# Spraying and Seeding High Elevation Tarweed Rangelands[1]

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## Highlight

**Twenty methods of seeding high-elevation tarweed infested ranges were tested over a 10-year period on a harsh site in southeastern Idaho. The most practical method was spraying in the spring with 1.5 to 2 lb/acre of 2,4-D, drilling in the fall without further seedbed preparation, and respraying with 1 lb/acre of 2,4-D the next spring. This method also gave excellent results when tested on eight large-scale seedings.**

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Tarweed (*Madia glomerata* Hook.), sometimes called cluster tarweed, is the dominant plant on extensive areas of depleted, but potentially productive mountain rangelands in the Western USA. This plant secretes a sticky substance and gives off a strong scent which accounts for its name. It is only slightly grazed by livestock. Stands range from scattered plants to over 1,000/ft$^2$. Tarweed infested lands yield from 200 to 2,000 lb/acre of tarweed and from 10 to 300 lb/acre of native grass (Fig. 1).

Tarweed seeds germinate under the snow cover, and plants commence growth before the snow melts. The roots elongate more rapidly than roots of seeded grasses, and the many spreading roots compete with seeded plants for moisture and plant nutrients. Seeding failures have been numerous when tarweed is present.

Carnahan and Hull (1962) found that death loss of seeded plants of intermediate wheatgrass (*Agropyron intermedium* (Host) Beauv.) increased significantly as the number of tarweed plants increased, and that as few as four tarweed plants/ft$^2$ resulted in loss of grass seedlings. Tarweed plants contained substances which inhibited normal laboratory germination of seeds of intermediate wheatgrass and also reduced the growth of intermediate wheatgrass in the greenhouse. The inhibitory sub-

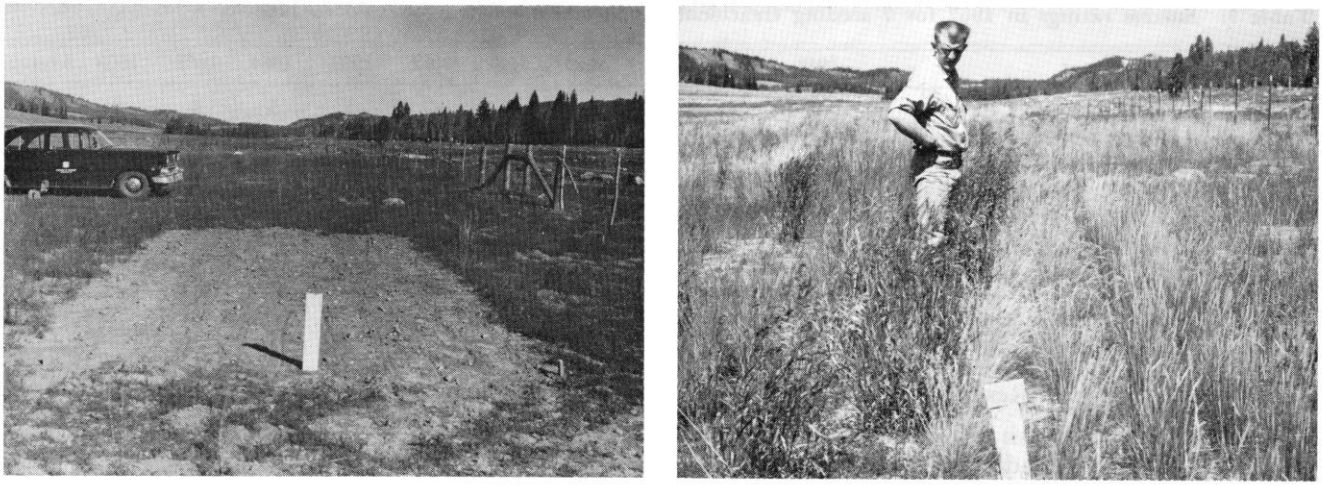

FIG. 1. This area in southeastern Idaho is typical of tarweed-infested ranges. Twelve years of protection did not increase useable forage. *Left*—Spraying with 1.5 lb/acre of 2,4-D in the spring of 1958 killed all tarweed on the experimental plot and gave a clean seedbed for drilling in the fall of 1958. *Right*—In 1963 a good stand of seeded grasses averaged 2,528 lb/acre.

stances were water soluble and not inactivated by boiling or freezing, or cold or warm storage. Ashing destroyed the toxic properties.

