Project COPMC-0202-WL
Maybell Bitterbrush
December-2003
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Effects of Seed Age on Germination and Emergence of Maybell Bitterbrush Seed

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INTRODUCTION:

Literature on Antelope bitterbrush (*Purshia tridentata*) suggests that seed dormancy is reduced with time. A recent study (Hammon and Noller- Fate of fall sown bitterbrush seed at Maybell, Colorado – In Hild, A.L. et.al. comps. 2003 Seed and soil dynamics in shrubland ecosystems: proceedings; 2002 August 12-16; Laramie, Wyoming) found that seed dormancy of bitterbrush does decrease with time (Figure 1). The 1994 seed was tested in 1995 and had 22% germination with 49% dormant seed. This lot was tested again in 2002 and had 69% germination and only 13% dormancy. As a result of this reduction in dormant seed, a small field study was initiated in 2002 to examine the effects of seed age on germination and emergence of bitterbrush.

MATERIALS AND METHODS:

Bitterbrush seed was hand harvested near Maybell, Colorado by the Colorado Division of Wildlife in 2002. Seed was also harvested in 1994 from an orchard of Maybell bitterbrush plants established at the Upper Colorado Environmental Plant Center in the early 1980's (The same seed lot that was cited in the introduction). Seed from these two collections were used for the study. Tests from the Colorado Seed Laboratory found the 2002 seed (Tested-April, 2003) had 71% germination and 16% dormant seed. The 1994 seed lot (Tested-March, 2002) had 69% germination and 16% dormant seed. The test results of the 2002 seed were not available before the planting in the fall of 2002. Germination and dormancy of the two lots were quite similar. This indicates that germination and dormancy of bitterbrush seed can vary substantially from year to year or site to site. For this study, it would have been desirable to have a greater difference in germination and dormancy between the two seed lots.

Two existing exclosures located approximately five miles West of Maybell, Colorado were used for the study. They were designated as "Windmill" and "North" due to their locations near a Windmill and North of US Highway 40. Fences on both exclosures did not completely exclude wildlife or livestock.

Two fall planting dates (October 7 and November 25, 2002) were used for the study. These dates were chosen, since dormant fall plantings are normally done after October 1.

The natural method for bitterbrush establishment is by rodents caching seeds. Holes (caches) approximately one inch in diameter were punched one inch, to one and one half inches deep in the soil with a dibble bar. Holes were easily made in 2002 in the damp sandy soil, while in 2001, (Study cited above) holes were difficult to make when the soil was dry and collapsed before seeding.

Bitterbrush seeds were treated with Kodiak (*Bacillus subtilis, Gustafson)* seed treatment for fungi control and dyed red to improve chances for recovery when sampling. Ten seeds were planted in each cache and eight

caches were located at intervals of one foot in both rows for each of the two seed lots (Figure 2). Rows were spaced one foot apart. Wire stemmed flags were placed on every cache so the location could be easily found when sampling.

Three sampling dates (November 25, 2002, May 6, 2003 and June 12, 2003) were used for the study. Two caches were dug for each seed lot (1994 and 2002) and each planting date (October 7 and November 25, 2002), except on November 25, 2002, when only the October 7, 2002 planting had been completed. Seeds were placed in plastic bags, along with soil to prevent rapid drying and were examined in more detail later. In addition, on October 9, 2003 (one year after 2002 plantings) caches that had not been dug in the two exclosures were briefly examined to see if any seedlings had reached the soil surface.

RESULTS:

Soil moisture at the time of planting (October 7 and November 25, 2002) was good. Soil was moist to a depth of 14 inches in October and to 20 inches in November.

Seeds were examined for viability, germination or dormancy. It is interesting to note that on November 25, 2002, all seeds were considered to be germinating, while on May 6, 2003, some seeds were found to be dormant, and on June 12, 2003, no dormant seeds were found. Uniform criteria for seed examination on all sampling dates should be developed to follow the process from germination to emergence.

November sampling

Two caches were dug for each seed lot (1994 and 2002) for seed planted on October 7. Eight to ten seeds were found for each cache. All seeds were considered to be in the process of germination, but none had reached the soil surface. Since all seed was in the process of germinating, soil temperature and moisture may be more important for a dormant fall planting than a calendar date.

- Considering the November sampling, no difference in germination or dormancy was noted between seed lots at either exclosure.

May sampling

On May 6, 2003, the soil was moist at both exclosures. Soil at the "Windmill" exclosure was moist to a depth of 20 inches. Only two caches had seedlings that had reached the soil surface, while a few natural caches outside the exclosures had seedling plants that were 1 to 2 inches tall. Some seeds that were found on this date were considered dormant, while in November all seeds were listed as germinating.

Windmill Exclosure

Two caches of bitterbrush seed in the 2002 seed lot, planted in October, had plants that had reached the soil surface. One cache had plants with leaves, while plants at the other cache had only stems (probably a result of insect or rodent use). The cache containing plants with leaves was not dug. These caches were the only ones with plants for either seed lot, planting date or exclosure.

