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GRASS AND FERTILIZER SELECTION FOR ROAD SPOIL EROSION CONTROL ON JACKSON STATE FOREST

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Finding economical ways to minimize erosion and the siltation of streams caused by logging roads is a problem of increasing concern to timber owners and operators.

A study and demonstration of possible ways to reduce erosion from road spoil was initiated on Jackson State Forest in October 1964. The purpose of this study was to find an efficient and practical method of reducing erosion on logging road spoil and fills.

An approach was sought that anyone engaged in timber harvesting could use with the equipment and manpower normally available. Natural revegetation of fresh spoil by native plants on Jackson State Forest required a period of four to five years. Since this is too long to expose the site to erosion, some means of protection in the interim should be provided.

Study Area

The study area selected was in the Caspar Creek watershed which has a redwood (Sequoia sempervirens) and Douglas-fir (Psuedotsuga menziesii) timber type with associated species.[2] The study plots were on soils of the Hugo and Mendocino soil series; these soils are very similar, with moderate erodibility and good productivity for timber growth. Average annual rainfall is about 40 inches, which generally falls between October 1st and May 15th. In the study area, grass plot trials were set up to determine which kind of seed and fertilizer combination would be best.

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[2] Minor conifers in the timber type are grand fir (Abies grandis), western hemlock (Tsuga heterophylla) and bishop pine (Pinus muricata).

Seed and Fertilizer Trials

Seed and fertilizer trial plots were established in two separate locations in fills along newly constructed logging roads near stream beds. Each location had 12 plots one chain in length; the width was determined by the width of the road fill. Plots were selected randomly for four replications of six different treatments. Locations allowed for duplication of each treatment on a north and west aspect. The six treatments tried are listed in table 1.

Table 1. Seed and fertilizer treatment rates used in erosion control studies.

Seed		Fertilizer		Date
Kind	Rate (lbs. per acre)	Kind	Rate (lbs. per acre)	applied
1. Control--undisturbed	none	Control	none	Oct. 27, 1964
2. Lana vetch (*Vicia dasycarpa*)	50	Superphosphate (0-20-0)	200	Oct. 27, 1964
3. Annual ryegrass (*Lolium multiflorum*)	100	Urea (45-0-0)	100	Oct. 27, 1964
4. Cereal barley--in rows (*Hordeum vulgare*)		Urea (45-0-0)	100	Jan. 15, 1965
5. Cereal barley--broadcast	150	Ammonium phosphate sulfate (16-0-0)	100	Jan. 15, 1965
6. Annual ryegrass and cereal barley	50 50	Urea (45-0-0)	100	Jan. 15, 1965

Several methods can be used in sowing seed and spreading fertilizer, but the method used depends on the equipment that is readily available. In this study the hand-operated "cyclone seeder" was used (except for barley in rows which was seeded by hand) because it was thought to be the most practical on an area this size.

Description of each treatment and a summary of the results follows:

1. Control

Four plots were randomly selected as control areas with no attempt made to control surface vegetation of the plots after road construction (fig. 1). Control plots observed in the first year showed that five percent or less of the total area was covered by native vegetation, mostly red alder (*Alnus rubra*) seedlings, with gully erosion quite pronounced. Natural revegetation of blueblossom (*Ceanothus thyrsiflorus*) and native grass has in five years established ground cover including conifer seedlings exceeding 90 percent density (fig. 2).

Fig. 1. Control plot in Orchard Gulch (westerly aspect) showing an example of the road spoil in first year of treatment.

Fig. 2. Natural revegetation on control plot after five years.

2. Lana vetch, with super phosphate

   This treatment did well on the two plots having a westerly aspect but did not show good results on the two similar plots with a northerly aspect. On all plots vetch had a high rate of germination within one week after seeding, but failed to put on satisfactory growth.

   Four months after seeding, vetch averaged two inches in height and appeared very sparse in most areas. Deer cropping was apparently responsible for lack of height.

   In the areas with a northerly aspect the few remaining plants were green and flowering as late as August 18, but 15 percent or less of the area was covered in the spring following plot establishment. Sheet erosion was one to one and one-half inches with some rilling or gullying evident up to four inches deep.[3]

   The two plots with a westerly aspect supported a fairly dense cover of vetch in a mature mat 10 months after planting (fig. 3). Erosion was not as severe on these plots as in the northerly aspect.

