directions. Drive stakes before mulch is applied. Secure mulch to soil surface by stretching twine between pegs in a crisscross-within- a-square pattern. Secure twine around each peg with two or more round turns or a clove hitch.

When using mulch netting staple lightweight paper, jute, cotton, or plastic netting to the soil surface according to the manufacturer's recommendations. The mesh size of the fabric should not exceed 1-1/2 inches by 3 inches. The plastic netting should contain a carbon black additive for longer life durability.

When using silt anchoring use a square-pointed spade and cut mulch into the surface soil in contour rows 12 inches apart.

If mulch is **anchored mechanically** use the following methods:

The seedbed must be tilled to a minimum of 4 to 6 inches deep immediately before placing and anchoring

The rows of furrows made by the mulch tiller should be spaced not more than 9 inches apart. Penetration depth should be about 2 to 3 inches. The mulch will not be covered with excessive amounts of soil. Limit to no more than two (2) passes by the disk. All mulching operations will be completed as close to the contour as possible.

A farm disk set straight may be used if weight is added to provide adequate penetration depths and if it tucks the material with cutting.

Travel speeds must be reduced to prevent excessive burial of seed and mulch material.

If asphalt or asphalt emulsion tackifier is used, use the following method:

See TABLE 2 for application rates.

Asphalt shall be liquid or cutback asphalt of grade RC-70 or equivalent and shall contain no water. Asphalt emulsion shall consist of liquid emulsion of water and natural bituminals of asphalt grade SS-1 or equivalent.

The asphalt shall be applied with a mechanical mulch blower equipped with an emulsion spray system that has a heating unit. Asphalt shall be applied continuously to the mulch as it passes through the nozzle end of the mulch blower and is broadcast upon the ground.

Do not apply asphalt to the surface of the mulch after it is spread on the ground. Do not apply asphalt when the air temperature is less than 50 degrees F.

If **resin emulsion mulch tackifier** is used, apply with the following method:

See TABLE 2 for application rates.

Resin emulsion shall consist of liquid emulsion of water and natural petroleum or acrylic resins prepared specifically for soil stabilization of a type and grade similar to Petroset SB, American Cyanamide, Aerospray 70, or Curosol AH.

The resin is applied with a mechanical mulch blower equipped with an emulsion spray system. Resin should be applied continuously to the mulch as it passes through the nozzle end of the mulch blower and is broadcast upon the ground.

Do not apply asphalt to the surface of the mulch after it is spread on the ground. Do not apply asphalt when the air temperature is less than 50 degrees F.

TABLE 1. Application Rates for Hay, Straw, and Wood Fiber Mulch Anchored with Anchoring Tools or Other Methods.

METHOD OF ANCHORING AND MULCH	RATE FOR MULCH (POUNDS)		RATE FOR ASPHALT OR RESIN EMULSION (GAL)	
	PER ACRE	PER 1,000 FT^2	PER ACRE	PER 1,000 FT^2
ANCHORED WITH DISK				
Native or tame hay	5,000	115	_____	_____
Small grain straw	4,000/5,000*	115	_____	_____
Wood fiber	4,000	91	_____	_____
ANCHORED W/ ASPHALT OR RESIN EMULSIONS				
Native or tame hay	3,000	70	300	7
Small grain straw	3,000	70	300	7
Wood fiber	3,000	70	300	7
ANCHORED W/ MULCH NETTING OR STAKE AND TWINE OR SHOVEL (SILT)				

TABLE 2. Rate of Application for Resin and Asphalt Mulches.

