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development of dwarf ground cover for erosion control in colorado

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16. Abstract

Colorado's arid regions and mountainous terrain create the need for a unique ground cover along its highway system to prevent erosion, enhance the beauty of roadside areas and reduce hazards to the motoring public.

This report summarizes a limited investigation into the possibilities for the development and use of a perennial, dwarf ground cover that would grow at nearly every elevation in Colorado. Such a plant would reseed itself, require no fertilization, and require little or no mowing. Maintenance costs would be reduced to a minimum.

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IMPLEMENTATION

Most of this research was directed toward developing a dwarf clover that would flourish, survive cold winters, require little moisture and create no maintenance. However, because of the "state of the art" limitations encountered in the propagation of such a ground cover, other solutions should be considered.

It is suggested that further research in Colorado be directed toward the comparison between using fertilizers and using topsoil to accelerate growth of native plant life or turf.

DEVELOPMENT OF DWARF GROUND COVERS FOR EROSION CONTROL IN COLORADO

INTRODUCTION

Years ago, when natural resources were considered virtually inexhaustible, highway engineers were indifferent to erosion problems. Little thought was given to landslide areas, drainage, deposits of soil on land outside the right-of-way, pollution of waterways, and erosion damage to new roadway construction.

With the development of all-weather roads in the 1920's and 1930's the need for erosion control became obvious. Professionally trained personnel were employed to investigate and utilize techniques for establishing vegetation on roadside areas laid bare by construction. These landscape architects emphasized the use of shrubs and vines for erosion control. But shrubs and vines took two or more years to mature. This time problem led to efforts to establish and maintain fast growing turf species on rights-of-way.

Today more than half of a modern highway right-of-way consists of unpaved areas of earth. This vast acreage, if left bare, is subject to erosion. If uninhibited, erosion can destroy a considerable portion of the highway investment, create hazardous driving conditions, and mar the beauty of the landscape. Erosion control has become almost as important as design and routing. The highway is not complete until all soil areas are protected by adequate vegetation. Normally, turf can be used as the quickest, most effective erosion control method.

While Colorado has many regions where turf grasses provide excellent erosion control on rights-of-way, it has also arid regions, steep slopes, and high elevations where this ground cover does not thrive or survive. Research into the development of a ground cover for such areas was undertaken in 1967.

DEVELOPMENT PLAN

The Horticultural Planner, Department of Highways proposed the research project under the overall supervision of the Planning and Research Division. The specific aims of the study, as submitted to the Bureau of Public Roads, were:

"(1) To select handy varieties of clover or some other ground cover plant which may be dwarfed by cross-breeding.

(2) To develop in planting beds by preferential selection several specific varieties of this plant with the following characteristics:

a. Perennial - or will reseed itself.
b. Will require little or no mowing.
c. Will require no fertilizing.
d. Will require no supplemental moisture.
e. Will root deeply and prevent erosion.
f. Will be attractive throughout the year.

(3) To test the selected varieties throughout the State of Colorado to determine the suitability for use.

(4) To establish a plan for seeding or transplanting the plant to desired locations."

IMPLEMENTATION

Upon approval and funding work commenced. Initial plant selections were clovers since a native variety of Yellow Sweet Clover had proved effective for erosion control, although its mature height exceeds three feet and it requires frequent mowing. These clovers were planted and cultivated at a number of sites on the highway system in an effort to establish one or two varieties that could produce desired results.

A site east of Denver, was selected as the check plot. Construction and installation of facilities began.

Six planting beds were installed. They were arranged as irrigated and nonirrigated, fertilized and nonfertilized, shaded and unshaded. They were then located to simulate south slopes and north slopes. These check beds were then planted with the same varieties as those planted on the highway system.

Consultations were carried on with horticulturists at Colorado State University. Discarded varieties of sweet clover and similar ground covers were obtained from the University for use in developing dwarf characteristics.