   Within two years after planting, no Lana vetch could be found on the plots. The parent plants died and what seed did germinate did not produce plants beyond the second growing season. The plots acquired native vegetation including conifer seedlings during the five years after the vetch planting (fig. 4).

3/ Sheet erosion was measured using metal pins with original soil level indicated on them. Gullying was ocularly estimated using existing soil level as a reference.

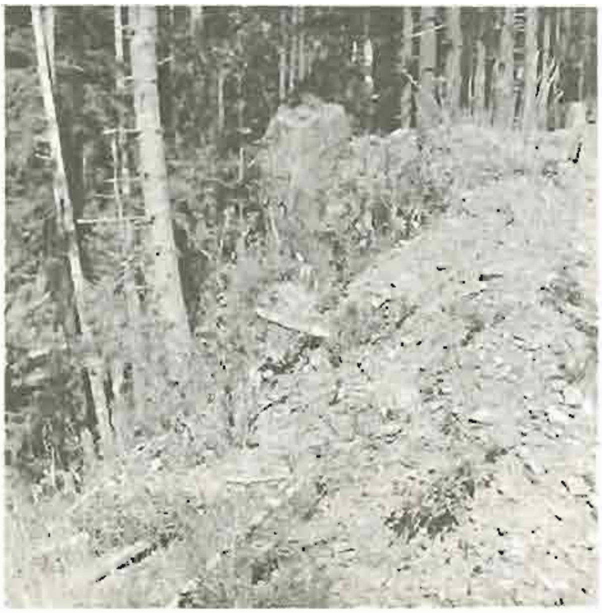

Fig. 3. Lana vetch as it looked in September 1965 (westerly aspect).

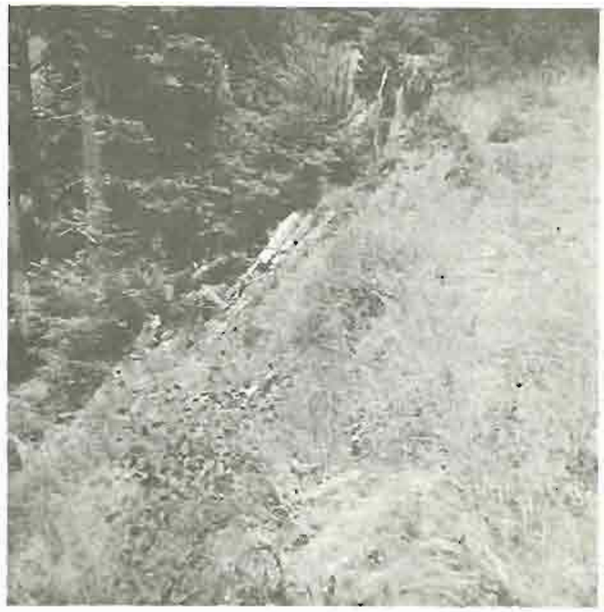

Fig. 4. Lana vetch has been completely replaced by native vegetation (July 1970).

3. Annual ryegrass, with urea

Two and a half months after seeding, the ryegrass on the plots was six to eleven inches high, forming a dense ground cover. At maturity the annual ryegrass measured 24 to 36 inches high; and covered 85 to 95 percent of the plot areas (fig. 5). Sheet erosion to a depth of one-half inch occurred on the exposed surfaces that had a sparse grass cover; however, only slight rill erosion was evident. The northerly aspect did not adversely affect germination or establishment of annual ryegrass.

In July 1970 the last observation was taken. At that time native plants had gained dominance (fig. 6). Annual ryegrass had mostly phased out and the plants remaining made up less than 5 percent of the total ground cover. Conifer seedlings had become established during the five years, and survival was more than adequate for a fully stocked stand even in the dense mats of ryegrass straw.

4. Cereal barley (in rows), with urea

Germination and initial growth were very rapid. Six weeks after planting the barley was four to six inches high. Mature plants (fig. 7) measured 20 to 30 inches high and were very dense in the rows the following spring. Erosion of soil across the rows downslope was quite apparent on the steeper plots; there was also an indication of surface erosion.

Fig. 5. Annual ryegrass on Plot 1 showing the thatch-like mat that had developed by September 1965.

