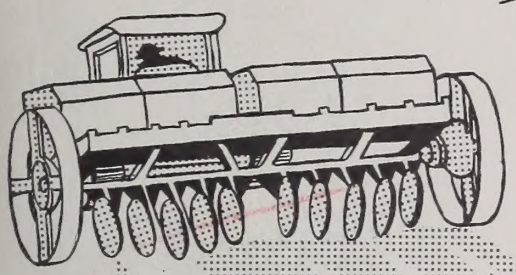
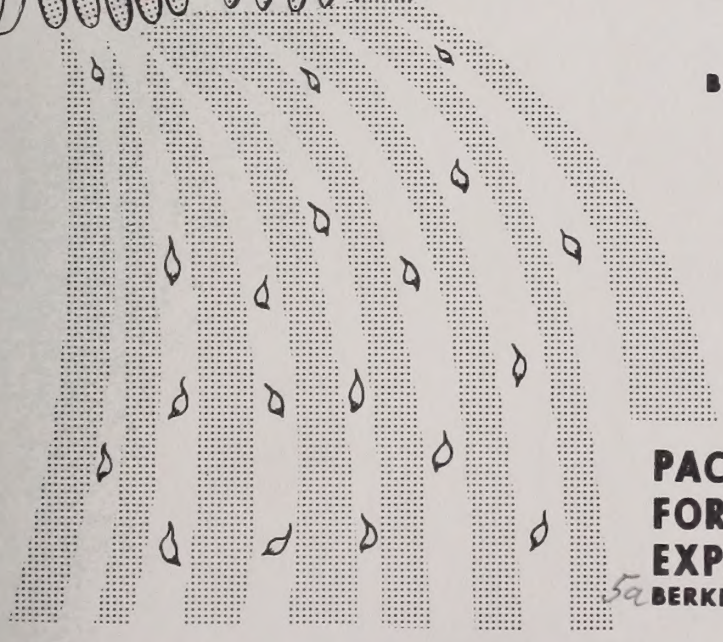
BITTERBRUSH RESEEDING...

a tool for the game range manager





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BITTERBRUSH RESEEDING - A TOOL FOR THE GAME RANGE MANAGER

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Division of Range Management Research

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BITTERBRUSH RESEEDING - A TOOL FOR THE GAME RANGE MANAGER[1/]

By Richard L. Hubbard, Eamor C. Nord, and Lyle L. Brown
Range Conservationists and Range Aid

Bitterbrush (Purshia tridentata) can be artifically seeded to improve critical deer ranges. This has been demonstrated on several areas in northeastern California. There is a crying need for restoration of bitterbrush ranges destroyed by fire, grazing, insects, disease, and natural succession. Some of these ranges have been important deer wintering areas. Given time, nature may restore bitterbrush on some of them--on others, perhaps not. Even where bitterbrush will come back naturally, it generally takes many decades, longer than most game managers, sportsmen, and deer are willing or able to wait. The condition of these ranges justifies the use of artificial seeding methods.

During the last few years, we've planted bitterbrush on 23 different areas varying in size from 1 to 18 acres. Some have been very successful; others have been failures. These plantings were made to test research findings and determine the practicability of range seeding.

One of the first obstacles, bitterbrush seed dormancy, was overcome by soaking the seed for 4 to 5 minutes in a 3 percent thiourea solution then drying at room temperature (Pearson, 1957; Hubbard and Pearson, 1958). In nature dormancy is broken by overwintering in the soil. The thiourea treatment makes spring planting possible.

Hubbard (1956) showed that good site preparation was another requirement of success. Site preparation reduces the number of plants competing with bitterbrush seedlings for moisture. Cheatgrass is a heavy competitor; more so than the broad-leaved, summer-annual weeds (Holmgren, 1956). Once bitterbrush seedlings are established, they persist and often achieve dominance over competing plants if protected from grazing.

