Downy Brome Seed Ecology: From Flower to Emergence

Downy brome reproductive phenology is largely determined by the unpredictable annual weather. Therefore understanding the plastic response of downy brome to the environment is a useful tool for management.

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Breeding system

Primarily considered a self fertilizing species, evidence for heterozygosity does exist. We theorize that during abnormally good weather years, anthers can be exuded **(Figure 1)** and outcrossing could occur, when the environmental risks are low (i.e. low drought stress). There is the belief that all genetic variation measured is a result of separate introductions, not outcrossing. We find this belief too rigid for such a successful plant.

Figure 1. Downy brome anther

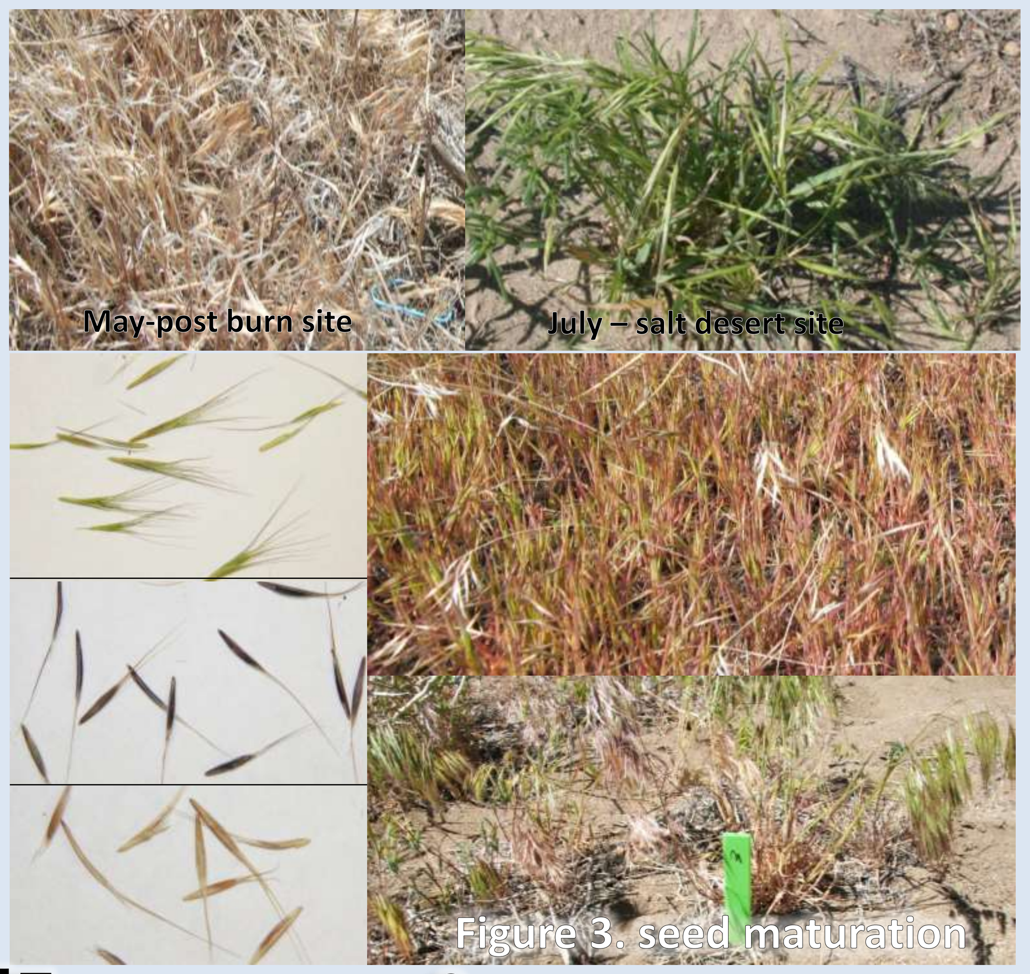

Figure 3. seed maturation

Figure 4. Second flowering event

Flowering

We have observed flowering from April through July **(Figure 2).** Flowering is more continuous than simultaneous. Usually green, red and tan seed can be found at once, spanning the maturation gradient **(Figure 3)**. We have also observed a second flowering event after initial seed maturation on individual plants **(Figure 4)**.