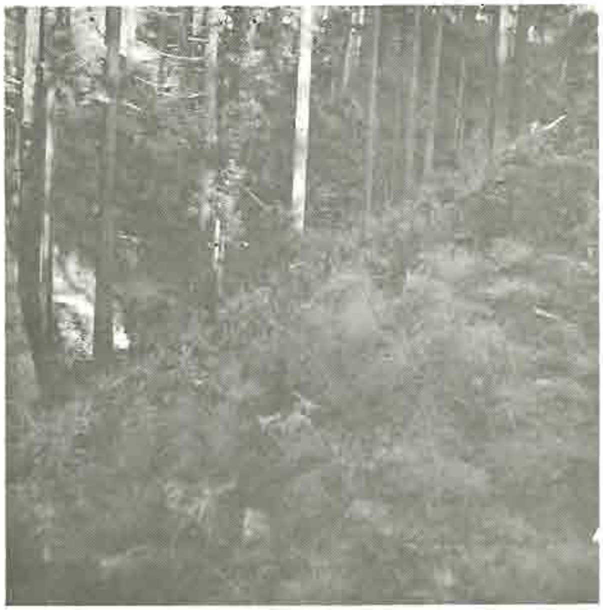

Fig. 6. Plot 1 showing the establishment of native plants five years after seeding annual ryegrass.

This erosion between the rows was greater than expected and it was apparent that barley planted in this manner has only a minimum degree of soil holding capacity. Excessive time and labor were required for the seeding, since approximately one man-day is required to plant an area 200 by 300 feet in rows. In addition, the barley heads were browsed heavily by deer or harvested by rodents thereby making the chances of adequate reseeding very uncertain.

5. Cereal barley (broadcast), with ammonium phosphate sulfate

Germination and initial growth were similar to that of barley planted in rows. Only a sparse cover developed, which persisted from the early growing stages to maturity. At maturity the barley was 18 to 24 inches high with 10 to 20 plants per square foot, and provided a ground cover of 40 to 70 percent (fig. 8).

Surface erosion was more noticeable under the barley than it was in the case of ryegrass or the barley-rye-grass combination. The barley gradually decreased until at the end of three years no barley plants could be found on the plots. After five years coniferous reproduction and native vegetation dominate the site (fig. 9).

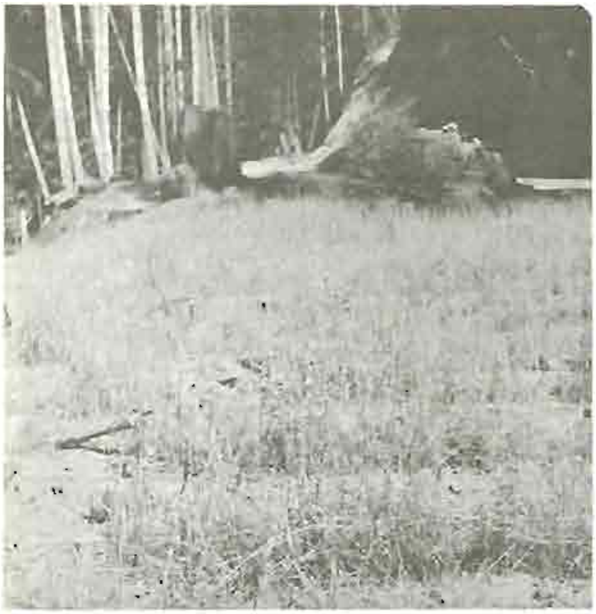

Fig. 7. Barley, in rows, September 1965. The soil between the rows had little protection.

Fig. 8. Broadcast barley formed a dense grass stand having about 70 percent coverage.

6. Annual ryegrass and barley, with urea

Six weeks after seeding, the barley was four to six inches high and was sparse. The ryegrass grew quite dense at 50 pounds per acre, but the initial growth was slower compared to the barley seeded at the same rate at the same time. However, the following spring when maturity was reached, the cover appeared to be predominately annual ryegrass from 24 to 36 inches high, and covering 70 to 90 percent of the plots (fig. 10).