Workers report some success from seeding tarweed infested lands, but most of them also indicate that no completely satisfactory seeding method has been found (Stevenson, 1950; Plummer et al., 1955; Hull et al., 1962; Hull and Holmgren, 1964). This report describes a method of seeding which has been successful on experimental and large-scale plantings.

## Experimental Seedings

Experiments were in a weedy opening in the spruce–fir type in Franklin Basin in southeastern Idaho. The area is at 8,400 ft elevation and slopes 3% west. Annual precipitation averages 46 inches with 6.7 inches from June 1 to September 30. Snow usually covers the area from early November to early June. The dominant vegetation is tarweed, though there is considerable bushy knotweed (*Polygonum ramosissimum* Michx.), collomia (*Collomis linearis* Nutt.), bicolor biscuitroot (*Lomatium leptocarpum* (Torr. and Gray) C. and R.), panicle willowweed (*Epilobium paniculatum* Nutt.), lambstongue groundsel *Senecio integerrimus* Nutt.); and many spring-growing, fleshy-rooted plants such as lanceleaf spring beauty (*Claytonia lanceolata* Pursh), Indian potato (*Orogenia linearifolia* S. Wats.), and tuber starwort (*Stellaria jamesiana* Torr.).

The soil is clay loam. The pH ranges from 5.6 to 5.8. It appears as though considerable topsoil has been lost. Though the soil is low in organic matter and plant nutrients, it is adequate for grass growth. A major undesirable characteristic of the soil is that it compacts and hardens quickly after snow melt. This slows and reduces seedling emergence. On this area there is also heavy seedling loss from frost heaving (Hull, 1966).

## Procedures

We tested many methods of seedbed preparation and seeding; several types, rates, and dates of applying herbicides; and many species. There were four replicates of each treatment. Seeding work which began in 1957 has continued each spring and fall to the present. Spring treatments were made after snow left the area, usually early June. At this time, tarweed was in the 2- to 6-leaf stage and from .2 to .5 inch tall. Fall treatments were made in September. Grass on fall-seeded plots was usually in the 1- to 2-leaf stage when plots were sprayed in the spring. Spraying was at 1.5 lb/acre acid equivalent of isopropyl ester of 2,4-D. Cultivation and plowing was to an average depth of 5 inches. The sawdust mulch was .5 inch deep over the entire plot area. Pocket gophers were controlled with poisoned grain.

Seed was planted from 0.5 to 0.75 inch deep, depending upon seed size, at 25 seeds/ft of drill row. This was 12 lb/acre for intermediate wheatgrass, 7 lb/acre for slender wheatgrass (*A. trachycaulum* (Link) Malte ex A. F. Lewis), and 8 lb/acre for smooth brome (*Bromus inermis* Leyss.). All counts and ratings are the average of these species.

Plants in each treatment were counted in spring and fall for the first 3 years, and each fall for the next 2 years. Success ratings were made in 1966 and 1967. These ratings indicate the success of an established stand or the potential of a seedling stand as follows: 9–10, excellent; 7–8, good; 5–6, fair; 3–4, poor; 1–2, very poor; 0, failure.

**Table 1. Success ratings in 1967 for 7 seeding treatments at Franklin Basin from 1957 to 1966.**

| Treatment | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Plow spring, drill spring | – | 3 | 8 | 5 | 5 | 7 | 5 | 5 | 5 | 8 | 5.7 |
| Spray spring, drill fall, spray spring | – | 5 | 4 | 2 | 5 | 2 | 2 | 4 | 2 | 7 | 3.7 |
| Drill fall, spray spring[1] | 1 | 3 | 1 | – | – | – | – | 2 | 4 | 3 | 2.3 |
| Spray spring, drill spring | – | 2 | 1 | 2 | – | – | – | 3 | 1 | 4 | 2.2 |
| Plow fall, drill fall | 3 | 4 | 2 | 4 | 1 | 1 | – | 2 | 3 | 3 | 2.6 |
| Summer fallow, drill fall | – | 5 | 3 | 0 | 4 | 1 | 2 | – | 2 | 2 | 2.4 |
| Plow and drill fall, apply sawdust mulch | 1 | 4 | 1 | 3 | 1 | 1 | – | – | 4 | 2 | 2.1 |

[1] Spray treatments were isopropyl ester of 2,4-D at 1.5 lb/acre.