MULCH	SOIL TYPE	RATE			
		CUPS/YARD^2		GALLON/ACRE	
		MATERIAL	WATER	MATERIAL	WATER
RESIN EMULSIONS*					
Petro set SB	Loamy sand	5/8	6	200	1,800
Aerospray 70		5/8	6	200	1,800
Curosol AH	Sandy loam	1/8	6-1/2	50	1,950
PetrosetSB	Loam	5/8	4-1/2	200	1,300
Aerospray 70		5/8	4-1/2	200	1,300
Curosol AH		1/8	4-1/2	50	1,450
ASPHALT EMULSIONS					
SS-1	all soils except	4	_____	1,200	_____
CSS-1	silty clay and clay		_____		_____
CUT-BACK ASPHALT					
RC-70	all soils	4	_____	1,200	_____

When a resin emulsion or asphalt emulsion is used to temporarily stabilize soil surfaces for wind erosion control, use the following method:

Resin emulsions and asphalt emulsions form a crust on the soil surface that will protect the soil against wind erosion for a period of time until other organic mulches can be applied. The crust will also significantly increase surface runoff from rainfall. Do not use where the potential for surface runoff exists during the period soil is to be protected. If these conditions exist, use an organic mulch to protect the site.

The crust will also hinder emergence of seedlings. Therefore, do not seed before applying resin emulsion or asphalt emulsion.

When a **soil retention blanket** is used, use the following method:

A soil retention blanket is made of a uniform web of interlocking wood fiber that has a backing of mulch net fiber on one side only. The fibers should be made from aspen wood and shou.id be 0.021 inch by 0.042 inch plus or minus 25 percent and a minimum of 4 inches in length. The top side is covered with extruded plastic netting. Maximum mesh size shall not exceed 2 inches by 1 inch.

For longer life and durability, netting with carbon black additive is recommended. Thickness of the blanket shall not be less than 1/4 inch before installation.

Roll weight shall average 0.8 pounds per square yard plus or minus 10 percent at the time of manufacturing. This information will be stenciled on the roll wrapper or attached tag. Staples used to anchor retention blankets should be U-shaped, 11 gauge or heavier wire, approximately 2 inches wide at the throat, and a minimum of 8 inches in length.

Place blanket with the netting on top and the fibers in contact with the soil over the entire area to be covered. The blanket should be unrolled approximately along the contour of the slope. Begin at the bottom of the slope. Lap each subsequent roll approximately 4 inches over the adjoining roll.

When used in water overflow areas, the blanket should be unrolled in the direction of flow and lapped 4 inches over the adjoining downstream roll. When using two or more blankets side by side in a ditch, do not put the seam (lapped edges of the adjoining blankets) in the center of the water flow. Offset seam 6 to 12 inches. In drainages, blanket shall be placed to cover design flow depths.

Blanket must be stapled at joints, corners, and approximately 5-foot intervals along the sides and lapped

Other Mulches

Wood chips or Bark: Wood chips or bark are well suited for mulching of woody plantings. Use bark chips from fir, pine, larch, hemlock, or western red cedar that has a maximum dimension of 3 inches or shredded particles from the bark. A layer of bark or chips greater than 1 inch may affect seedling emergence.

Cover the entire area when making mass shrub or tree plantings. For single plant seeding, spread chips or bark around the base and extend outward 18 inches from the main stem or trunk. Applying a depth of 3-4 inches will assist in controlling weed competition.

Do not use in water flow areas.

Straw Mulchina on Irriaated Land: Straw may be applied in furrows under either furrow or sprinkler irrigation at the minimum rates shown in TABLES 3 and 4.

TABLE 3. Straw Mulch Application on Irrigated Land.

SLOPE	MULCH RATE lbs/100 feet of ROW
0-2	2.00
2-3	4.00
3-4	6.00
>4	8.00

TABLE 4. Straw Weight for Irrigated Row Widths.

ROW SPACING (in)	POUNDS OF STRAW PER 100' OF ROW 1.0	2.0	3.0	4.0	8.0
22	240	480	720	960	1,920
30	175	350	525	700	1,400
36	145	290	435	580	1,160
44	120	240	360	480	960

Guidelines for Operation and Maintenance

- Review the 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.
- Observe setbacks required for nutrient applications adjacent to water bodies, drainageways, and other sensitive areas.
- Maintain records of nutrient application as required by state and local regulations.
- Clean up residual material from equipment and dispose of properly.

SUMMARY OF MULCHES, EROSION CONTROL BLANKETS, TACKIFIERS, AND GEOMATRIXES.*

This is a representative list.
Other suppliers are available.