1/ Contribution from cooperative investigations between the Pacific Southwest Forest and Range Experiment Station and the California Department of Fish and Game. Work was done under Federal Aid in Wildlife Restoration Act, Pittman-Robertson Research Project W51R entitled "Game Range Restoration."

Hubbard (1956 B) reported optimum bitterbrush seedling emergence from seed planted at depths of between 1/2 and 1-1/2 inches.

Nord and Knowles (1958) facilitated seed distribution with ordinary fluted-feed drills by mixing the bitterbrush seed with loose rice hulls.

Knowing where to plant bitterbrush is as important as how to plant. According to Gardner[2/] bitterbrush makes its best development on coarse textured soils that are excessively drained, rapidly permeable throughout, and have a slightly acid reaction (pH 6.0 to 7.0) to a depth of 5 feet or more. Bitterbrush generally does not grow naturally in northeastern California on soils that are saline or calcareous within 3 feet of the surface or on imperfectly or poorly drained soils.

Many of the plantings in our experience were conducted jointly by the Pacific Southwest Forest and Range Experiment Station and the California Department of Fish and Game. Although too small to provide much herbage for big game or livestock, they have demonstrated how to do the job under the usual run of field conditions.

PLANTING SITES

Some of the chosen sites were classed as good, others as intermediate, and some downright no good. All were on critical deer-winter range in need of reseeding. Also, each area could be plowed and seeded with ordinary equipment. They represented different site conditions to aid widening the applicability of research findings.

Elevation varied between 4,000 and 4,500 feet. The northernmost plantings were on the California-Oregon Interstate deer herd range in Modoc County (fig. 1). Total precipitation in this area averages about 12 inches annually with a seasonal range of 8 to 22 inches. Most of the soils are formed from basalt. The natural vegetation is predominately a sagebrush-juniper type on the edge of the pine timber belt. Fires have converted some of the areas into sagebrush-cheatgrass or other seral types. The Mears, Flukey Well, Adobe Flat, Casuse Mountain and Dead Horse sites were chosen in this general area.

2/ Gardner, Robert A. 1956. Reconnaissance soil investigation Game-Browse restoration experimental areas and soil-bitterbrush relationships. Typed. Soil-Vegetation Survey Project, Calif. Forest and Range Expt. Sta., Berkeley, 22 pp.

Figure 1.--Juniper, sagebrush and decadent bitterbrush must be removed from ranges to be seeded. Flukey Well-Mears sites.

Other plantings were made on the California portion of the Washoe-Lassen deer range between Hallelujah Junction and Janesville in southern Lassen County. Average annual precipitation for this area is about 10 inches with a range of 7 to 15 inches. The soils are largely derived from granite. The natural vegetation is sagebrush-bitterbrush or juniper-sagebrush with cheatgrass and a sparse stand of perennial grasses (fig. 2). Repeated burning has changed it to straight cheatgrass on some sites. Five sites, Doyle A, B, and C, Red Rock, and Hallelujah Junction, were planted in this general area.

Figure 2.--General view of the vegetation type near Red Rock (Doyle), California.

Some of the sites--Mears, Flukey Well, Doyle A and B, and Dead Horse--supported natural stands of bitterbrush. These sites differed somewhat in moisture retention qualities of the top soil, and in the amount and distribution of annual precipitation. These two factors operate together either for or against planted seed during the critical germination and emergence period. Light, sandy soils dry rapidly, and consequently germination is poorer there, especially during a dry year, than on soils having good moisture retention qualities.

The soil at the Mears and Flukey Well sites belongs to the Underwood Series, a slightly gravelly loam. This series retains moisture much better than the coarser soils at Dead Horse and Doyle A and B.

Soils at the Red Rock and Hallelujah Junction areas seemed suitable for bitterbrush even though local spots had high pH at depths from 36 to 50 inches.

The Doyle C and the Casuse Mountain areas were considered marginal bitterbrush sites. The moderately well drained soils had high pH readings at 42 and 36 inch depths, respectively.

