



## **REVEGETATION OF BIG SAGEBRUSH**

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## SECTION 5A: SEEDING BIG SAGEBRUSH

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### Applicability

For most sites, revegetation of big sagebrush is required where big sagebrush occurred prior to disturbance.

### Special Considerations

*Artemisia sp.* seed is very sensitive to being placed too deep in the soil. It should actually be broadcast-seeded because light enhances seed germination. Therefore, seeding should be done after drilling of grasses and mulching practices are completed. The soil surface of the seedbed should be firm enough that the seed is not easily buried. If good quality seed is purchased and broadcast on the surface, the seed will provide opportunity for new seedling establishment for at least 4 years after the initial seeding (Schuman et al. 1998; Schuman and Belden 2002). Seed viability in the field is much greater than in seed storage conditions and it seems to lie on the soil until micro-climate relief characteristics are desirable from a moisture and temperature standpoint.

Recent research has shown that initial (1-2 years) seed germination and seedling density is related to grass competition, topsoil management, and mulching (Schuman et al. 1998). Sagebrush seedling density in the first two years was greater in direct-placed topsoil compared to stockpiled topsoil. This response to direct-placed topsoil was attributed to the improved physical and microbial characteristics of the topsoil. Direct-placed topsoil had greater soil moisture storage throughout the first two years compared to the stockpiled topsoil and also exhibited a higher level of arbuscular mycorrhiza (AM) inoculum.

Infection by AM early in the seedlings development has been shown to significantly increase its drought stress tolerance; hence, increasing its ability to survive short dry periods during early seedling stages (Stahl, et al. 1998). Mulch, straw or stubble, has also been shown to increase sagebrush seedling density compared to seeding on a bare soil surface, in the initial years of establishment (Schuman et al. 1998). The benefits of mulch, direct-placed topsoil, and grass competition seemed to have less of a long-term effect on sagebrush seedling density but should still be an important consideration to ensure establishment of the shrub at required densities to meet the shrub density standard at the time of bond release.

Research to more precisely delineate the prescription for establishing big sagebrush at the desired density to meet bond release was initiated in 1999 (Williams et al. 2002). This research evaluated the effect of seven grass seeding rates and three sagebrush seeding rates on sagebrush density and sagebrush canopy size. The authors concluded that to achieve the desired sagebrush density to meet bond release density requirements, the grass mixture seeding rate should not exceed 4-6 lb PLS/acre and sagebrush should be seeded at 2 lb PLS/acre. The reason for the recommended seeding rates is that no differences were observed in aboveground grass production in the second and third year after seeding between grass seeding rates of 4-14 lb PLS/acre and significantly greater sagebrush seedling density was achieved with 2 and 4 lb PLS/acre sagebrush seeding rates compared to the 1 lb PLS/acre seeding rate.

The 2 lb PLS/acre sagebrush seeding rate also provides a good seedbank of big sagebrush for a multi-year period and greatly reduces the probability of having to reseed big sagebrush considering the long-term field viability of the seed. The lower grass seeding rates provided adequate protection of the soil and also resulted in greater big sagebrush canopy size than was exhibited at grass seeding rates above 4 lb PLS/acre.

Utilizing the data discussed above and long-term survival data from northwestern Colorado (Kiger et al. ) and the Powder River Basin of Wyoming (Schuman and Belden 2002), Schuman et al. (2001) have shown that direct seeding of big sagebrush can be achieved very economically at these higher sagebrush seeding rates even when big sagebrush seed nears \$150/PLS lb. The authors calculated cost per surviving big sagebrush seedling to range from \$0.01 to \$0.05 depending on seed cost, sagebrush seeding rate, and survival. Therefore, further reason to seed at the higher sagebrush seeding rate of 2 lb PLS/acre.

### **Techniques**

Big sagebrush and many of the native shrub species produce a very small seed which have large and fuzzy appendages associated with the seed making it difficult to seed with standard drill equipment. For best results these species should be broadcast on the surface of the soil after drill seeding of the grass mixture has been completed. This is assuming that the grass seeding is being accomplished in a stubble mulch. If the reclaimed area is to be straw mulched, sagebrush seeding should be done after the mulch has been broadcast and crimped into the soil surface to prevent burying of the seed by the crimping process.

Ideally, sagebrush seeding should take place in the winter months. This schedule should work well with seed availability because Wyoming big sagebrush seed matures in late fall and after-ripening occurs in late November or December. Shrub seedings done in January through March have also been very successful.

Seeding can be accomplished with either a drill or broadcast seeder. If sagebrush is seeded during the drilling of the permanent grass mixture, the legume box should be used and the seed deliver tubes removed from the disk opener on the drill and extended to the rear of the drill so the seed is dropped on the soil surface behind the packer wheels or chains used to cover the grass seed. If the drill does not have a small seeded species box then a broadcast seeder can be attached to the rear of the drill. The other option is to make a second trip across the reclaimed area with a broadcast seeder but this is time consuming and more costly.

To enable accurate calibration of the drill or broadcast seeder, the fine sagebrush seed may need to be mixed with either rice hulls, cracked corn, or crushed walnut shell material. This ensures uniform flow of the seed and aids in seeding rate calibration because of the large numbers of seed per pound resulting in very low rates of seed dispersal.

It is very important to ensure that good quality seed is purchased or collected, because this is the single most important factor in ensuring successful establishment of big sagebrush on mined lands. Big sagebrush seed is available from seed companies both from wildland collections and seed orchard production.

Because big sagebrush seed viability has been shown to persist for at least 4 years in a seeding, there is increased opportunity for adequate moisture and temperature conditions to occur over that period of time and provide for adequate big sagebrush seedling density. The reclamationist should strive for big sagebrush seedling densities of 2-3 seedlings/m<sup>2</sup> in the early years of the reclamation to ensure that the 1 shrub/m<sup>2</sup> requirement at the end of the 10 year bond release is achieved. Therefore, sagebrush and grass seeding rates should be carefully considered based on research information cited in this section.

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