October planting

Nineteen seeds (for both caches) of each seed lot were found. Comparing seed lots, the 2002 seed lot had more seeds that had germinated, while the 1994 seed lot had more dormant seeds (Table l). This would not be the result we would have anticipated.

November planting

Nearly the same numbers of seeds (for both caches) were recovered for both seed lots (1994 and 2002). As with the October planting, the 2002 seed lot had more seeds that had germinated, while the 1994 lot had more dormant seeds (Table 1).

North Exclosure

Seeds were more difficult to find at this exclosure than at the Windmill site. However, wire flags were still present for locating each cache.

October planting

Only nine seeds were found of the 1994 seed lot (one cache could not be located), while 19 seeds were found of the 2002 lot (Table 1). Germination was greater than dormant seeds for both seed lots on the October sampling date.

November planting

Both seed lots had more seeds that were germinating than dormant for this planting date. This was also true for the October planting.

- Considering the May sampling date, no substantial difference was noted for either seed lot, exclosure or planting date.

June sampling

None of the seed sampled at either exclosure in June was considered dormant. All seed was considered germinated (when only seed coats were found), or dead (when seed was found with endosperm, but was not viable). It should be noted that no plants were found at either exclosure or planting date.

Windmill Exclosure

Soil at this site was moist to a depth of approximately one foot.

October planting

Seeds were hard to locate on this sampling date, although flags were still present for each cache (Table 2). However, most of the seeds that were located for each seed lot had germinated. Five seeds in the 1994 seed lot were considered dead.

November planting

Seeds for this planting date were also difficult to find, while flags for each cache were still present. The seeds that were found for the 1994 seed lot were dead, however, most of the seeds found for the 2002 lot had germinated (Table2).

North Exclosure

In June, seeds at this exclosure were also difficult to locate. Flags were still present, but seeds or seed coats could not be easily located.

October planting

Seeds were not found for either cache of the 2002 seed lot (Table 2). Fourteen of the twenty seeds were found for both caches of the 1994 lot and 13 of those had germinated.

November planting

Only a few seeds of either seed lot were found in June (Table 2). Most of the seeds that were found of the 1994 lot were dead, while all of the seeds of the 2002 lot had germinated.

- Considering the June sampling date, no difference in seed lots could be found for either exclosure on this sampling date.

October 9, 2003 Observation

This observation was conducted because a nearby project was evaluated on this date. Caches that had not been dug were briefly examined to see if any plants might have reached the soil surface. Plants were not found at either exclosure for both planting dates. It should also be noted, probably due to the dry growing season, all plants were dead in the natural caches located in May outside the exclosures.

OBSERVATIONS:

1. After the project was planted, seed tests indicated that germination and dormancy of the two lots (1994 and 2002) were quite similar. This suggests that seed dormancy may be quite different for bitterbrush from year to year or from site to site.

2. The 1994 seed lot when tested in 1995 had 22% germination and 49% dormant seed. This lot was tested in 2002 and had 69% germination and only 13% dormant seed. Dormancy of this lot declined substantially with time and was one factor considered when designing the study.

3. The use of a dibble bar for making holes for caches can produce different hole depths depending on soil moisture in sandy soils. When the soil is dry, holes tend to collapse making it is hard to maintain a uniform depth and caches may be shallow. However, when the soil is moist, holes can be easily made deeper than intended. As a result, seeds may have been planted deeper than necessary in 2002.

4. Soil temperature and moisture conditions are probably more important for achieving a dormant fall planting than calendar date. This was indicated by the lack of dormancy of the October 7, 2002 planting, when sampled in November.

5. Uniform criteria for seed examination on all sampling dates should be developed to follow the process from germination to emergence.

6. Consistent differences in viability, germination or dormancy between the two seed lots were not observed for either sampling date or exclosure.

7. All seeds or plants died as a result of the dry conditions in 2003, which includes natural caches located outside the exclosure.