The Adobe Flat area probably never supported bitterbrush. The soil is poorly drained and it has a pH of 8.0 at depths less than 3 feet.

Figure 3.--The brushland plow in action on the Flukey Well 18 acre pilot planting in the spring of 1957. Before plowing, the heavy brush was removed with a brush blade mounted on this same tractor.

SITE PREPARATION AND PLANTING PROCEDURES

Plowing and drilling were done with conventional farm equipment. It was easily available and cheaper to operate than other types, but at Flukey Well in 1957 this type of equipment was not entirely satisfactory. Here we switched to heavier equipment. A D-7 tractor with brush blade removed the brush. The area was then plowed with a brushland plow and seeded with a rangeland drill (figs. 3 and 4). In 1958, conventional equipment was used to prepare the sites, but planting was done with a "baby" rangeland drill.

Figure 4.--The rangeland drill is ideal for planting bitterbrush seed. Mixing the seed with rice hulls gives a good seed distribution.

Figure 5.--Ordinary farm machinery can be used for drilling bitterbrush seed on good sites having gentle topography. Accidental wildfire removed the kind of vegetation shown in figure 2 and created a satisfactory seedbed.

Eight sites were planted in the fall; 15 in the spring. Accidental wildfire prepared the sites at Hallelujah Junction and Red Rock (fig. 5). All others were plowed. Two areas, one at Mears in 1955 and one at Flukey Well in 1957, were plowed in the spring and seeded immediately afterward. All of the 1956 and 1958 seedings were on sites plowed in the fall and allowed to settle over winter. The 1956 seedings were preceded by a light harrowing in spring to mulch the upper soil crust and knock out any germinating weed seeds. No additional spring preparation was performed on the 1958 seedings. The soil was firmed by rolling or cultipacking, or with press drill wheels. Firming the soil is worthwhile, especially if the soil is rather loose or dry. It helps to squeeze moisture around the planted seed. No rolling was done on any of the 1957 or 1958 plantings because heavy rains during or immediately following drilling firmed the soil adequately in the seed zone.

All seed used was collected from native bitterbrush stands in northeastern California. Spring plantings were with thiourea-treated seed. Untreated seed were planted in the fall. Rice hulls were mixed with bitterbrush seed in 16 to 6 proportions. Seed agitators were disengaged and drill feed regulators adjusted to sow 6 to 8 pounds of seed per acre.

Sampling for seedlings was done on 3- by 50-foot belt transects during late summer or fall after planting. Data were statistically analysed from square root transformations. Because of these transformations, the upper and lower limits of significance from the means were somewhat asymmetrical.

We classified planting success as follows:

Class:	Number of seedlings per acre
Good to excellent	3,000 or more
Fair	1,000 to 3,000
Poor	100 to 1,000
Failure	Less than 100

We consider the 2 top classes to be satisfactory stands and the other 2 to be unsatisfactory.

RESULTS AND DISCUSSION

Spring seeding on prepared seedbeds gives best results

All of the good and excellent stands and 8 out of the 11 satisfactory plantings were from spring planting on clean firm seedbeds (fig. 6). The best stands were found on soils with good moisture holding capacity. The Flukey Well and Mears areas typical of this condition also had the highest average annual precipitation. The only good planting outside the Flukey Well-Mears area was at Adobe Flat. Adobe Flat is not considered a good bitterbrush site, but the soil does retain moisture very well.

Fall seedlings produced 1,700 and 2,300 seedlings per acre, whereas comparable spring plantings produced 5,200 and 8,600 seedlings on adjoining plots.

