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COMPETITION AS A CONTROL FOR HALOGETON GLOMERATUS

by

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Dennis T. Cleaves and John Taylor

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During the 1978 growing season, preliminary sampling was initiated to determine the effectiveness of perennial vegetation in the control of *Halogeton glomeratus*, through competition. The study was originated to determine possible alternative methods of control other than spraying with 2,4-D, which eliminates all broad-leaved vegetation on the treated site. Prior studies have indicated that competitive control could be the most beneficial. At the Jim Bridger Mine in southwestern Wyoming, native stands of *Artemisia tridentata*, *Atriplex confertifolia*, *A. gardneri*, and other shrubs adjacent to heavily infested minespoils have successfully prevented the establishment of Halogeton. First year sampling of two minespoil treatments, one with 7.5% cover of native perennials and the other with 1.2% cover of native perennials yielded 199.8 g/m^2 and 327.4 g/m^2 of Halogeton (oven dried weight) respectively. Nearby stands of native vegetation had 22.8% cover of shrubs and yielded only trace amounts of Halogeton (attributed to edge effect and the continued trampling of the area by investigators). Cover data were obtained using 30-meter steel tapes in a line intercept format. Weight data was taken by clipping 0.5 x 2.0 meter quadrats. All transects and quadrats were placed using baselines and random number tables. Second and third year sampling will include two additional minespoil treatments and more extensive sampling in order to reinforce the authors' hypothesis.

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INTRODUCTION

Each year in the western United States, more and more areas are set aside for the mining of coal and uranium. As these areas become disturbed by surface mining procedures, the problems of noxious weed invasion, and hence their control is becoming a matter of grave concern to both the mining companies and government agencies. In the Red Desert, a large area of southwestern Wyoming, the most prevalent weed problem is *Halogeton glomeratus*. This study was initiated in order to evaluate, thru some of the literature, the best possible methods of dealing with halogeton, particularly on strip mine spoils. Tentative results of the literature scan and first year sampling indicate that the best control of halogeton may be accomplished through the competition of established perennial plants.

BACKGROUND

Although much of the literature about halogeton in the last thirty years is contradictory, there are several aspects which are generally agreed upon by most authors.

The growth habit of halogeton, coupled with the total environmental disturbance caused by surface strip mining, creates an ideal situation for the establishment of halogeton, particularly as the local spread of this weed is greatly aided by the wind, Harvester ants, and rabbits, all of which are very abundant in this area of Wyoming. Also, higher salt content of the soil, especially sodium salts, are beneficial to halogeton establishment as less grass density is usually found under these conditions.[5]

There are seven identifiable growth stages of <u>Halogeton glomeratus</u>.[1]

1. Germination and emergence,
2. Seedling stage,
3. Prostrate stage,
4. Erect branching,
5. Flower,
6. Fruiting,
7. Maturation.

Germination and emergence can occur from February thru mid-August, although the majority generally occurs in April and May. The relative germination and abundance of halogeton is dependent largely upon yearly precipitation, correlated with July-thru-September precipitation of the previous year, and May-thru-June precipitation of the present year. Adequate fall and winter precipitation for soil moisture recharge as well as dry spring months are critical for germination and establishment.[5]

The most rapid development of halogeton seems to occur at soil temperatures between 60 and 80^{o}F, and although it is unable to produce either a large shoot or root system early in the growing season, the roots of a vigorous, mature halogeton plant can penetrate to a depth of 20 inches with a lateral spread of 18 inches. Low vigor plants usually have a maximum depth of nine inches with a lateral spread of three inches.[4]

The early seedling stage appears to be quite critical, and the resultant survival of intra-specific competition is usually about 25 percent. Approximately 50 percent of the total growth of halogeton is accomplished in June, and 90 percent of the total growth is accomplished by the end of July.[1] The remainder of the growing season or until about September, is used for flowering, fruiting, and seed production.