## Results

The abnormally harsh growing conditions of the experimental site made seedling establishment difficult; hence all ratings are low. Seeding in the spring gave the best stands. However, spring seeding is not generally feasible on high elevation lands. The next best method was spraying in the spring with 1.5 lb/acre 2,4-D and drilling in the fall. This was followed by respraying the next spring at 1 lb/acre 2,4-D if tarweed had more than 2 plants/ft$^2$. The second spraying was made in 5 of the 10 years. This treatment gave fair stands, was feasible under most conditions, and was the only method used for large-scale seeding. This discussion is, therefore, concerned mainly with this treatment. Six other treatments are used for comparison (Table 1).

Thirteen seeding treatments, not listed in Table 1, were used during some or all of the 10 years. They were either impractical, did not increase the seeded stands, or gave poor results:

1. Plow and drill in the spring and apply lime at 5 tons/acre.
2. Plow and broadcast seed at 25 lb/acre in the spring.
3. Furrows 4 inches deep on 2-ft centers and drill in the bottom of the furrows and on the ridges between.
4. Cover seed in open furrows with .75 inch of sawdust.
5. Cover seed in open furrows with .5 inch of sand.
6. Straw mulch 1 inch deep.
7. Drill wheat one fall and forage grasses the next.
8. Use wheat as a nurse crop for forage grasses.
9. Cover seeded rows with different types and widths of plastic strips.
10. Spray seeded rows with different types, rates, and widths of strips of asphalt and wax emulsions.
11. Spray with different types and rates of herbicides.
12. Remove blocks of soil to a 12-inch depth and replace with valley soil and seed spring and fall.
13. Apply nitrogen, phosphorus, potash, and minor elements at different rates and seasons.

### Large-Scale Range Seedings

The 1957 and subsequent experimental seedings showed that spraying with 2,4-D and drilling held promise. Therefore, this method was tested on the following eight depleted range areas in the Cache National Forest in northern Utah and southeastern Idaho: Roundup Spring, Roundup Spring (north), Six-bit Spring, Red Wells, Running Water Spring, Big Spring, Eli Ridge, and Paris Meadows. The first 7 areas are in the vicinity of Monte Cristo, about 40 miles northeast of Ogden, Utah. The last one is in Paris Canyon, 15 miles west of Paris, Idaho. Treated areas were depleted openings in the aspen (*Populus tremuloides* Michx.), spruce–fir (*Picea* spp. and *Abies* spp.), or lodgepole pine (*Pinus contorta* Dougl.). On weedy openings, tarweed was dominant with much the same associated species as at Franklin Basin, plus some slender hairgrass (*Deschampsia elongata* (Hook.) Munro) on most areas and large patches of wild onion (*Allium* spp.) at Paris Meadows. Roundup Spring and Running Water Spring had many areas of big sagebrush (*Artemisia tridentata* Nutt.) which were treated the same as the weedy openings.

Most areas are near 8,000 ft in elevation. They range from near flat drainage bottoms up to moderately steep slopes, which face mainly south but with some facing east and west. The soil is mostly loam with some areas of gravel and rocks. Soil nutrients and organic matter are low, but usually sufficient for grass growth. Annual precipitation averages approximately 40 inches, with 6 inches from June to September.

The standard seeding procedure was to spray in the spring by ground rig or helicopter at 2 lb/acre of the isopropyl ester of 2,4-D, drill in the fall, and respray the next spring at 1 lb/acre. Seeding was followed by pocket gopher control with the "burrow-builder" and by hand. The harsher sites at Red Wells and Running Water Spring had contour furrows to help hold water on the area (Fig. 2).

