# OBSERVATIONS ON *BROMUS CARINATUS* AND *ELYMUS GLAUCUS* SEED STORAGE AND LONGEVITY

| Craig Dremann |

In autumn 1988 I bought 2 samples of native grass (Poaceae) seeds collected in May and June 1988 from California: *Bromus carinatus* Hook. & Arn. and *Elymus glaucus* Buckley. Both species were chosen for longevity tests because their seed-storage ability is notoriously short-lived when kept at room temperature. In earlier trials, *B. carinatus* and *E. glaucus*, when stored at room temperature, failed to germinate after about 3 y (Dremann 1995).

The seeds for this study were stored at room temperature from their 1988 harvest until February 1990 when germination tested at 100%.

On 26 March 1990, I placed 50 g (1.8 oz) of both species in twelve 220 ml (8 fl oz) mason jars having screw-down canning lids. In 6 jars I only put seeds. In each of the other 6 jars, along with the seeds, I placed 1 paper envelope (manila #1, 28 weight coin envelope) containing about 10 g (0.4 oz; 1 tbsp) of loose indicator silica gel.

The indicator silica gel (S5112, 6-12 mesh granular) was purchased from Silica Gel Desiccant Products Co (734 E Hyde Park Blvd, Inglewood, California 90302; (800) 426-1529) and was bulk packed in 0.7 and 2.3 kg (1.5 and 5 lb) cans. The silica costs about US$ 5 per 28 g (1 oz). The silica gel is cobalt blue color when dry and turns pink when fully saturated with moisture. An in-between lilac shade appears when it reaches an equilibrium indicating the seed's moisture is stable.

Three jars of each species were stored at one of following storage temperatures: 1) room temperature (12 to 30 °C [55 to 85 °F]) with 35% to 45% relative humidity; 2) refrigerated 1 to 6°C (33 to 42 °F); or 3) frozen –6 to –1 °C (20 to 30 °F).

From February 1990 through April 2002, I periodically removed the jars of seeds from storage and samples were taken for germination testing. The frozen and refrigerated jars stood for 24 h at room temperature before samples were

ABSTRACT

*Bromus carinatus* Hook. & Arn. and *Elymus glaucus* Buckley are 2 notoriously short-lived native grasses (Poaceae) of the western US. In my operational trials, refrigeration with indicator silica gel is the best energy-efficient method of storage, maintaining *Elymus* germination > 60% for at least 10 y and *Bromus* germination > 90% after 14 y.

KEY WORDS
silica gel, germination, seed testing, Poaceae

NOMENCLATURE
USDA NRCS (2002)

removed which prevented condensation on seeds. I used 25 to 33 seeds per test for the first few years, but when it appeared that the seeds were going to have a longer viability, I reduced the number of seeds per test to only 10 to 20 seeds to ensure enough seeds for future tests. To avoid missing any low germination numbers, I used a maximum of 50 seeds for the September 2001 tests. The germination tests were done in aluminum trays ("Danish trays" about 28 x 38 cm [11 x 15 in] with a 2.5-cm-tall [1-in] rim around the edge) purchased at the household section of a hardware store. Sterile rolled Johnson & Johnson™ cotton in a 0.45 kg (1 lb) box was laid out and cut to size to fit the bottom of the tray. Distilled water was added to saturate the cotton and the excess poured off. Then seeds were placed on the cotton, spacing them about 1 cm (0.4 in) apart in each direction, and toothpicks were placed between the different lots to keep them separated. A plate of single thickness window glass, cut to size and with taped edges, was laid over the top of the tray to keep moisture in and to let light on to the seeds. Germination tests lasted 35 d, with periods of 3 to 4 d cold (1 to 6°C [(33 to 41 °F]) moist stratification alternated with 3 to 4 d of warm temperatures (21 to 26 °C [70 to 80 °F]). The first count of germinating seedlings occurred when seedlings were about 2.5 to 5.0 cm (1 to 2 in) tall, often as early as the fourth day for either species. *Bromus* and *Elymus* seeds generally all germinated in 6 to 17 d, but occasionally germination occurred until 25 d for *Bromus* and 35 d for *Elymus*. I conducted a total of 18 germination tests during this 12-y trial.

Each time seeds were tested, the color of the silica gel was checked and redried if it had become saturated. The silica gel was recharged 3 times (after years 1, 5, and 9) by drying in an oven at 65 °C (150 °F) for an hour until the color turned cobalt blue.

