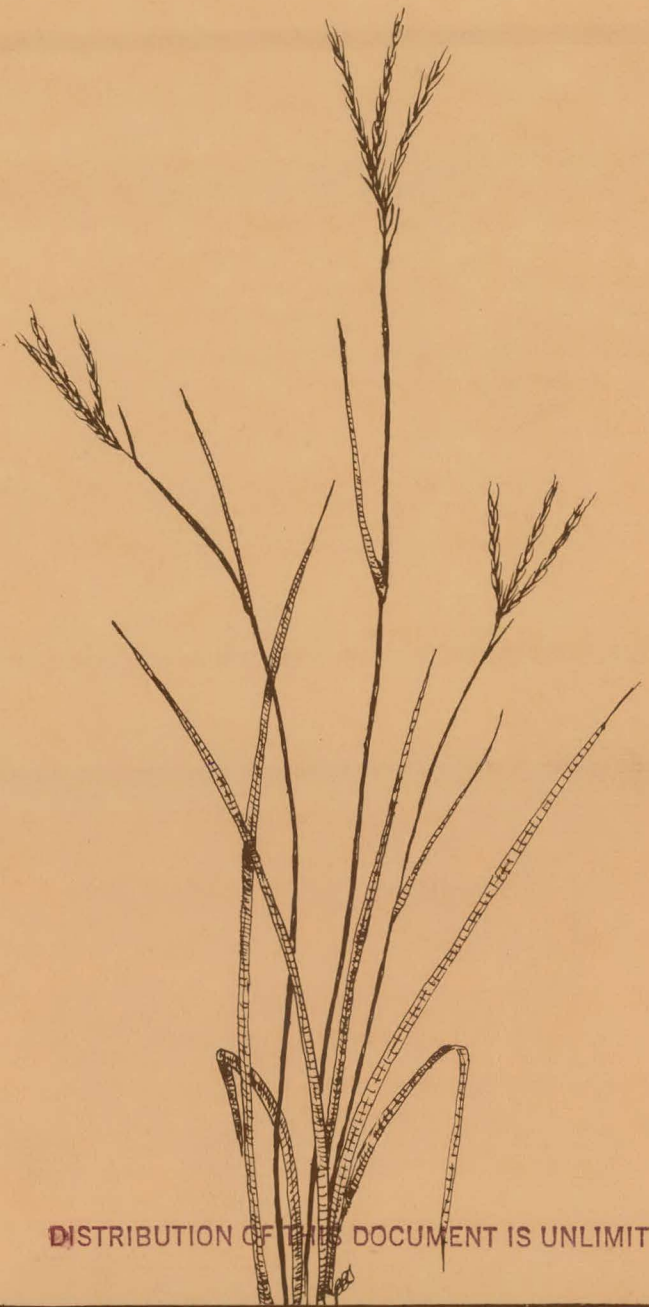


**GRUNDY COUNTY
DEMONSTRATION SITE**

**PHASE II
PROGRESS REPORT
FOR 1976-1977**

**BY
B. B. GREEN AND
S. D. ZELLMER**



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ENERGY AND MINERAL RESOURCES

ARGONNE NATIONAL LABORATORY

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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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GRUNDY COUNTY DEMONSTRATION SITE

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Becky B. Green and Stanley D. Zellmer

April 1976

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INTRODUCTION AND REVIEW

Reclamation of abandoned lands has recently become a national issue, primarily with the introduction of federal strip mine legislation. Illinois, like many other states in which coal is mined, has extensive acreages of abandoned mine spoils. Most of the approximately 109,000 acres mined before the enactment of Illinois' 1962 Open-Cut Land Reclamation Act are unproductive and sources of health and environmental hazards (Carter, et al., 1974). In order to develop a methodology for reclaiming these problem sites, the Illinois Institute for Environmental Quality is sponsoring an Argonne National Laboratory project that is examining selected treatments for acidic spoils and developing reclamation techniques for abandoned lands.

The demonstration site selected for this research, located in Grundy County, is approximately 40 miles southwest of Argonne National Laboratory. It is an area of 110 acres, approximately 50 of which were affected by mining and regrading. The mine spoils are adjacent to Goose Lake Prairie State Park, which is receiving acid runoff from the site.

In 1972, the Illinois State Department of Conservation purchased the land and commenced regrading the spoils. The regraded site (Fig. 1) was seeded in 1973 with a combination of prairie and pasture species. All of the site was limed, and some parts were topsoiled. Site surveys by Argonne in 1975 indicated that approximately 35 acres, including the majority of the slopes and the flat areas north of Lakes A and B, remained unvegetated. The pH of these spoils ranged from 2.9 to 3.5 while the pH of Lakes A, B, C, D, and E were 3.5, 3.5, 4.0, 5.4, and 3.3, respectively. A more detailed discussion of this survey appears in Green and Zellmer (1975).