Outstanding success came from the 1957 spring planting at Flukey Well. Stocking a year after planting was more than 12,000 seedlings per acre. The excellent stand on this area was due mainly to high site quality, good seedbed preparation before planting, and the amount and distribution of rainfall. In contrast,

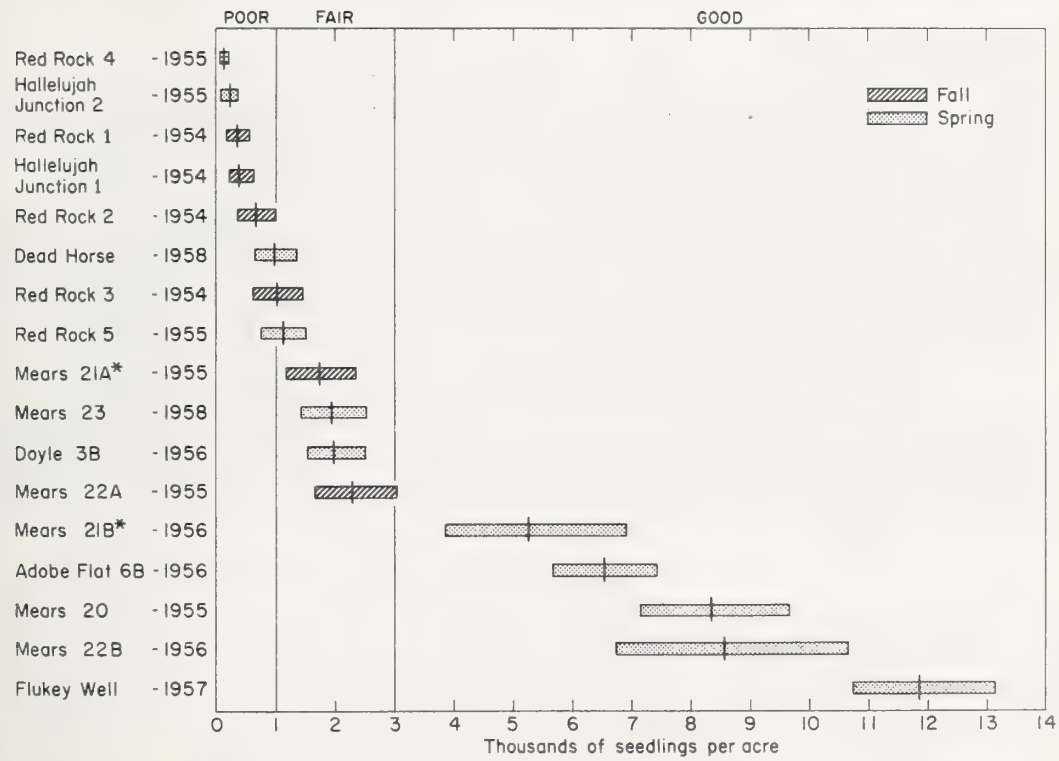

Figure 6.--Bitterbrush seedling stocking on the various drill plantings. The middle crossbar represents the mean and the 2 other crossbars are 2 standard errors above and below the mean. Stocking on the plots marked with an asterisk (*) was estimated in the second growing season. All others were estimated in the first growing season.

spring planting has not been satisfactory in Idaho. There, much better success has come from fall planting (Personal communication from Joseph V. Basile).

Not all of our spring plantings were successful, however. Four of the 6 Spring of 1958 plantings failed. All four were in the Doyle and Casuse areas on soils with poor moisture holding capacity. Poor rainfall distribution, especially during the critical germination and emergence period, aggravated the situation and undoubtedly reduced the stand. Also, we found that the seed sown in 1958 did not effectively respond to the thiourea treatment as it had in other instances. Except for the 1958 failures only 2 other spring plantings failed. One was at Hallelujah Junction and the other at Red Rock--both difficult sites.

Good site preparation essential

Good site preparation cannot be over-emphasized. The seedbed must be clean and firm. All plantings that produced more than 1,500 seedlings per acre were on well prepared seedbeds. Fall-plowed areas were smoothed with a harrow and allowed to settle over winter. In spring they were harrowed lightly just before planting.

Rainfall also helps

Unfavorable rainfall distribution was one of the factors which adversely affected the 1958 spring plantings. During the critical germination and emergence period very little rain was received, although there was good rainfall immediately after planting and again in the late spring. Apparently much of the germinating seed dried out before the seedlings could develop. The stocking on the 1958 Mears planting is the lowest of any of the spring plantings in the area. However, it can still be classed as fair stocking.