**Table 2. Year seeded, percent composition of species, and 1966 ratings of seeded stands at eight locations.**

| Species | Roundup Spring 1964 | Roundup Spring (north) 1964 | Six-Bit Spring 1964 | Red Wells 1964 | Running Water Spring 1964 | Eli Ridge 1964 | Big Spring 1965 | Paris Meadows 1963** |
|---|---|---|---|---|---|---|---|---|
| Brome, mountain | 10* | 30* | 5* | 1* | 5* | 65* | 20* | 1* |
| Brome, smooth | 20 | 5 | 20 | 20 | 25 | 5 | 0 | 5 |
| Foxtail, meadow | 10 | 5 | 5 | 10 | 10 | 0 | 0 | 0 |
| Oatgrass, tall | 5 | T | 5 | 4 | 5 | T | 0 | 0 |
| Orchardgrass | 5 | 10 | 15 | 10 | 5 | T | 0 | 10 |
| Timothy | 25 | 20 | 15 | 25 | 15 | 5 | 0 | 40 |
| Wheatgrass, intermediate | 5 | 5 | 20 | 5 | 5 | 5 | 20 | 20 |
| Wheatgrass, slender | 15* | 25* | 10* | 25* | 25* | 15* | 30* | 20* |
| Misc. | 5 | — | 5 | — | 5 | 5 | 30 | 4 |
| Rating | 10 | 6 | 6 | 10 | 9 | 10 | 9 | 8 |

* Most of this is native grass.
** Some parts seeded again in 1965.

Seeds were drilled with the rangeland drill in deep furrows spaced 12 inches apart. Efforts were made to cover seed .5 inch. The following species were drilled at 17 lb/acre on sprayed areas or broadcast on the newly constructed contour furrows:

| Species | lb/acre |
|---|---|
| Intermediate wheatgrass | 4 |
| Slender wheatgrass | 4 |
| Smooth brome | 4 |
| Tall oatgrass (*Arrhenatherum elatius* (L.) Presl) | 2 |
| Meadow foxtail (*Alopecurus pratensis* L.) | 1 |
| Orchardgrass (*Dactylis glomerata* L.) | 1 |
| Timothy (*Phleum pratense* L.) | 1 |

The 1966 estimated percentage of each species in the eight areas and the ratings are shown in Table 2. Seeded plants ranged from 2.4 plants/ft², with a patchy distribution at Six-bit Spring and Roundup Spring (north), up to 6.0/ft² with more even distribution on the areas which rated 9 and 10. Prior to treatment these areas averaged 100 to 300 lb/acre of grass and 300 to 500 lb/acre of tarweed and other forbs. One year after treatment, grass increased to between 900 and 1,300 lb/acre (Fig. 3).

Spraying killed 100% of the sagebrush. Native grasses, especially slender wheatgrass and mountain brome (*Bromus carinatus* Hook. and Arn.), increased and formed a good stand on sagebrush areas at Roundup Spring and Running Water Spring. These same species increased rapidly and formed most of the stand on Eli Ridge.

FIG. 2. An excellent stand of seeded grass at Red Wells producing 1,200 lb/acre in 1966 as compared to less than 300 lb/acre of grass before treatment. This area was sprayed with 2 lb/acre of 2,4-D in the spring of 1964; seeded in the fall of 1964; and resprayed in 1965. The bare strip is where the "burrow-builder" passed through for pocket gopher control.

## Discussion

Most of the 20 seeding methods tried on the experimental plots gave poor stands. The major reason was soil compaction and frost heaving on the experimental area (Hull, 1966). Methods which were poor to fair on the experimental area gave good stands on other sites and on the large-scale seedings. The best experimental method was plowing and drilling in the spring. However, because of wet roads, uneven drying, and a short planting season, spring seeding on high elevation ranges is practical only on accessible areas. Fall plowing and drilling gave poor stands on experimental areas and was a failure on large-scale seedings. Because of rocks, gullies, steep slopes with attendant erosion hazards, and the high incidence of failures, plowing is not practical for large-scale seedings.