I observed fluctuations in germination rates between tests. I believe this is partially due to the official rules of germination test counting: only "normal" seedlings may be counted as germinated

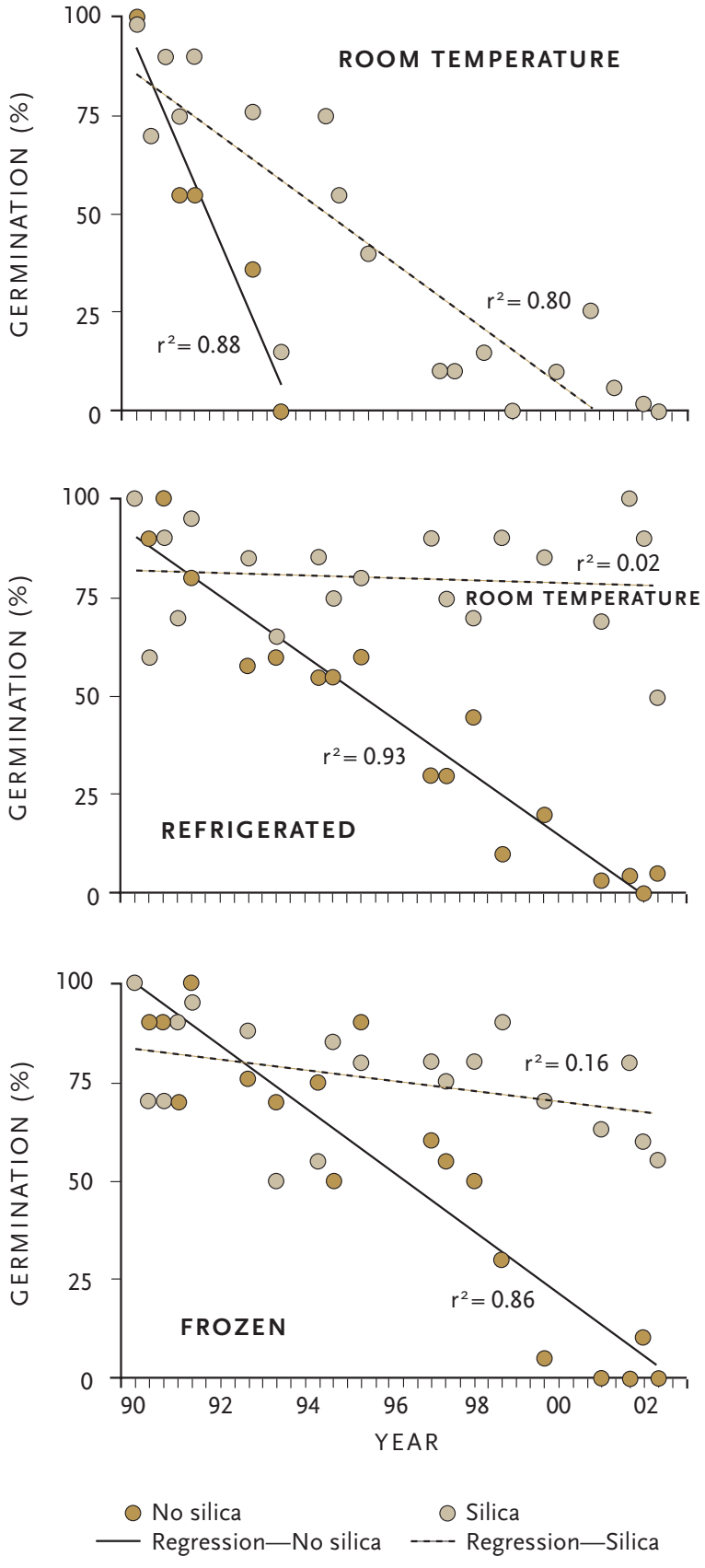


*Figure 1.* Percent germination of *Bromus carinatus* seeds harvested in May 1988, stored at room temperature until February 1990, and then stored under 6 conditions for 13 y (1990 through 2002).