The Flukey Well planting received lots of precipitation well distributed throughout the critical germination and emergence period. Two days after seeding, 0.87 inch rain fell on the area. This was followed by continued favorably distributed precipitation throughout the first season.

Insect larvae may damage or destroy seedings

Cutworms and wireworms took a toll of emerging bitterbrush seedlings on most of the plantings. On a small planting at Doyle, where we observed causes of mortality of individual seedlings, these larvae killed 98 percent of the seedlings within a few weeks after emergence (Hubbard, 1956). Enough seedlings were destroyed by cutworms on the 1955 fall planting at Doyle to turn what might have been a fairly successful planting into a failure. In the same area, the 1956 spring planting was a fair success only because we were able to go in and treat it with insecticide soon after insect damage started. Where these larvae are present in large numbers--and we don't know, as yet, how often, or where, this happens--they can totally destroy a planting.

Other conditions affecting seedling establishment

Soil crusting and cracking was evident on the 1955 fall planting at Adobe Flat. Here the seedlings failed to break through the thick crust. There was good emergence on an adjoining spring-planted plot when this soil crust was broken by harrowing before planting.

Frost action, too, may be detrimental on some soils. Cracks often open up and speed soil drying. Also frost action disturbs the seed by moving it to either a shallower or deeper depth than optimum.

Rodents are known to cut down success by removing seed. However, despite high rodent populations, we got good stands without rodent protection. Spring planting may be a partial solution by virtue of the shorter time the seed is exposed to rodent activity.

Effectiveness of the thiourea treatment should always be checked. This was not done before planting in 1958, and it was later found that the treated seed yielded only about 35 percent germination. Previously treated seed had given 90 percent or better germination. In this case a longer soaking time would have been justified.

Seedling mortality after establishment

To round out the picture, we must consider growth and mortality of the seedlings in later years. Seedling mortality is highly variable from site to site and from year to year. There are a number of causes--some relatively unimportant, others considerably so.

The major cause of seedling loss in the Flukey Well-Mears area, was frost heaving during the first winter after emergence. On the 1957 Flukey Well spring planting, mortality was about 20 percent to the end of the second growing season. On the 1956 Mears spring planting, seedling loss was about 13 percent during the first winter.

Further losses occur after the end of the second growing season. On the Mears area third season seedling mortality ranged from 10 to 23 percent. We haven't been able to single out a cause. Grazing by rabbits, deer, and in one instance by sheep has been observed. Reduction of vigor through grazing undoubtedly reduced seedling ability to compete with invading annual grasses and weeds for available moisture. A study of ungrazed bitterbrush plants (Hubbard, 1956) showed that seedlings can gain dominance over invading species if grazing is not permitted. This points up the need for control of animal numbers before attempting bitterbrush seeding.

Seeding mortality at Red Rock and Hallelujah Junction was mainly due to jackrabbits. On these areas over a 4-year period at least 80 percent of the seedlings were eaten by jackrabbits. Inside a rabbit exclosure, installed at the end of the first growing season, mortality was only about 8 percent during the same period. The amazing thing is that any seedlings at all are still living outside the exclosure.

A few years of observation are needed to determine total plant mortality between emergence and maturity. As plants get older mortality from the causes cited should decrease.

Cost of seeding

The total cost per acre on the 18-acre planting at Flukey Well was $45.62 (table 1). These are actual operating costs except an arbitrary 10 percent for miscellaneous expenses such as equipment transportation and breakdown.

More than a quarter of the total cost was for removing the brush before plowing. Light stands of brush not justifying mechanical removal can probably be burned at much lower cost.

One of the bottlenecks in reducing costs of seeding is the lack of adequate equipment hitches. Development work is underway, however, and it may not be too long before we can do the plowing, smoothing, firming, and the drilling all in one operation.

