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MULCHING FOR ROAD BANK FIXATION ^{1/}

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Road bank fixation experiments begun by this Station in the spring of 1934 now offer an opportunity to compare the results of different methods after five growing seasons. During recent years large scale road bank projects have been carried out by several agencies and a comparison and study of these extensive projects has just been completed.

It is obvious that no uniform method of road bank fixation can be applied throughout any large road bank project in the Southern Appalachian region. Each individual road bank actually may present a specific problem requiring modification of the general method used. For example, on through cuts direct planting of root clumps of honeysuckle have quickly covered a north facing road bank, whereas the opposite south facing bank planted in an identical manner showed practically no growth on the middle portion of the bank. This difference in growth is attributed to unfavorable moisture and temperature conditions on the south facing bank and indicates that moisture was the limiting factor for successful establishment of the vegetation.

Observations of road bank plantings in North Carolina, Tennessee, and Georgia show that far too much confidence has been placed in the ability of certain plant species, particularly honeysuckle, to grow on any site regardless of the moisture, fertility, soil reaction, or steepness of the slope. Although honeysuckle is one of the very best plants to be used for road bank fixation, and will grow under a remarkably wide range of soil conditions, nevertheless, it will not thrive on dry infertile banks and attempts to plant such banks have frequently resulted in a complete loss of time and money expended. When no mulching is used, honeysuckle planted in sloping furrows or in contour furrows has generally grown better than when planted in holes. However, except on comparatively moist rich banks, honeysuckle plantings have not been successful in covering the bank and holding the soil as well as had been anticipated.

It now appears that present methods of handling and transplanting root clumps of woody shrubs are adequate. To obtain more thrifty growth, however, more attention must be given to improving the growing conditions on planting sites. Severe erosion of the banks and extreme desiccation of the soil should be prevented until growth has developed sufficiently to form a ground cover. Unless this is done frost heaving may cause sloughing of the bank and the root clumps become

^{1/} Field crew organization data were obtained on the Coweeta Experimental Forest by J. W. Wood, Junior Forester, and T. F. Swofford, Assistant to Technician, CCC personnel assigned to road bank stabilization projects by the Atlanta Regional Headquarters of the U. S. Forest Service.

exposed or washed out entirely during the winter seasons. The exposure of the transplanted clumps facilitates their drying out, either killing them completely or else greatly inhibiting their growth.

Wherever moisture conditions have been improved and the soil stabilized by applications of mulch to the banks, plantings have been more successful. There are many instances where plantings of woody shrubs and vines have been brought into vigorous growth by mulching even after one or more seasons of very meager growth have elapsed since transplanting. When honeysuckle, coral berry, privet, or similar woody shrubs are used, the bank should be mulched at the time the planting is done if maximum growth is to be expected.

Probably the most valuable results obtained from experimental plots and from extensive road bank fixation projects concern the use of mulches. Woods litter and wood straw containing seed of local plants have been employed with much success as mulches to improve soil moisture and fertility, and at the same time to furnish seed for the vegetation which will establish itself naturally. The growth on banks so treated may be composed of tall weeds and briars the first season, but in the following seasons local grasses appear and sod is frequently established after the second growing season if sufficient grass seed is present. The amount of sod may be increased with relatively little cost by seeding local sod-forming grasses. After this preliminary stage of protecting the bank by herbaceous vegetation, honeysuckle or other species may be planted with more assurance of success.

The use of mulches for dry and infertile banks, as previously recommended by this Station,^{2/} has proven successful on extensive projects. The procedure appears to be the most simple and inexpensive known today. Best results have been obtained on slopes of less than 1-1, and when the bank is not left too smooth. Where the terrain does not permit a lower slope, mulches have been applied to slopes greater than 1-1 with better results than any other feasible method. Elaborate landscaping methods, such as covering the bank by transplanted sod strips, are effective but the cost is prohibitive for general use.

Some project superintendents have avoided using mulches on the honeysuckle plantings because of the appearance of weed straw, litter, and other debris on the banks for the first few years and because of the belief that the fire hazard along the road would be greatly increased. It is true that mulches may create a fire hazard for a time if they are applied as loose, bulky material, but when applied so that they will lie close to the ground the mulches will decompose rapidly to a stage where they are unimportant as a fire hazard.

Mulches may be applied in many ways and no attempt should be made to write rigid specifications because each road bank may call for some slight modification of the procedure. However, to help establish the principles concerned, some general suggestions have been outlined on the following pages. The superintendent of every project should consider mulching methods in the light of his own local conditions and source of material and should make his recommendations accordingly. Two general methods of mulch application may be outlined, based on the nature of the mulching material available, (1) staked weed mulches, and (2) staked brush and litter mulches.

^{2/} Appalachian Forest Experiment Station Technical Note No. 12, Control of Exposed Soil on Road Banks. March 7, 1935.