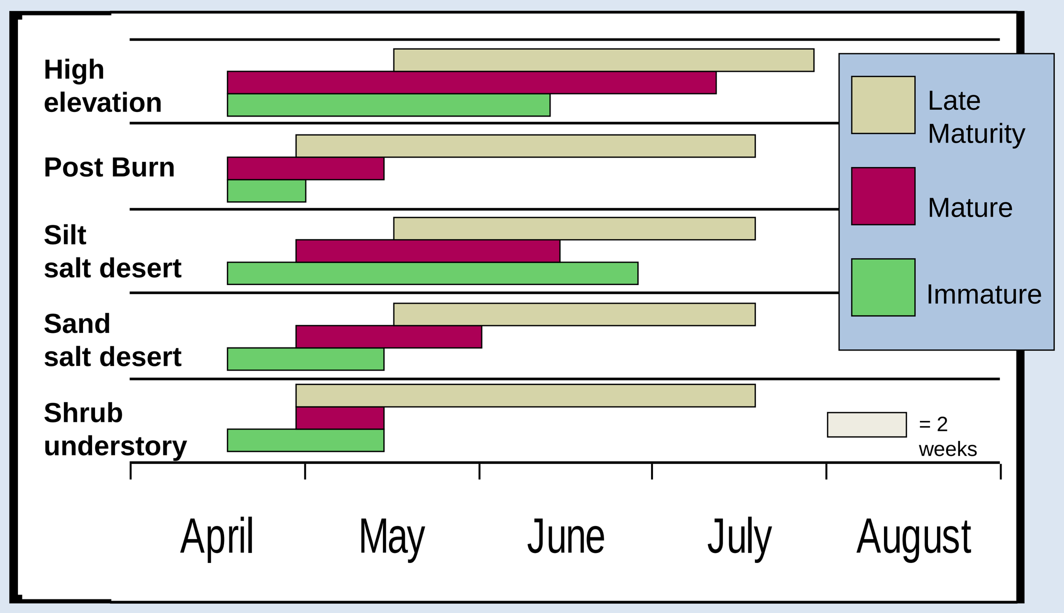

Figure 2. Seed maturity timeline of three seed phenotypes for collection dates in 2009.

Seed Dormancy

Primary Seed Dormancy

Contrary to the belief that primary dormancy is near complete, a significant percent of seed is non dormant at seed drop **(Figure 5)**. A period of after ripening time reduces primary dormancy by the first fall/winter.

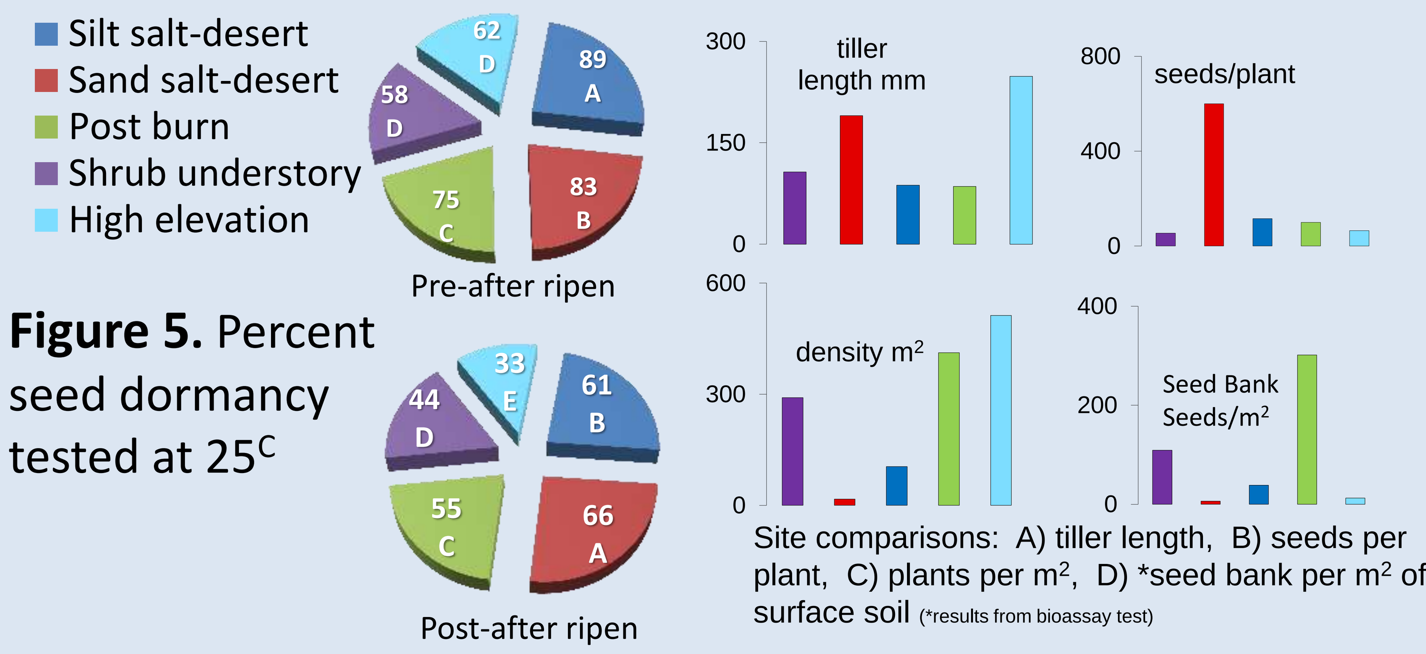

Figure 5. Percent seed dormancy tested at 25C

Site comparisons: A) tiller length, B) seeds per plant, C) plants per m², D) *seed bank per m² of surface soil (*results from bioassay test)

Secondary Induced Seed Dormancy

Through the action of wetting-drying and freeze-thaw, seed can acquire a strong secondary dormancy. Seed on the interspace soil surface is more likely to rapidly change temperature and moisture content than buried (soil or liter) seed, making it more prone to secondary dormancy. This dormancy once again degrades with time. The constant acquiring and degrading of secondary dormancy ensures carryover seed and seed banks.