Reclamation of the unvegetated areas was initiated by Argonne in the fall of 1975, and the first progress report was issued in the spring of 1976 (Green and Zellmer, 1976). The monitoring and research will continue for at least two years to obtain cost-effectiveness data for the respective treatments.

GOOSE LAKE PRAIRIE STATE PARK

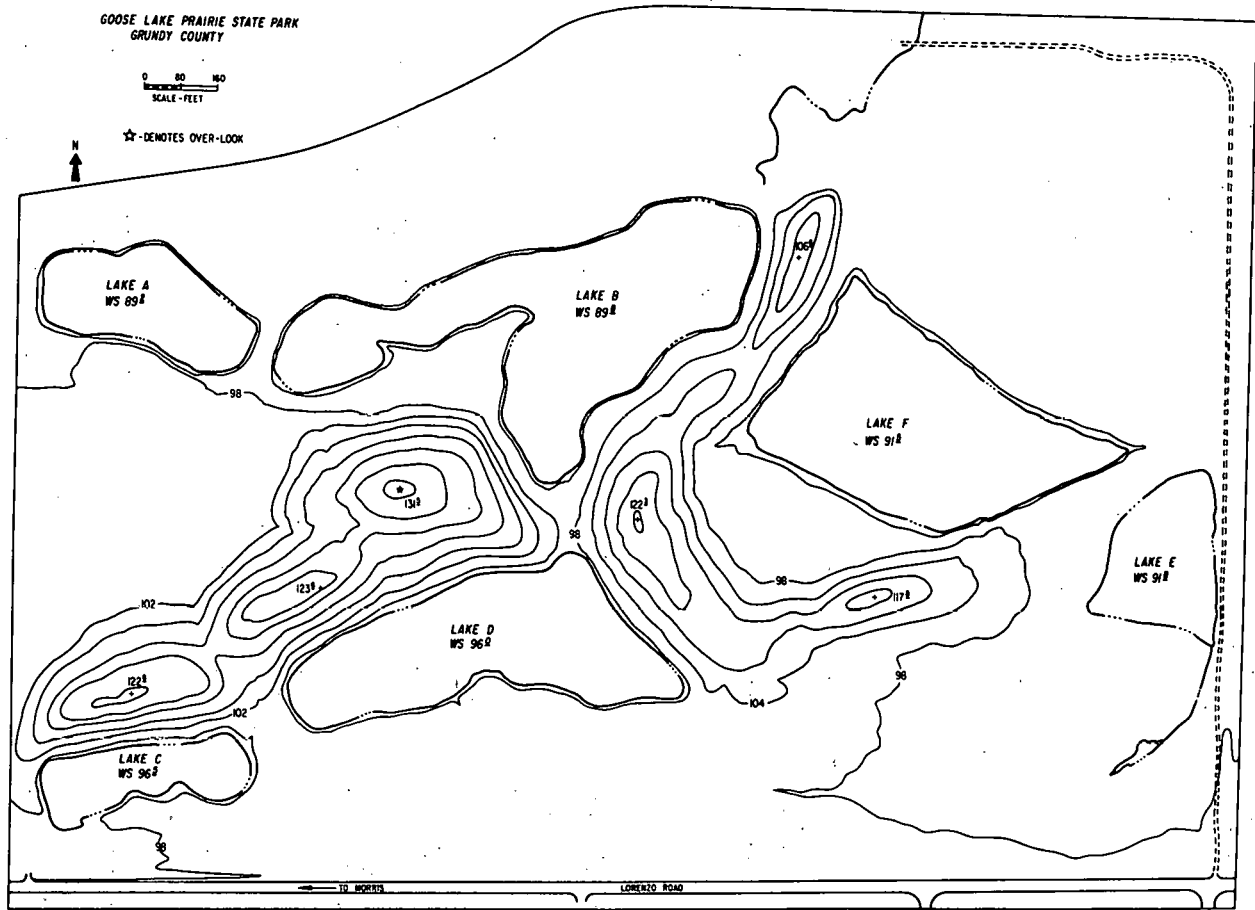


Fig. 1. Map of the Grundy County Demonstration Site Showing Its Relationship to Goose Lake Prairie State Park

METHODS

The preliminary survey identified pH and low infiltration as the two major problems at the demonstration site (Green and Zellmer, 1975). The treatments which were selected were therefore chosen to ameliorate these conditions. Since slopes and flat areas presented two different aspects of the problem, treatments were divided into two parts. The treatments applied to each part were:

<u>Flat Area</u>	<u>Slope</u>
Scrubber Slag	Chemical Stabilizer
Topsoil	Sludge
Sludge	Straw Mulch
Lime	Control (includes lime)
Control (no treatment)	

EXPERIMENTAL DESIGN FOR GRUNDY COUNTY

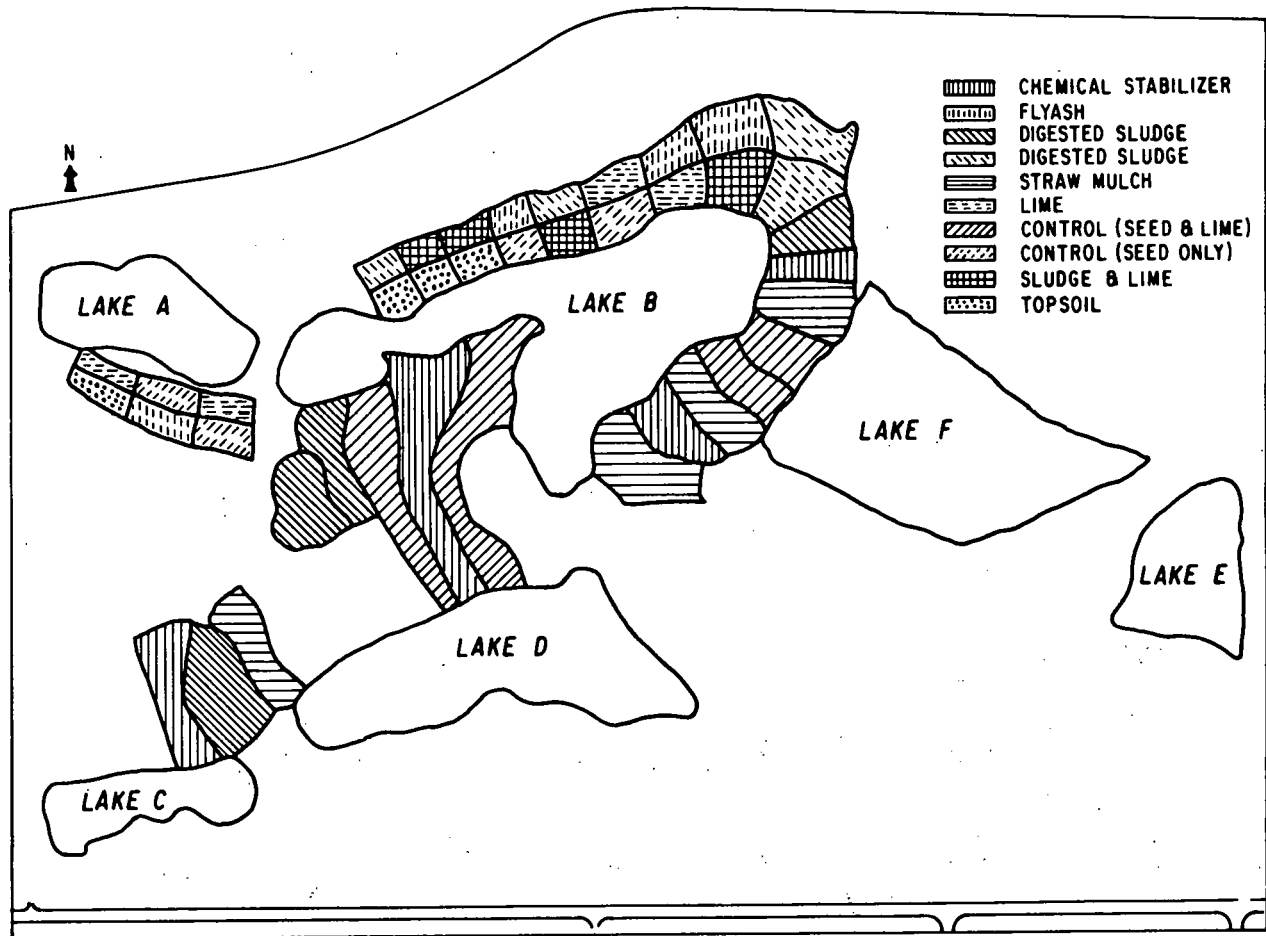


Fig. 2. Treatment Design for the Grundy County Demonstration Project as Applied in the Fall of 1975

Treatment placement sectors appear in Fig. 2. Scrubber slag, which was obtained from a coal-fired power plant in Joliet, was first applied by truck and then graded to a depth of 3 in. Topsoil was borrowed from an old field adjacent to the site and applied at a depth of approximately 2 in., and lime was applied at a rate sufficient to neutralize the pH in the range of 4.5-6.0. Sludge was delivered to the site but proved extremely difficult to spread, rendering data gathered from these plots unreliable. Chemical stabilizer (Phillips Petroset SB) was applied by hydroseeder at the recommended rate for clay soil. Additional slope treatments which were applied in only one sector included a woven paper mulch (Gulf States Paper Corp.) and a fiber mulch (Weyerhauser Silvafiber Mulch).