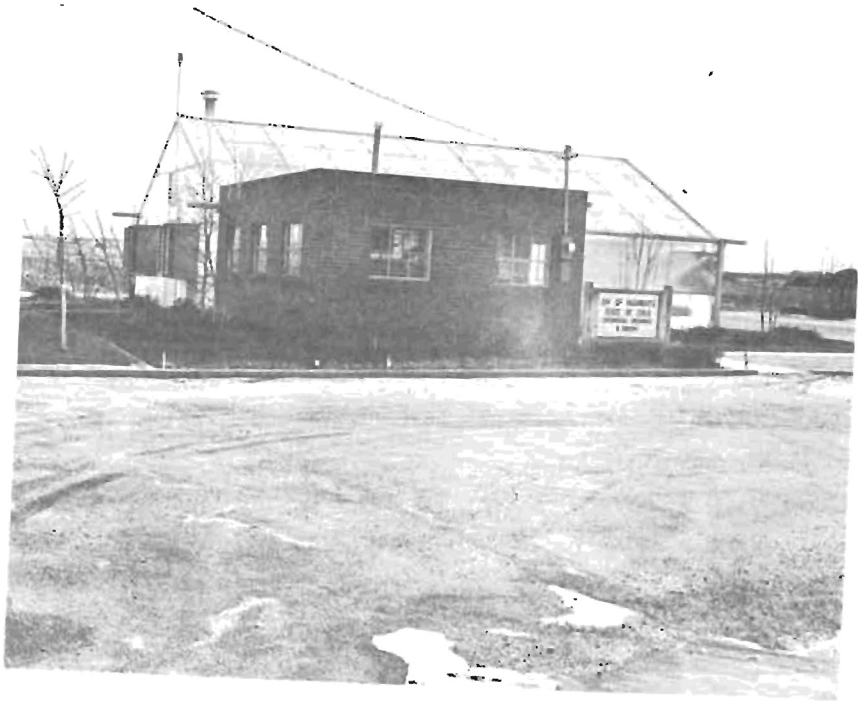
By use of a greenhouse, development of several varieties could be accomplished in a year or two. By the end of three years the prospects for the development of a good dwarf plant appeared good.

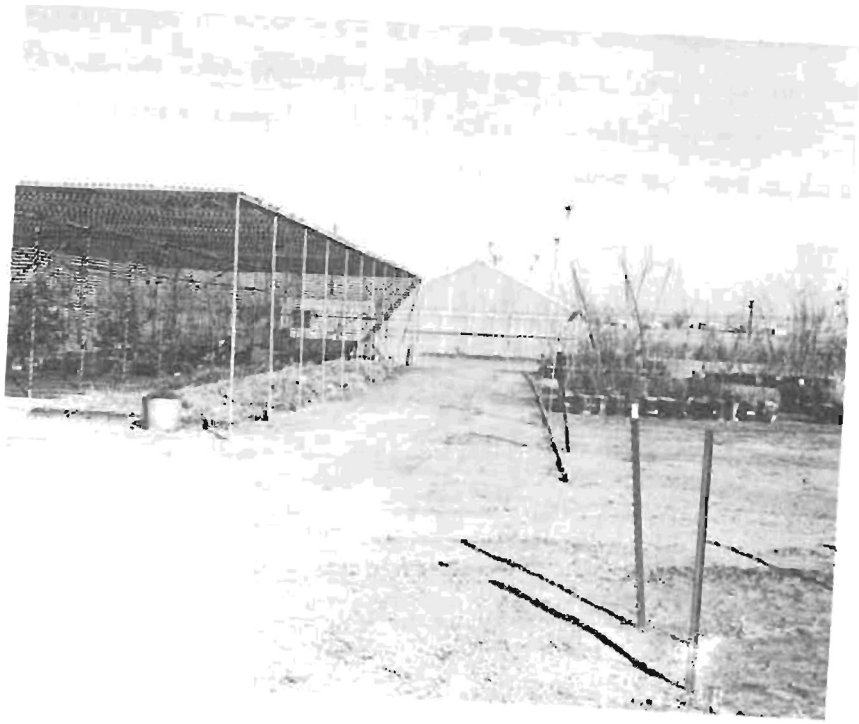
FACILITIES

The District 1 Maintenance yard, east of Denver, was selected as the site for installation of the facilities required to carry out the project. A sprinkling system, a lath house, and a small greenhouse were acquired. The 30' by 40' greenhouse was purchased and assembled. See the photographs on page 4. It contains a heating system, air conditioning system, and sprinkler system, all with automatic controls. An alarm system has been installed to signal extreme temperature fluctuations due to power failure.

TEST SITES

Test sites were selected throughout the state in order to obtain experience with a wide variety of soils, climatic conditions, and elevations. Plantings were completed by the fall of 1967 at Durango, Grand Junction, Vail, Pueblo, Raton Pass, Alamosa, Poncha Springs, Wolf Creek Pass and Fort Collins.





PROGRESS AND PROBLEMS

This research project encompassed a period of a little over four years from its inception. Work began in the spring of 1967. Evaluations were completed by the summer of 1971.

The following chronological sequence of events reviews the progress made and problems encountered:

1967-1968

The program was funded to begin in 1967. A 30' X 40' greenhouse was purchased and assembled.