Seed banks

Downy brome seed is ubiquitous to the soils of most low lands of the Great Basin. We used a bioassay **(Figure 6)** to test 1000 samples (100 sites x 10n) from disparate habitats and found that <6% did not contain downy brome seed. Two site characteristics correlated with the seed bank size, wildfire history and soil surface liter.

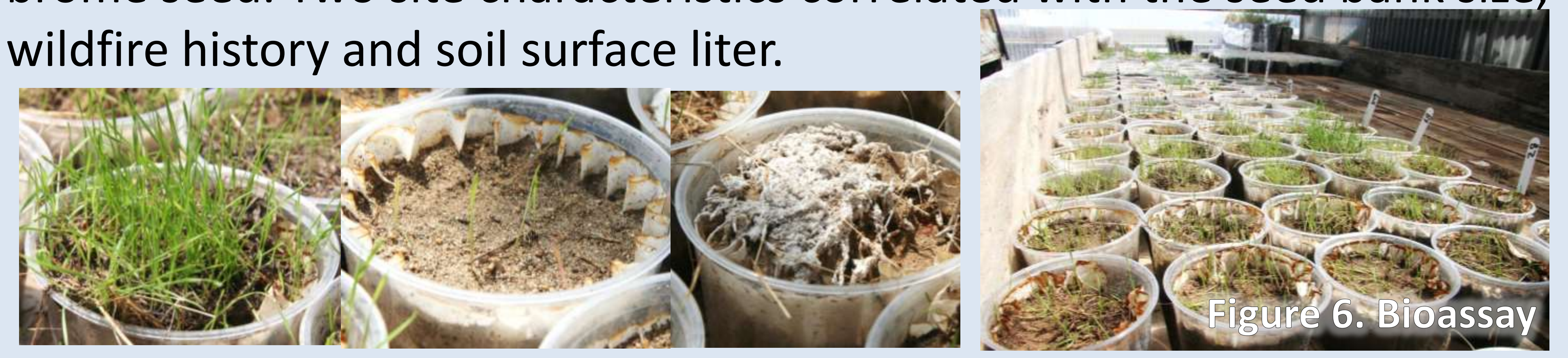

Figure 6: Bioassay

Depleting the seed bank is critical to establish a long-lived perennial grass, which is the only hope for downy brome suppression and successional function.

The most reliable method is to use a soil active herbicide (i.e. Plateau®, Landmark® [ALS inhibitor]) in the fall and fallow the site for one year prior to seeding perennials **(Figure 7)**. This allows downy brome to germinate (deplete the seed bank) and die before any new seed is produced.
(Seed banks reduced from 1000+seeds/m² to <100 seeds/m²)

Figure 7. Downy brome control after 1st year

	Undisced	Disced	
Directly after discing	302	87	Seeds/m²
1st year after discing	3286	2415	
1st spring after discing	9	8	Plants/m²
2nd spring after discing	48	18	

A discing treatment can be used. Discing must occur late enough to avoid any post discing germination but early enough to avoid any new seed production (~April).
(Kill germinated plants and bury un-germinated seed)

Grazing has also been proposed. Plants would have to be grazed April-July heavily since grazing does not kill the plant and new seed will be produced after grazing release. Rotational grazing does not allow prolonged repeated downy brome use, making it improbable to achieve seed control.

Figure 8. Suppression ring

Germination

Cheatgrass germinates poorly on the bare soil surface and in the suppression ring of highly competitive mature perennial grasses **(Figure 8)** (i.e. crested wheatgrass).

Figure 9. Downy brome caches

Emergence

We have observed emergence from October 1st through June . Often the earliest emergence occurs from rodent caches **(Figure 9)**. The later germination usually occurs at salt desert sites with summer germination after rain events **(Figure 10)**. We theorize the water holding capacity of the fine silt soils (Figure 4) facilitates a longer wetting period required for germination (~1 week).

Figure 10. June germination, at silt salt desert site.

Earlier emergence is often cited for downy brome dominance, however when we observe simultaneous emergence with native perennials downy brome is still victorious at the seedling phase. Its dominance centers on its drought tolerability. We rarely see downy brome die before seed production. Even during the driest times it simply responds by reducing vegetative efforts (small plants) and quickly producing seed.