Table 1. Seed Applied to Grundy County
Demonstration Site

Species	Seeding Rate (lbs/acre)	
	Oct. 1975	April 1976
Tall Fescue	-	32
Red Fescue	8	32
Red Clover	8	32
Alsike Clover	2	8
Ladino Clover	½	2

All slope sites were limed, gouged, treated, and seeded. Flat area sites were manipulated in a similar manner although lime was not applied to all plots. Seed was applied to all areas at 15-20 lbs/acre in October 1975 (Table 1), and vegetation cover was recorded in 1 ft² quadrats spaced 10 ft apart for 66 ft (Fig. 3). There were two of these transects in each treatment.

Based on data gathered in the fall of 1975, the site was reseeded in the spring of 1976. All areas outside the treatment sites were treated with a straw mulch and seeded; the seeding rate for the entire site was 106 lbs/acre (Table 1). Fertilizer (10-20-10) was also added with the seed at 320 nutrient lbs/acre. Erosion plots (Fig. 4) were installed in each slope treatment to record sedimentation and runoff. Temperature and humidity are monitored by a hygrothermograph, and a precipitation gage records rainfall.

RESULTS

The climate at the Grundy County site is representative of north central Illinois with humid summers and cold, snowy winters. The average monthly temperature in 1976 ranged from -10°C in February to 25°C in July, while humidity showed little variation all year (Fig. 5). Rainfall was distributed evenly throughout the growing season (April through September), with the highest total monthly precipitation falling in two days in mid-April (Fig. 6). June, July, and August showed monthly totals of over 7 cm of rain, which was received in a series of weekly showers.

Vegetation data indicate that straw and topsoil were the most effective treatments in promoting stand establishment (Fig. 7). Straw was significantly



Fig. 3. Recording Vegetation Cover in Straw Mulch Treatment Sector at the Grundy County Demonstration Site in 1976



Fig. 4. Erosion Plot Installed in Slope Control Treatment Sector at the Grundy County Demonstration Site in 1976