<u>SEED PRODUCTION AND LONGEVITY OF VIABLE SEEDS IN THE SOIL</u>

Several attempts have been made to explain the seed production in halogeton. These explanations range from the mature, viable seed and immature non-viable seed theory to the presently accepted two-seed theory of a black wingless seed and a brown winged seed, produced on the same plant.

The black seeds are readily viable at maturity although it is believed that they have a two stage after-ripening process, or destruction of germination inhibitors. In germination trials, no black seeds have been shown to germinate after one year of storage.

The brown winged seeds appear to have true dormancy which can be broken by natural weathering processes. They have been shown in seeding trials to have 50 percent germination after two years of storage.[1]

With no separation of black and brown seeds at the time of collection, trials showed that 24 percent of the halogeton seed germinated within two weeks of an October collection. Under a warm and dry storage regime, seeding trials produced 60 percent germination after six weeks of storage. Under a cool wet storage regime, 95 percent germination was accomplished after the same storage period. There appeared to be no decrease in viability after six months of storage, although after ten weeks, the incidence of diseased seedlings was higher.[3]

Actual production estimates of halogeton are somewhat controversial, but large, vigorous plants have been cited as producing 25,000 seeds each. Plants three inches tall have produced as many as 800 seeds, and one-inch high plants reaching maturity have produced seed. One pound of halogeton seed contains 900,000 black seeds and 460,000 brown seeds. A one-acre stand of halogeton can produce approximately 200 to 400 pounds of seed.[8]

Estimates of viable seed longevity in the soil have varied over the years, but some of the more recent investigators contend that that brown seeds of halogeton can remain viable in the soil for up to ten years.[3]

CHEMICAL AND MECHANICAL CONTROL OF HALOGETON

Control of halogeton, both chemical and mechanical, has interested investigators from several different fields since massive livestock die-off episodes in the 1940's and 1950's were attributed to it. More chemical control than mechanical control has been attempted in the western states, and although chemicals, especially the ester form of 2,4-D, have had the best success rate, neither of the methods have proved to be as effective as was necessary to control already infested sites or to halt the spread of halogeton. There has been no chemical treatment that has given 100 percent control, in any circumstance.[1,5] On the contrary, in several cases, attempts at chemical control of this weed have caused even greater invasion problems as the broad-leaved vegetation that would normally compete against halogeton are destroyed by the treatment.[2] The spraying of halogeton immediately after flowering causes the production of less viable seeds, but enough are viable to insure its survival on the site.

COMPETITION AND HALOGETON

Several species of native and introduced perennial plants have been tested and shown effective in reducing or excluding halogeton from dry range sites. These perennials include the shrubs *Artemisia tridentata*, *Sarcobatus vermiculatus*, *Atriplex confertifolia*, *A. gardneri*, *Chrysothamnos nauseosus*, *Ceratoides lanata*, and the grasses *Agropyron cristatum*, *A. riparium*, *Elymus junceus*, *Stipa comata* and *Sitanion hystrix*.

In several test situations seedling mortality of *Halogeton glomeratus* was greatest when competition of perennial vegetation was highest. This amounted to 97 to 100 percent mortality in stands of *Agropyron cristatum*. Pure stands of *A. cristatum* and *Elymus junceus* with five percent cover were sufficient to totally exclude seeded halogeton.[7] In stands of native shrubs, 22.5 percent cover of perennials *(Ceratoides lanata)* was sufficient to exclude halogeton entirely. Most of the competitive studies and grazing trials have shown that halogeton infestations are directly related to varying densities of other plants.[4] Halogeton does not seem to have the ability to compete with shallow-rooted perennials especially ones as highly competetive as *Elymus junceus* and *Agropyron cristatum*.[7]

METHODS AND PROCEDURES

In order to obtain an indication of whether competition could exclude halogeton on mine spoils, three sites were chosen to begin preliminary sampling. These sites included a native area adjacent to the mine spoil area, and two different mine spoil treatments nearby. All treatment areas had the same basic slope and aspect.