8. Difficulty in locating caches and seed had an adverse influence on the study.

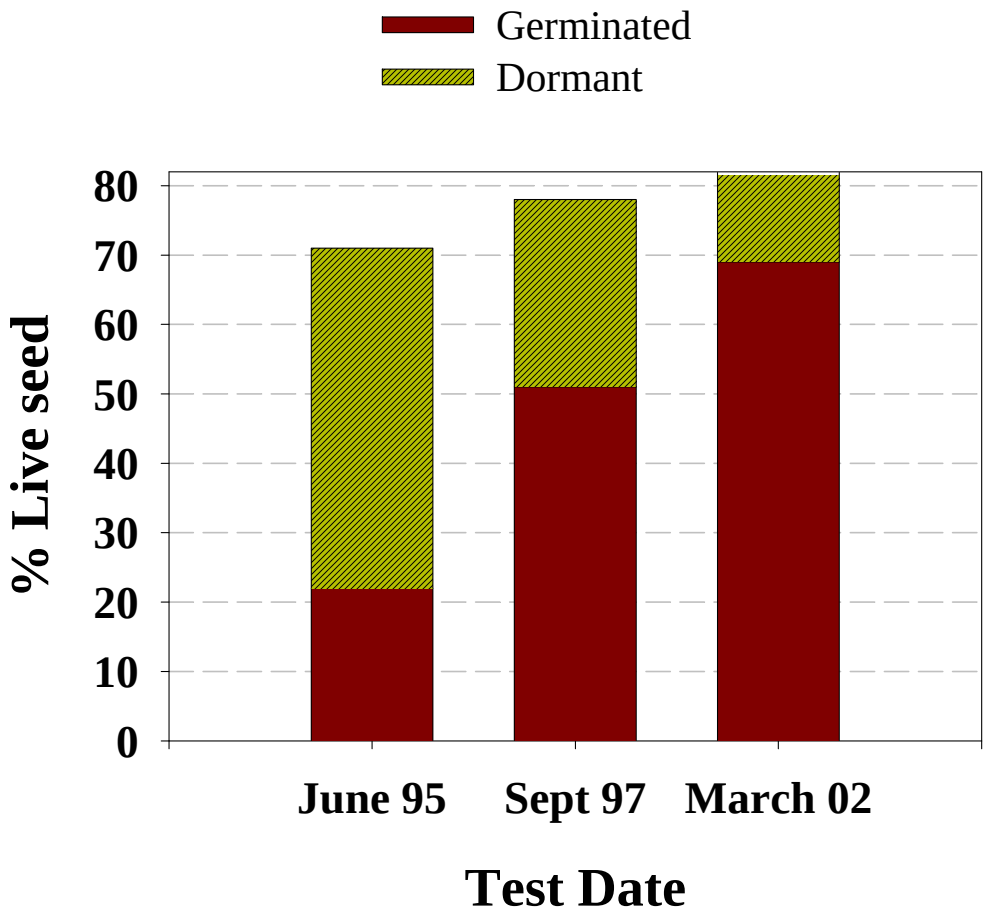

Figure 1. Seed germination tests conducted on 1994 grown Maybell bitterbrush seed, showing changes in dormancy and germination over time.

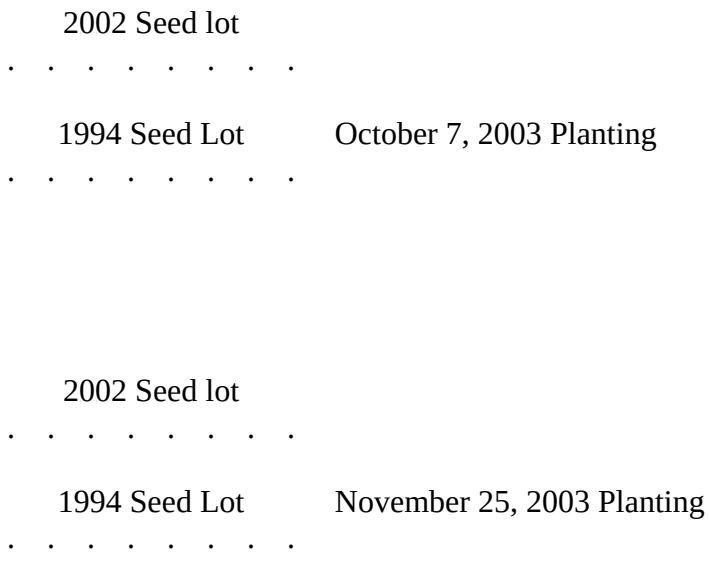

Figure 2. This figure show the design used for planting at both exclosures. The two dates (October 7 and November 25, 2002) for planting are shown. Eight caches were located one foot apart in each row, and rows were separated by one foot for both planting dates. Ten seeds were planted in every cache.

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Table 1. A listing of the results for the May Sampling Date for both planting dates and exclosures. Two caches were dug for each seed lot and planting date.

Windmill Exclosure

		Seeds found in two caches	Germinated	Dormant
October planting -	1994 lot	19	7	12
	2002 lot*	19	10	9
November planting –	1994 lot	17	2	15
	2002 lot	18	13	5

*Plants present, 3 stubs above ground, tops gone.

North Exclosure

		Seeds found in two caches	Germinated	Dormant
October planting -	1994 lot	9**	8	1
	2002 lot	19	11	8
November planting –	1994 lot	15	10	5
	2002 lot	19	18	1

** One cache was not found

Table 2. A listing of the results for the June Sampling Date for both planting dates and exclosures. Two caches were dug for each seed lot and planting date. All seed was considered germinated (when only seed coats were found), or dead (when seed was found with endosperm, but not viable).

Windmill Exclosure

		Seeds found in two caches	Germinated	Dead
October planting -	1994 lot	14	9	5
	2002 lot	12	12	0
November planting –	1994 lot	4	0	4
	2002 lot	10	8	2

North Exclosure

		Seeds found in two caches	Germinated	Dead
October planting -	1994 lot	14	13	1
	2002 lot	0*	-	-
November planting –	1994 lot	7	1	6
	2002 lot	6	6	0

*No cache found