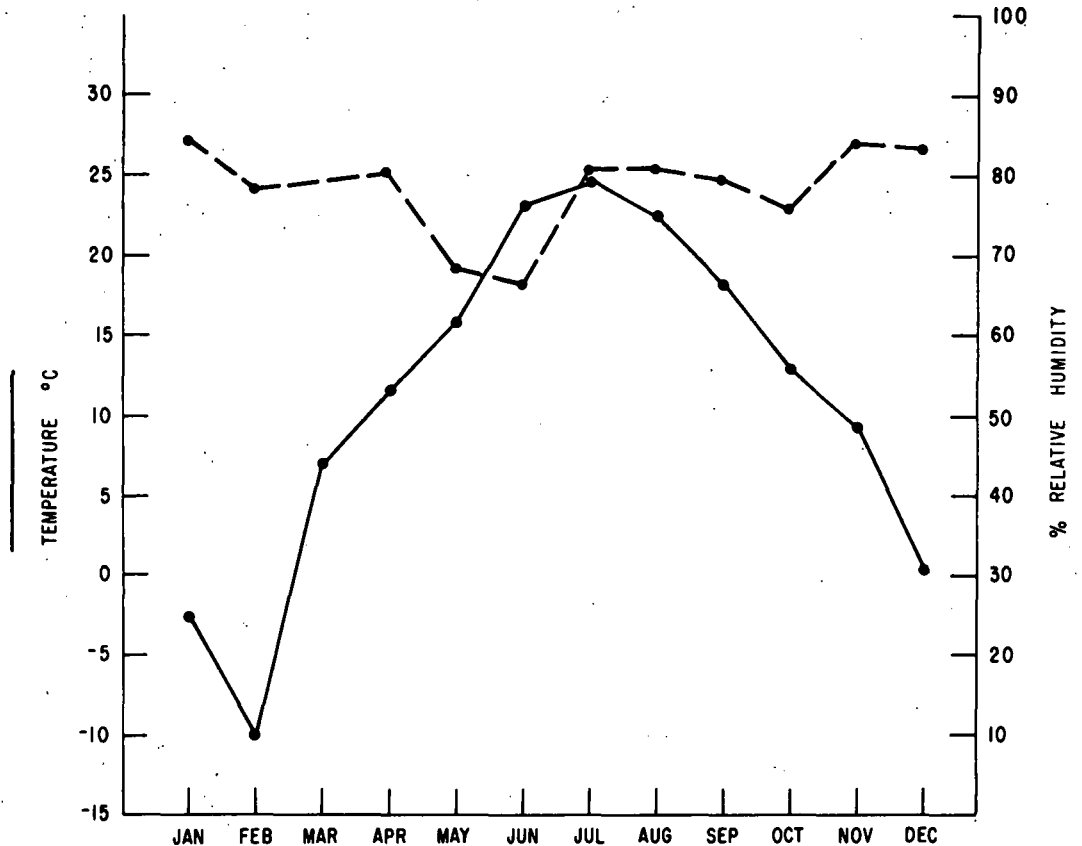


Fig. 5. Average Monthly Temperature and Humidity at the Grundy County Demonstration Site in 1976.

more effective on the slopes than were the chemical stabilizer or control treatments (ANOVA, $\alpha = 0.05$). Cover on the straw sectors ranged from an average of 18% to 46% while variation in the stabilizer treatment was 4% to 16% and in the controls 0% to 4%.

This variation was not a function of aspect, but it did reflect soil pH. For example, the two straw sectors which showed 45% cover in July had pH values of 5.8 and 4.5 in the upper 6 in. The other two sectors, which had 18% and 29% cover, had a pH of 3.3. A similar pattern was indicated in the stabilizer and control plots although the correlation was not as dramatic. Data from the paper and silvafiber mulch treatments were not included in the analysis of variance since there was only one sector of each. Both treatments showed 0% cover in July 1976. Germination did occur in the silvafiber mulch, but the mulch broke down and was washed downslope within one month of its application.