The native area was considered typical for the Jim Bridger Mine area. The dominant vegetation is *Atriplex* spp., except for small areas which are dominated by *Artemisia tridentata*. Other species present include *Artemisia* *pedatifida*, *Grayia spinosa*, *Sarcobatus vermiculatus*, *Ceratoides lanata*, *Elymus cinereus* and *Oryzopsis hymenoides*. The *Atriplex* spp. present are *A. confertifolia* and *A. gardneri*. Several other species of grass and shrubs occur but only in trace amounts.

The two mine spoil treatments lie adjacent to each other and are in close approximation to the native treatment. Both of the treatments were topsoiled and seeded in the spring of 1976; however, one was topsoiled from a stockpile, the other with topsoil freshly scraped from a native area.

The area with directly-applied topsoil from the native area had a visibly higher percent of native perennial cover than the other mine spoil treatment. Because of the proximity of this treatment to other treatments with considerably less cover, it was assumed that the native perennials occurring here were volunteers from the viable seed source in the fresh topsoil. The dominant native perennial vegetation is *Atriplex gardneri* and *A. confertifolia*.

The remaining treatment, or the stored topsoil area, is entirely dominated by *Halogeton glomeratus*. The only obvious vegetation other than halogeton is some volunteer *Atriplex gardneri*.

In order to obtain the desired information it was decided that data would be collected in two phases. Phase one would be to establish cover data for all treatments using the line intercept method, which has been shown to be effective in areas dominated by shrubs. To supplement the cover data, it was also decided that clipping and oven-drying techniques would be used to make comparisons of halogeton production on all treatments. This gave investigators relative comparisons between treatments of both the differences in amount of native perennials and in the amount of halogeton produced, without sacrificing any of the native perennials.

Baselines were established for all treatments, and using a random numbers table the positioning of line transects was accomplished. Periodically along these transects, also using a random numbers table, points were picked for the positioning of 0.5 x 2.0 meter quadrats. The line transects were 30-meter tapes, and four quadrats were placed on every other transect. As the data was used only for tentative indications, no adequacy of sample tests were run.

The cover estimates were run during the first week of August, when most of the vegetation seemed to be at its peak development. The clipping of halogeton was done in September, just after flowering.

RESULTS AND CONCLUSIONS

This first year's sampling determined that a native cover of 24.7 percent totally excluded *Halogeton glomeratus*. A trace of *H. glomeratus* was present, but the sampled native area was adjacent to disturbed sites, and had been trampled extensively by investigators. The mine spoil treatment with directly-applied topsoil had a 7.4 percent cover of perennials, and the stored topsoil treatment had a 1.2 percent cover of perennials. In comparison, the cover of halogeton was a trace, 31.6 percent and 36.8 percent cover on the native, directly-applied topsoil and stored topsoil, respectively. This was not a significant cover difference between the spoil treatments. However, the oven-dried weight of halogeton exhibited a much more significant difference. The directly-applied topsoil treatment yielded an average of 199.8 grams per meter squared of halogeton while the stored topsoil treatment yielded 327.4 grams per meter squared. This was a significant enough difference to indicate that a more comprehensive study should be initiated.