PRODUCT NAME	SUPPLIER	DESCRIPTION, ADVANTAGES, AND DISADVANTAGES.
Enkamat	American Excelsior	Heavy-duty nylon monofilament fibers with 95% pore space. Lightweight, flexible, and permeable to water. Expensive, permanent.
Curlex	American Excelsior	Aspen wood shavings in Biodegradable plastic mesh. Lightweight, easy to install, netting decomposes in 2-5 years. Netting may decompose unevenly.
Hi-V Curlex	American Excelsior	Aspen wood shavings with heavy plastic netting. Effective on steep slopes with high velocity run-off. Heavy plastic has long biodegrade time.
Am-Tak	American Excelsior	Tackifier for wood and straw mulches. Non-toxic, biodegradable and easy to use. Increased costs and application equipment needed.
Excel mulch	American Excelsior	100% aspen fiber mulch. Organic, biodegradable, effective in promoting seedling survival. Increased cost.
Bio-D-mat	American Excelsior	100% coconut fiber blankets. Very strong, heavy-duty erosion control blanket. Expensive and long biodegrade time.
Armater Geomatrix	American Excelsior	Non-woven polyester hexagonal matrix. Provides strength, flexibility, and anchors soil surface. Expensive.
S2 Straw Blanket	Bonterra American	Straw blanket with netting on both sides. Inexpensive, biodegradable, lightweight, easy installation and promotes seedling survival. May decompose too fast. Not suited to high velocity run-off.
CS2 Coconut and Straw Blanket	Bonterra American	Coconut and straw blanket with netting on both sides. Strong, lightweight, biodegradable, easy to install, promotes seedling survival. Uneven decomposition.
CS Coconut Blanket	Bonterra American	100% coconut blanket with netting on both sides. Strong yet still lightweight, good for high velocity run-off. Slow biodegrade.
SFB synthetic	Bonterra American	Polyethylene fiber blankets. Light weight and strong. Expensive and very long decomposition time.

* Taken in part from the Region 1 Native Plant Handbook, US Forest Service.

Table 5. Mulch Types*

Type	Description	Required Equipment	Application Rate	Consideration	Cost	Life
Straw	Certified Straw	Hand application, blown-on, or applied by Helicopter	4,000 lbs/ac on North slopes 5,000 lbs/ac on South slopes	Difficult to install on extremely Steep slopes except by helicopter.	$1,000/ac by Hand $3,000/ac by Helicopter	2 Years
Hydro Seed Wood Cellulose Mulch	Hydro Mulch with Wood Cellulose	Applies with a Hydro Seeding Machine	2,000 lbs/ac	Hydro Seeders are expensive to move in and are in short supply in the fall. Seeding may not be current with construction. Highly effective.	$1,000/ac by Hand $3,000/ac by Helicopter	1 Year
Hydro Seed Paper Mulch	Hydro Mulch with Paper Cellulose	Applies with a Hydro Seeding Machine	2,000 lbs/ac	Same as Above.	$1,000/ac plus Mobilization	1 Year
Blankets (some come mpregnated with Seed)	Various types of Pre-Made Erosion Control Blankets	Rolled out and staked or pinned down	By the square foot	Effective, netting decomposes at a rate different than mulch. Expensive.	$.49-$3.50 per Sq. Yd. for material only; add labor	2 Years
Netting	Various types of Biodegradable and Non-degradable Netting	Rolled out and staked or pinned down	By the square foot	Can trap animals, decomposes Slowly; used over mulch. Biodegradable types are available.	$.20-$.50 per Sq. Yd. for material only; add labor	2 Years
Channel Liners	Various width Heavy Duty Blankets	Rolled out and staked or pinned down	By the square foot	Effective; usually left in place. Very expensive.	$3.00-$3.50 per Sq. Yd. for material only; add labor	3 Years
Tackifiers	Sprayed-on material used to hold soil in place	Sprayed-on, usually with a truck-mounted sprayer	By the square foot	Short Term	$800/ac plus Mobilization	1 Year
Sodding	Grass Sod	Rolled out and pinned down	By the square foot	Used when instant plant establishment is important.	$.17 Sq. Ft.; add delivery and labor	Indefinite

*Taken in part from the USDA - Forest Service, Region 1, Native Plant Handbook.