At least two other cost items, amount of seed planted and insecticide treatment, might be reduced. With perfect germination and emergence, 2 pounds of seed per acre would give satisfactory stands. Accurate forecasts of insect damage could remove the necessity for soil treatment at least in some years. Even if it is necessary to apply insecticide, application of crystalline material directly into the drill row by means of a fertilizer attachment on the drill would reduce both the amount of insecticide used and the cost of application.

Together these possibilities indicate a future bitterbrush seeding cost of $20 or less per acre.

Table 1.--Summary of costs for seeding one area of rangeland to bitterbrush

Job	Type of equipment	Cost per hour	Number of hours/acre	Cost/acre	Percent of total cost
Brush removal	D-7 Caterpillar	$10.00	1.17	$11.66	26
Plowing	D-7	10.00	.83	8.33	18
Dragging	TD-9	6.18	.50	3.09	7
Dieldrin Treatment	Ferguson wheel tractor	4.50	.44	1.99	4
Drilling	TD-9	6.18	.42	2.57	6
Seed	--	--	--	12.00	26
Dieldrin	--	--	--	1.83	4
Misc. expenses	--	--	--	4.15	9
Totals per acre	--	--	--	$45.62	100%

GENERAL RECOMMENDATIONS

The experience and research cited here do not justify a bitterbrush planting prescription for all sites and situations. They do, however, indicate the importance of several points which should be considered in any planned bitterbrush seeding program.

1. Site Selection: Pick a site which is known to have supported a good stand of bitterbrush. The soil should have high water holding capacity. Annual precipitation should average at least 12 to 14 inches.

2. Site Preparation: Do a good job of farming. Plant a clean firm seedbed.

3. Planting Time: Plant as early in the spring as possible. Spring planting minimizes seed exposure to rodents and the weather.

4. Use High Quality Processed Seed: Obtain seed locally whenever possible. Remove husks, chaffy material, and immature or empty seed. Use only the larger well-filled seed, those which sink after a few minutes soaking. Any seed that remains floating after about 3 minutes in a thiourea solution should be discarded.

5. Seed Treatment: Soak the seed for 4 to 5 minutes in a 3 percent thiourea solution and then dry. Do not wash seed after treatment. Before planting, run a germination test to make certain that the seed dormancy is broken.

6. Protection of Seeds and Young Seedlings: Use control methods wherever rodents, cutworms, wireworms, or other pests are numerous.

7. Planting Methods: Drill with a full sized or "baby" rangeland drill. To get good seed distribution, mix the seed with rice hulls in a ratio of 3 pounds of seed to 8 pounds of rice hulls. Disconnect the seed agitators in the drill seed box. A setting of 43 notches on the rangeland drill or 89 pounds barley equivalent of fluted feed drills, will seed about 6 pounds per acre. These settings should be checked by bagging the drop spouts and running the drill over a measured distance.

Planting depth should average 1 inch under favorable soil and moisture conditions--a little shallower on heavy soils, a little deeper on lighter soils.

Firm the soil after drilling with press wheels on the drill or with a roller.

8. Protection from Grazing: Livestock grazing and, so far as possible, deer browsing should be excluded from the reseeded area the first 2 years. Fencing is the only known protection against rabbits, but may or may not be justified.

SUMMARY

During the past several years, twenty-three different areas in northern California have been seeded to bitterbrush. Some of these plantings were very successful, others failed. Best results were from spring planting on bitterbrush sites receiving relatively good precipitation and having soils which retained moisture well.

Despite mortality from frost heaving, cutworms, wireworms, rabbits, and other causes, several of the plantings have good prospects of developing into well-stocked stands of thrifty bitterbrush.

The key to successful planting lies in doing a few things properly at the right time. Select a good site and farm it well. This is expensive on range lands. Costs can be reduced. How much we can afford to spend depends on how badly we need to get bitterbrush established on a particular site, and how much we are willing to pay for whatever benefits may derive. Application of the "know-how" set down here will give satisfactory results under certain conditions.

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