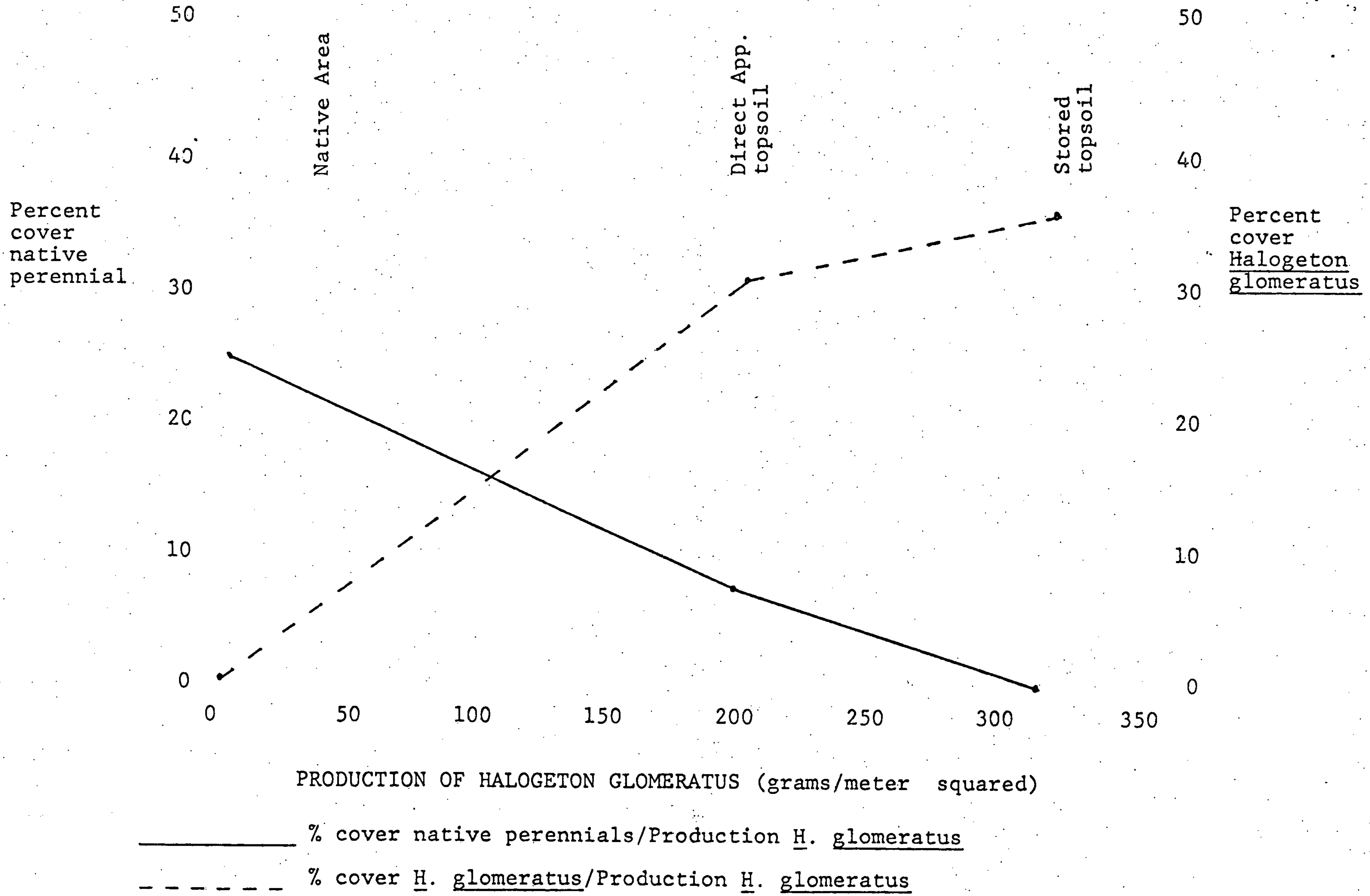
DISCUSSION

Because of heterogeneity within treatments, and the probable inadequacy of the sampling conducted during the 1978 growing season, additional sampling and a change in procedural format will be used during this year's growing season.

All treatments will be subdivided into a 3 x 5 grid, and all sampling will be conducted within each grid. Grid size will be determined by the size of the smallest treatment. Also, native areas will be subdivided into two vegetation types - Atriplex spp. dominated and Artemisia spp. dominated - and a grid will be established in each subdivision.

Instead of clipping four quadrats along every other transect, quadrats will be positioned on every transect. However, quadrat size will probably be somewhat smaller.

Hopefully, this grid system and the increased sample size will result in more comprehensive and significant data.



Native Area
Direct App. topsoil
Stored topsoil
Percent cover native perennial
Percent cover Halogeton glomeratus
50
40
30
20
10
0
0
50
100
150
200
250
300
350
PRODUCTION OF HALOGETON GLOMERATUS (grams/meter squared)
% cover native perennials/Production H. glomeratus
% cover H. glomeratus/Production H. glomeratus

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