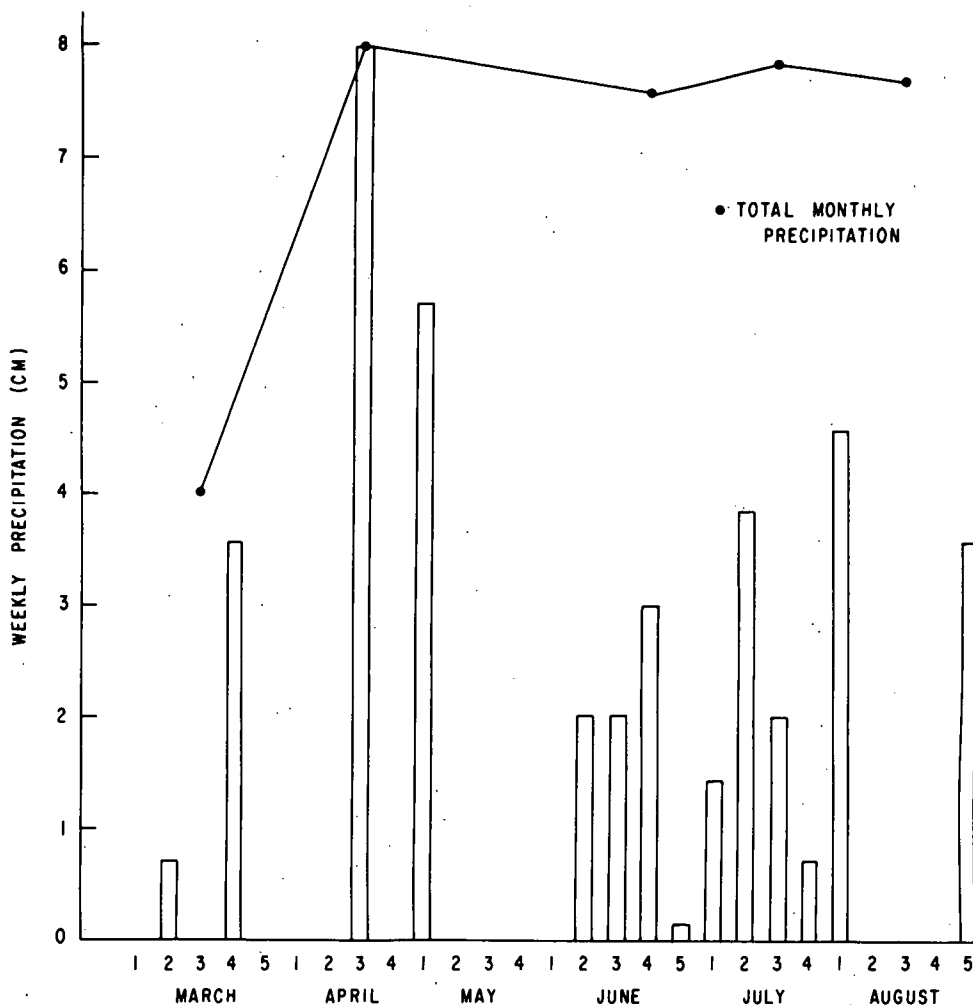


Fig. 6. Weekly and Total Monthly Precipitation at the Grundy County Demonstration Site in the Growing Season of 1976

Topsoil and slag treatments on the flat area were both significantly more effective than lime only and control treatments. Cover ranged from 22% to 43% in the topsoil sectors, from 2% to 77% in the slag, and from 0% to 13% in the lime; cover in the control was always 0%. The topsoil sectors showed consistently high establishment and did not reflect changes in pH, which ranged from 2.9 to 5.3 in the upper 6 in. Cover figures for the slag plots are misleading, however. Three of the sectors showed averages of 2%, 7%, and 8%, with one sector showing 77%. This sector is located adjacent to an old field, and invading old field vegetation, composed primarily of ragweed, made up approximately 20% of the cover. The pH was not a major factor in cover establishment.

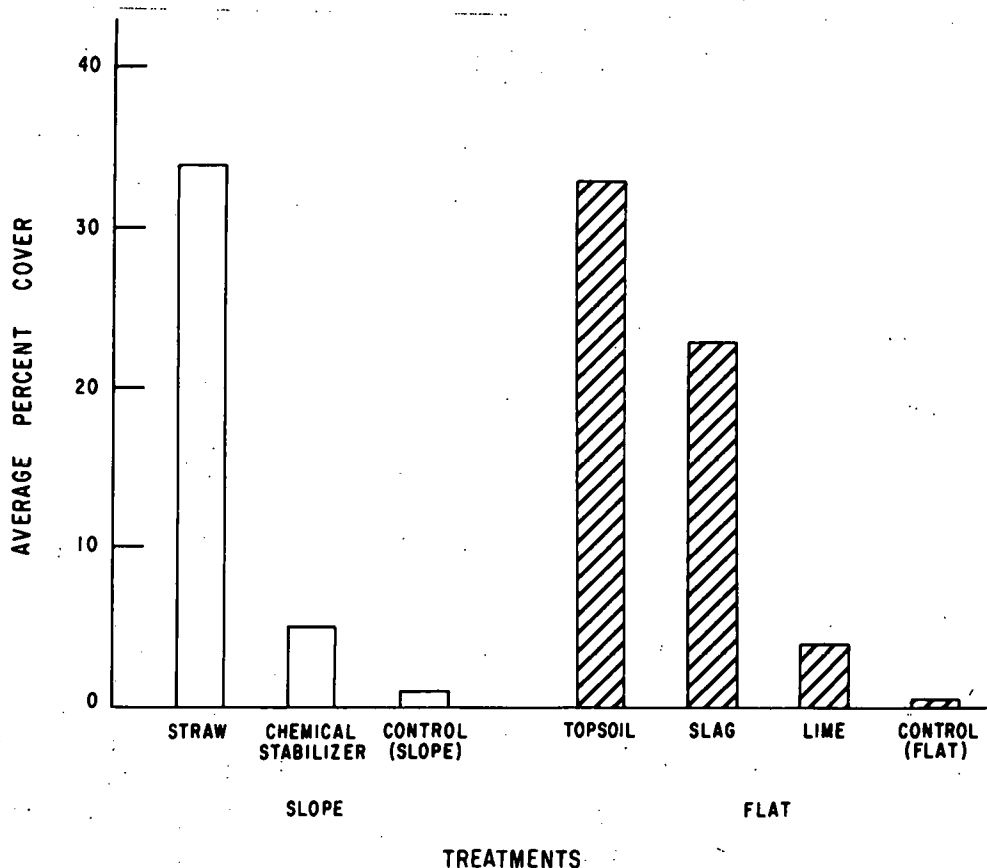


Fig. 7. Average Percent Cover for Each Treatment at the Grundy County Demonstration Site in July 1976.

Sedimentation and runoff showed a definite correlation with vegetation establishment (Figs. 8 and 9). Straw sectors were consistently lower in both sediment and runoff yields for all rainfall events. Chemical stabilizer and control sectors were alike in runoff yields, but for the early part of the summer the chemical stabilizer showed consistently lower sediment yields. Data collected near the end of the growing season indicated that the stabilizer was becoming less effective.