Staked weed mulches

Materials. (a) Small stakes 18 inches long and about 2 inches in diameter. The use of straight grained, easily sharpened wood, such as dead chestnut, saves time in preparing stakes. (b) Coarse weeds, briars, grass, meadow hay, or similar material. Clean threshed grain straw is less desirable than wild growth, since it is more difficult to keep in place and as a rule carries fewer natural seed.

Procedure. One row of stakes, about 12 inches apart, is set at the bottom of the bank but just high enough up the slope so as not to be disturbed by the road machine. Additional stakes are set either at random or more or less uniformly over the entire bank; the exact spacing to be governed by the nature of the mulch material to be used. Stakes are set leaving 6 inches above the ground.

Coarse weed straw, briars, or long grass straw is then laid by hand so as to reach between the stakes and form a continuous framework over the entire bank. Additional weed straw, grass or other plant debris is then placed on this framework to the depth of not over 4 to 6 inches, depending on the nature of the material. Too heavy mulching of fine debris may cause composting and kill any seed present. The litter should be sufficiently thick to prevent movement of the soil, but should not interfere with germination and establishment of natural vegetation. This mulching method is applicable to banks on which soil is present so that stakes can be driven with little difficulty. Exposed banks of rotten granite can be improved in appearance by mulching the upper soil horizons on the top of the bank, and planting to trailing plant species.

On moist rich banks at higher elevations staked weed mulches have been successful in establishing a natural sod on slopes of 1-1 $\frac{1}{2}$. Elsewhere on drier locations, steep banks make vegetation establishment extremely difficult and banks greater than 1-1 cannot be justified as efficient road construction in regions of repeated winter freezing except where the topography does not permit a lower slope. When dry sterile banks are stabilized with mulch, vegetation appears first on the lower slopes but will gradually advance to the top of the bank as the soil improving mulch makes growing conditions more favorable.

General guide to equipment and organization - 20-man crew.

Equipment

4	"Men Working" signs	200	Feet 1/2-inch rope
5	Pitch forks	1	1 $\frac{1}{2}$ -ton stake body truck
4	Scythes and stones	1	1 $\frac{1}{2}$ -ton pickup truck
3	Swamping axes	1	Horse mower (if desirable)
2	Falling axes	1	Dump rake (if desirable)
3	Hatchets or small axes		
2	Cross cut saws		
10	Leather gauntlets		
5	10-lb. mauls		
5	2-lb. stone cutter's hammers		
1	Tool box		
2	Ladders		
4	Safety belts and ropes		
2	Wooden pulleys 1/2-inch		

Organization

2	Men loading mulch
1	Man driving truck
2	Men unloading & spreading mulch
4	Men cutting mulch
1	Man raking mulch
5	Men making stakes
5	Men setting stakes

Staked brush and litter mulches

Materials. (a) Small stakes as described for weed mulches. (b) Duff and litter from forest floor; limbs from small culled trees.

Procedure. There are five steps in applying staked brush and litter mulches.

1. Stakes are set as described for weed mulches.
2. A low wattle is constructed on the contour row at the bottom of the slope. Small flat brush is hung downward from all other pegs to form a light framework over the entire bank. All brush must be less than one-inch diameter.
3. Duff and litter collected with council tools from the forest floor above are raked down over the bank. A uniform covering about four inches deep will be satisfactory in most cases.
4. A second layer of light brush is placed over the litter layer, if the duff and litter is of a nature that it will be moved by wind or rain.
5. The poles from which the limbs have been cut to obtain the light brush are laid horizontally on the bank, and cross staked if necessary to bring the entire mulch as close to the bank as possible.

In cases where the litter has wind-blown from the forest floor above the bank, it can be obtained more conveniently from accumulations in accessible ravines. Pine litter and mixtures of pine and hardwood litter will hold on steep banks more readily than will hardwood litter alone.

Council tools have been found to be most effective in raking up the litter and cutting into the duff to bring weed seed from the forest floor to the bank. Where stones are present on the forest floor above the bank, the raking will start rocks moving. For safety, bank operations must be suspended during the raking.

The flat brush can be trimmed from the limbs by using pruning knives, machetes, light axes, or knives. Heavy bowie knives are less dangerous in the hands of unskilled workers than are machetes. The foremen in charge must check with superiors and inform workers where to obtain brush and what species are to be cut in order to protect silvicultural and ornamental values along the roadway.

One-half inch ropes and pulleys have been used advantageously in pulling material up high steep banks. For the men working on long dangerous slopes, safety belts of homemade construction have been used.

General guide to equipment and organization - 20-man crew.

Equipment

4 "Men Working" signs	4 Safety belts and ropes
8 Council tools	2 Wooden pulleys 1/2-inch
5 Pitch forks	200 Feet 1/2-inch rope
5 Light axes	1 1 1/2-ton stake body truck
2 Falling axes	
5 Pruners, knives or machetes	<u>Organization</u>
2 Cross cut saws	8 Men raking litter
5 10-lb. mauls	4 Men making stakes
5 2-lb. stone cutter's hammers	2 Men setting stakes
1 Tool box	2 Men cutting brush
2 Ladders	2 Men trimming brush
6 Mill files	2 Men laying brush