A variety of dwarf clovers were planted at Durango, Grand Junction, Vail, Pueblo, Raton Pass, Alamosa, Poncha Springs, Wolf Creek and Fort Collins. Those clovers that survived the winter of 1967-1968 showed promise of developing into good ground cover. Seeds from them were started at the greenhouse so that cross pollination could be accomplished, and the resulting species could be set out in field locations.

Delays were encountered in getting the greenhouse built and equipped during this period. It became apparent that additional help was needed to carry out the planned programs.

In 1968 a representative from the Bureau of Public Roads Engineering Systems Division in Washington inspected the project. He considered the project worthwhile and pledged continued support

1969

By the spring of 1969 the research greenhouse was completed and in full operation. Plants obtained from the seed and other means of propagation were moved to a lath house to harden off prior to being planted at the selected experimental sites throughout the State. A number of plant genera other than Melilotus species were selected for inclusion in the study. Check plots were located near the greenhouse facility. A full time employee was placed in charge of the facility after July 1, 1969.

1969 (Continued)

There were two varieties of Melilotus species which appeared to have desirable characteristics. These plants had been observed during the summer and fall of 1968. The plant heights varied from 7 1/2" to 9 3/4". They retained a good green color and continued to bloom into the late fall. However, because of a long winter season it was not possible to determine their susceptibility to winter kill until late the following year.

Geographical selections of Crownvetch, Lippia species, Sedum species, Potentilla species, Juniper species, and Phlox subulata were prepared for inclusion in the study.

All physical facilities for the program were completed by the summer of 1969. An alarm system was installed in the greenhouse to warn against extreme temperature fluctuation due to power failure.

A number of soil mixes were tried for plants propagated in the greenhouse. Compost material was also tried in actual field conditions and a number of the plants died, apparently due to oxygen starvation. The plants lacked root development, yellowed, and showed lack of new growth.

By the fall of 1969 observations were completed for both tall and dwarf plants, such as the clover and vetches which had undergone two winters in the test sites throughout Colorado. Selected varieties of dwarf yellow sweet clover did not survive as perennial plants due to the adverse effects by cycles of freezing and thawing, wetting and drying (desiccation).

Plants with short, thick, fleshy roots did not survive over the two year period. There was some reestablishment of plants by natural seeding; however, the plants were not hybrids and they did not have the desired dwarf characteristics. Crownvetch varieties appeared to have promise as good erosion control ground cover plants. They tolerated a wide range of soil conditions as well as draught conditions.

In October 1969, Colorado experienced an extremely cold period. Fifty to 75% of certain varieties of plants did not

1969 (Continued)

survive. Some plants on the highway right-of-way were killed in the near zero temperatures.

Seed flats were sown in December and January. The majority of seed sown was Mahonia Repens, Four Wing Saltbush, Native Clematis, Rocky Mountain Juniper, Woodbine Crownvetch, and Gambel Oak. Seedlings were then transplanted.

1970

Propagation of native materials was emphasized. The bench area in the greenhouse was increased to handle the propagated plants. The number of test plots throughout the State was expanded to allow for an increase in the number of new plants to be observed.

Investigations were conducted to find a substitute for the crested wheat used in medians because the crested wheat was known to attract deer.

By summer of 1970 plants were developing rapidly from the seed flats sown during the winter. Seedlings were transplanted and native Clematis, Rocky Mountain Juniper, Woodbine Crownvetch, and Gambel Oak appeared strong and vigorous.

Bureau of Roads representatives visited the project again and agreed, at this time, that dwarfing of regular erosion control plants used throughout the country will not result in as much success as efforts to develop native ground cover.

By the fall of 1970 it became obvious that other native plants provide a better means of erosion control when compared with the yellow sweet clover. Those showing good potential were Alsike Clover, Strawberry Clover, White Dutch Clover, Crownvetch, native grasses, and numerous trees and shrubs.

As of June 30, 1971, total accumulated expenditures for the program were $19,649.00

CONCLUSIONS

Further investigation is needed to determine the best approach to the problem of right-of-way erosion control in Colorado. A perennial dwarf ground cover that would flourish, survive cold winters, require little moisture, and create no maintenance would provide an ideal solution. However, because of the "state of the art" limitations encountered in the research into the propagation of such a ground cover, other solutions should be considered.

An analysis of the use of commercial fertilizer on existing soils to accelerate the growth of native turf or plant life should be made. This analysis would include the costs incurred for fertilization versus those for placing topsoil where the need exists.

If mowing requirements should become heavy, research and experimentation with growth retardant chemicals should be undertaken.