Treatment data are summarized in Table 2.

DISCUSSION AND PRELIMINARY CONCLUSIONS

While pH showed definite influence on within-treatment establishment of vegetation, the overriding factor for cover establishment appears to be water availability. The straw with asphalt tack provided a water-holding cover

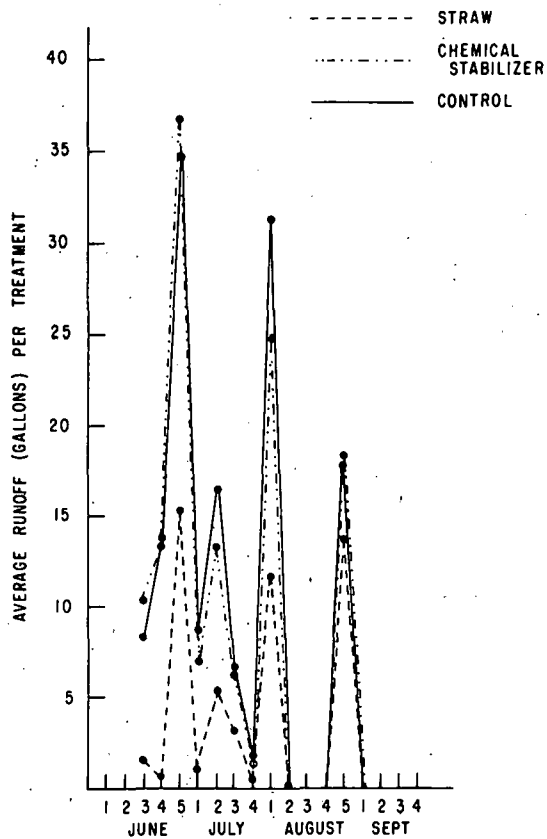


Fig. 8. Average Runoff from Treated Slope Sectors during Summer of 1976

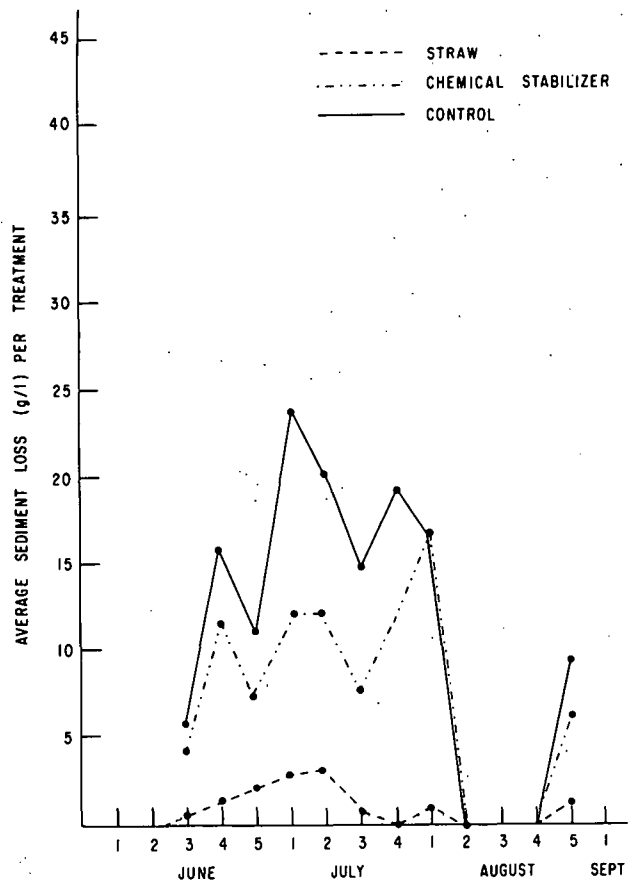


Fig. 9. Average Sediment Loss (g/l) in Runoff from Slope Treatments

Table 2. Summary of Treatment Data from the Grundy County Demonstration Site in 1976

Treatment	Results
<u>Slope</u>	
Straw	Average 34% vegetative cover, reduced runoff and sediment loads, cover establishment influenced by pH.
Chemical Stabilizer	Average 5% vegetative cover, sediment loads slightly reduced, runoff high, surface crusted.
Control	Average 1% vegetative cover, runoff and sediment loads high, surface crusted.
<u>Flat</u>	
Topsoil	Average 33% revegetative cover, high percentage old field weeds, cover establishment not influenced by pH.
Slag	Average 23% vegetative cover, one plot high percentage old field weeds, other fields low average cover, cover establishment not influenced by pH.
Lime	Average 4% vegetative cover, surface crusted.
Control	Average < 1% vegetative cover, surface crusted.

and aided in the prevention of surface crusting. Results from the chemical stabilizer treatments indicate that sediment control and, therefore, retention of the seed on the slopes, is not sufficient for cover establishment. Neither the paper nor the silvafiber mulch was effective in preventing crusting and water runoff.