Eliminating plowing and spring seeding, herbicidal spraying and drilling was the most practical and economical method for seeding these weedy rangelands. Several combinations of seeding and spraying with 2,4-D have been tested. The three most widely used are: (1) spraying in the spring, drilling in the fall, and respraying the next spring;

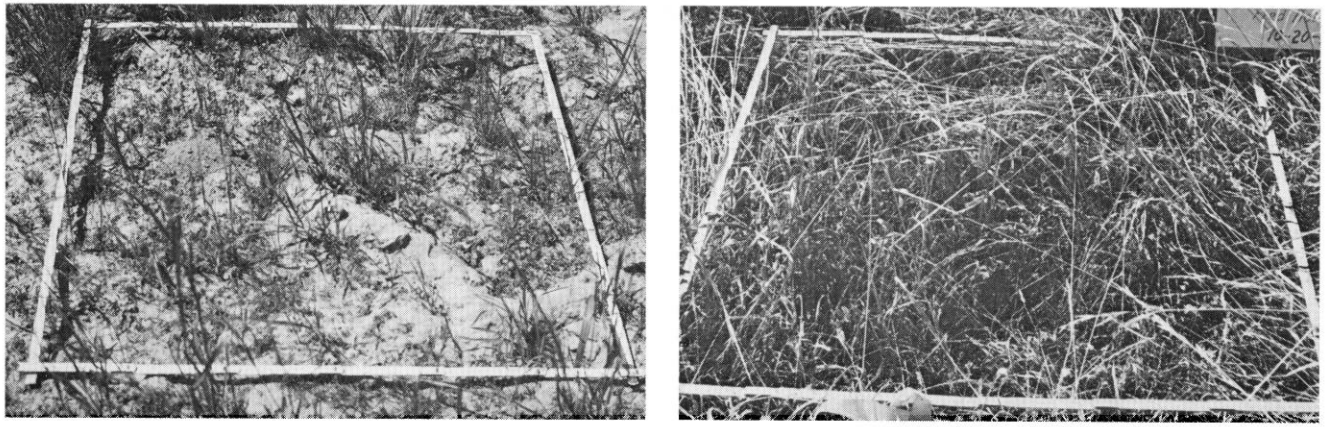

FIG. 3. This area at Monte Cristo produced 230 lb/acre of grass before spraying and drilling. *Left*—This photo taken after the 1964 spraying shows the dying tarweed, the sparse stand of native grass, and the casts and mounds of pocket gophers. *Right*—In 1965 seeded grass yielded 1,205 lb/acre.

(2) drilling in the fall and spraying in the spring; and (3) drilling and spraying in the spring. The first mentioned gave the best results. Spraying early in the spring for 1 or 2 years usually eliminated tarweed for 2 or more years. With little competition, the seeded plants grew rapidly. For example, at Big Springs, the production of grass increased from 104 lb/acre prior to spraying and seeding to 910 lb/acre one year later.

Respraying the 2nd spring was necessary where tarweed was present. Respraying was with 1 lb/acre of 2,4-D when grasses were in or beyond the 4-leaf stage so that there was little grass damage.

Some workers report no damage to grass at any stage of growth with up to 2 lb/acre of 2,4-D.[2] Work by Klomp and Hull showed that spraying with 2,4-D damaged seedling grasses in the field and in the greenhouse.[3] Damage decreased as plants developed beyond the 1–2 leaf stage and also when lower rates of 2,4-D were used.

All experimental and large-scale seedings showed the necessity of tarweed control for success. The thin stands of seeded grass at Six-bit Spring, Roundup Spring (north), and in spots at Paris Meadows were attributed to tarweed competition. This agrees with work by Carnahan and Hull (1962).

Most high-elevation lands with a weedy plant cover have heavy pocket gopher populations. Gophers must be controlled because they can prevent the establishment of a seeded stand, and even destroy an established grass stand.

[2] Personal communication.

[3] Unpublished annual progress reports for 1965 and 1966.

## Conclusions

The most practical method of seeding high-elevation tarweed infested ranges was spraying in the spring with 2 lb/acre of isopropyl ester of 2,4-D, drilling in the fall, and respraying the next spring. Though this method gave only fair stands on the harsh experimental site, it gave good-to-excellent stands on large-scale seedings. Plowing and seeding in the spring was the only experimental method which gave better stands than spraying and drilling. Seeding in the spring, however, is not practical for most large-scale seedings.

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