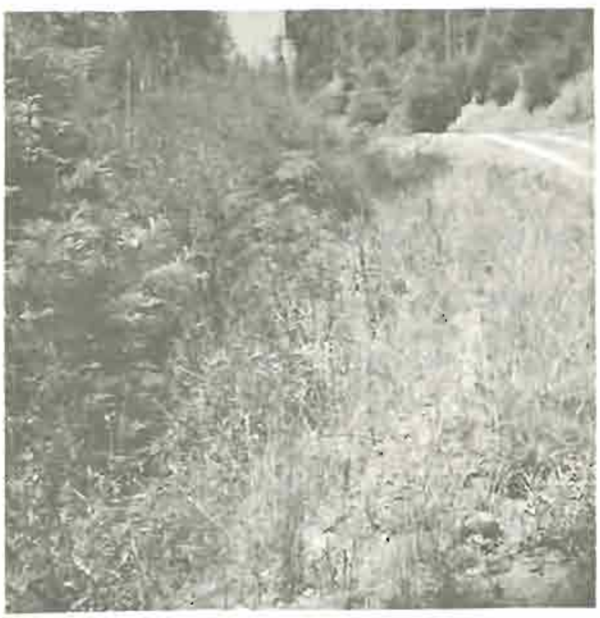

Fig. 9. Note the native vegetation dominating the site five years after seeding barley.

Fig. 10. Annual ryegrass and barley September 1965, showing mature dense mat with ryegrass predominating.

Erosion conditions on these plots appeared to be comparable to plots seeded entirely with annual ryegrass. The density of the ryegrass seeded at 100 pounds per acre was not significantly different from the grass seeded at 50 pounds per acre.

Native plants had completely replaced the barley and ryegrass by July 1970 (fig. 11). Vegetation covered 90 percent of each plot.

Fig. 11. Annual ryegrass has been completely replaced by native vegetation July 1970.

Discussion

The results of this study indicated that ryegrass and urea were the best combination of seed and fertilizer tried. The ryegrass and barley combination trials indicated that ryegrass sowed at 50 pounds per acre gave equally good results as the 100 pounds per acre treatment. Subsequent operational trials have shown that ryegrass and urea (45-0-0) each applied at 50 pounds per acre gave equally good results as the heavier urea application. Although this final selection of a grass seed and fertilizer combination was not entirely due to the controlled trials described here, these trials did lead to the final selection.

The establishment of coniferous regeneration in roadside spoil areas may not be overly important, but the fact that the establishment of a good grass cover apparently does not retard coniferous regeneration may be significant in other erosion control work. For example, in cases of streamside disturbances or other areas, coniferous regeneration and grass cover for erosion control are both desirable.

Based on operational work done in 1965, the cost of sowing ryegrass and applying urea fertilizer was as follows:

COST DATA - 1965

A. Grass

Annual ryegrass	$190.00 per ton
Application rate	50 lbs. per acre
Application time	One man can seed one acre per hour

B. Fertilizer

1. Urea (45-0-0)	$108.00 per ton
2. D. A. P. (21-23-0)	$309.00 per ton
Application rate	50 lbs. per acre
Application time	One man can fertilize one and a third acres per hour

C. Cyclone seeder

Purchase cost	$6.00 approximately (est. replacement needed after 100 acres of use)

D. Cost per acre

1. Seed	@ 9.5¢/lb. @ 50 lbs. =	$ 4.75
2. Man	@ $4.00/hr. =	4.00
3. Fertilizer (Urea)	@ 5.4¢/lb @ 50 lbs. =	2.70
4. Man	@ $4.00/hr. 3/4 hrs. =	3.00
5. Seeder	@ $0.06 =	.06
Cost per acre		$14.51

Average cost per mile of roadside treated: $14.51/acre X 6.24 acres/mile = $90.54/mile.

<u>Conclusions</u>

1. Based on the original data gathered and subsequent experience, the best seed and fertilizer combination was annual ryegrass fertilized with urea, each applied at 50 pounds per acre.

2. The optimum time to seed and fertilize was shortly after the first light rain (at least one-half inch in a single storm) in the fall.

3. An efficient and practical method of sowing grass seed and spreading fertilizer is by use of the hand-operated cyclone seeder.

4. The seeded grass cover is replaced by natural vegetation in four to five years.

5. There was no detrimental effect on coniferous regeneration in the areas seeded to annual ryegrass.

6. From observations of seed accidentally spread beyond fertilized plot boundaries, it was observed that growth does not provide more than 50 percent cover without fertilization.

7. An obvious benefit in addition to erosion control is an almost immediate esthetically pleasing cover of green grass that lasts until the native vegetation recaptures the site.

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