Soil pH was a factor in stand establishment on the slopes. Red fescue and white clover are acid tolerant, but they appeared to establish a denser stand when soil pH was about 4.0 or higher. The lack of correlation between flat area treatments and soil pH may be due to the fact that both the topsoil and slag treatments provided more favorable germination sites. Both were applied approximately 2 in. thick, which would allow germination and initial seedling establishment prior to contact with the spoils.

The difference in cover establishment between topsoil and slag was probably due to two factors: weed seed in the topsoil and the black color of the slag. The topsoil was taken from the weedy old field community which surrounds the affected area (Green and Zellmer, 1975). This soil apparently contained numerous weed seeds which germinated on the treated sector. These weeds primarily included ragweed and a species of mustard. The fescue and clover also established well here, probably due to the more favorable germination medium and to the increased cover which improved infiltration. Germination in the slag was also high, although only one plot contained weed seeds. Seeds germinated earlier on these sectors, probably due to the black color which, in the early spring, warmed the medium more quickly than other treatments. Later in the summer, however, the slag appeared to dry out and heat up more quickly than the other treatments, which probably reduced species survival. This problem of soil moisture and temperature will be examined by the use of double-junction soil psychrometers which will be installed in 1977.

FUTURE RESEARCH

Monitoring of stand establishment and runoff/sedimentation will continue in an effort to determine actual survival and treatment effectiveness. Germinating seedlings, if any, will be counted and followed to examine the possibility of community maintenance. Monitoring of soil physical and chemical characteristics will also be continued.

On-site ponds will be mapped and monitored for species establishment, and chemical characteristics of the ponds will be measured and related to species development.

Prairie plots which were disced in 1976 will be seeded and monitored. The treatments will include:

- Prairie hay applied in fall 1976 (this containing seed) -- no additional seeding;
- Spring seed prairie species; and
- Spring seed fescue/clover mix, mow after 2 years, spring seed prairie species.

The above treatments will be repeated on a vegetated spoil area, pH 5.9, and an old field, pH 6.5. These treatments, in combination with greenhouse tolerance experiments, will indicate the best methods to be used in restoring native prairie to the site. The site is intended to be a high use nature area for Goose Lake Prairie State Park and will provide valuable information on the requirements of establishing recreation sites on abandoned lands. Shown

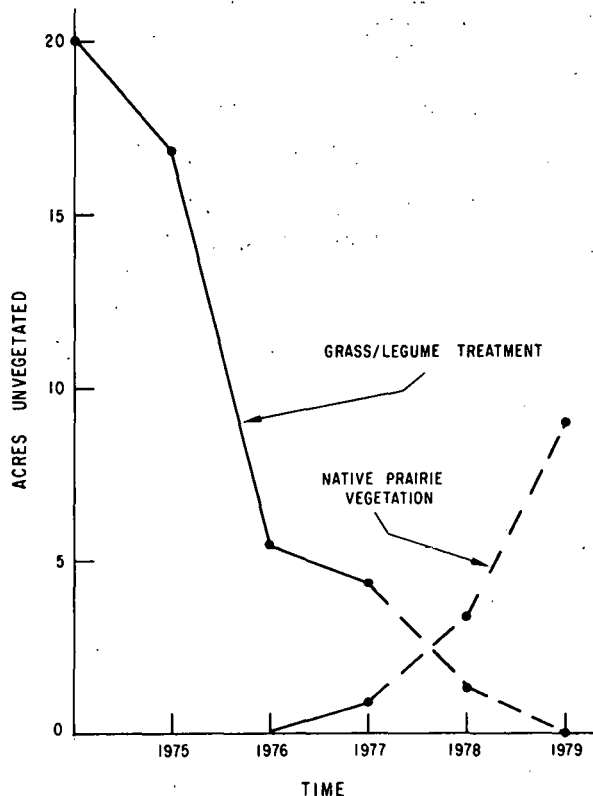


Fig. 10. Actual and Projected Re-vegetation at the Grundy County Demonstration Site (— = actual, - - - = proposed).

in Fig. 10 is the estimated establishment of the grass/legume vegetation which is seeded on the bare spoils and the estimated establishment of native prairie at the Grundy County demonstration site.

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