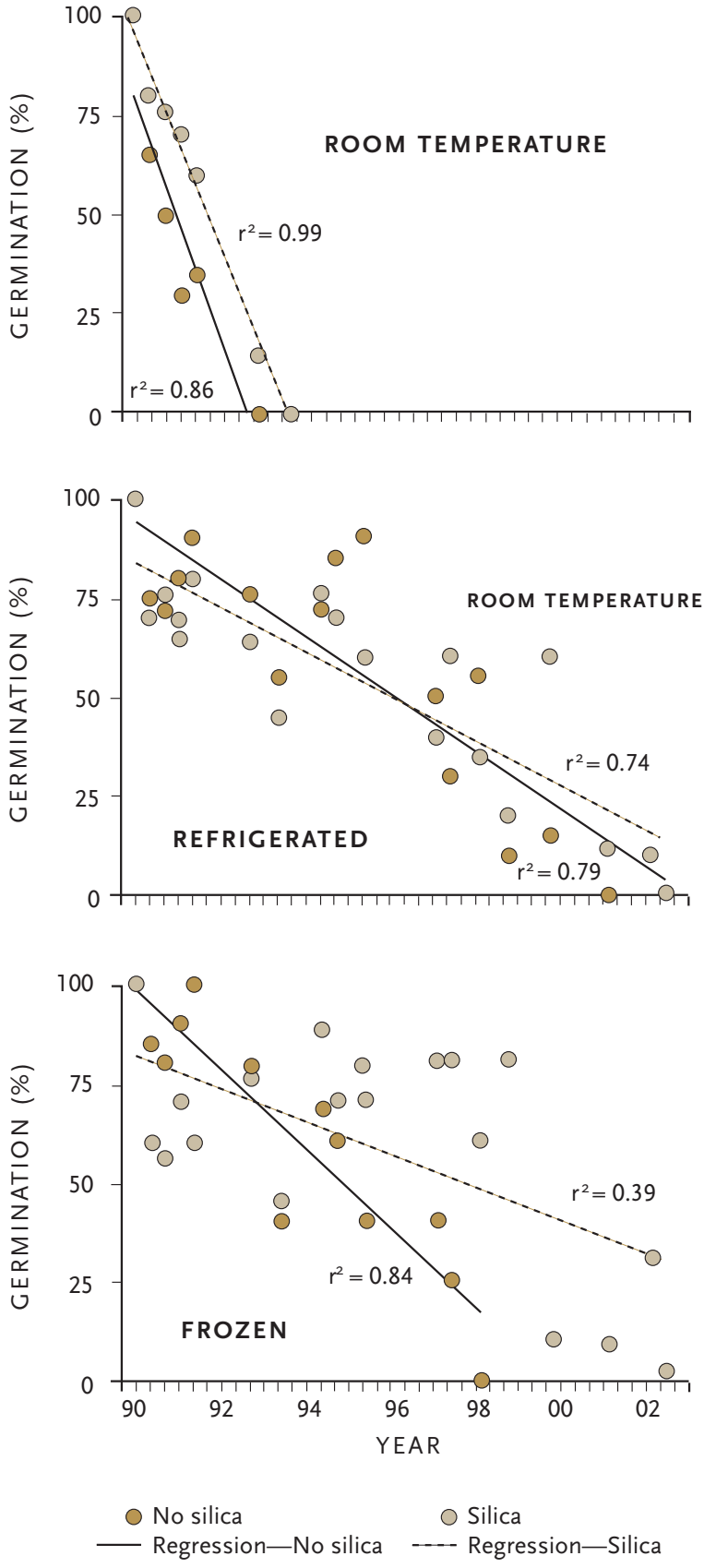


*Figure 2.* Percent germination of *Elymus glaucus* seeds harvested in May 1988, stored at room temperature until February 1990, and then stored under 6 conditions for 13 y (1990 through 2002).

seeds, meaning that seedlings must have well-developed root systems, green leaves, and lack deformities. It may also be due to small sample sizes and lack of replication. Simpson (1990) reports that these types of fluctuations may also be due to inherent, periodic changes in seed dormancy.

Despite these fluctuations, my data indicate that refrigerated storage or frozen storage are better methods than room temperature for long-term storage of these short-lived native grass seeds (Figures 1 and 2). In addition, silica gel appears to extend the overall longevity of either species when stored at any temperature. At room temperature, silica gel placed with *Bromus* seeds adds 2+ y of longevity and 4+ y when seeds are refrigerated or frozen. Silica gel was less influential for *Elymus* seeds at room temperature, and the effect seems apparent only when seeds are frozen.

Assuming that seeds are adequately dried when placed into storage, indicator silica gel can be used to guarantee that seeds remain at the proper storage moisture, ensuring viability of short-lived native grass seeds put into long-term storage. Indicator silica gel is a relatively inexpensive method—28 g (1 oz) of material per 45 kg (100 lb) of seeds would indicate when excess moisture was present in stored seeds. The gel is reusable for about 10 y and costs about US$ 5.

When the energy costs of long-term frozen versus refrigerated storage are compared, it appears that refrigerated storage is adequate as long as silica gel is placed with the seeds. The use of lower-cost refrigeration rather than more energy-intensive frozen storage could translate into significant cost-savings over time.

I will continue to test these *Bromus* and *Elymus* seed lots periodically until they no longer germinate, probably sometime later this decade, and will write another update in 5 y.

This technique may be particularly suitable for small batches of other native plant seeds, and I would encourage others to test silica gel for enhanced storage of seeds.

## REFERENCES

Dremann CC. 1995. *Bromus carinatus* & *Elymus glaucus* storage, longevity, genetic changes and ecotypical variations. Grasslands 5(3):2–5.

Simpson GM. 1990. Seed dormancy in grasses. Cambridge, United Kingdom: University of Cambridge. 297 p.

USDA NRCS. 2002. The PLANTS database, Version 3.5. URL: http://plants.usda.gov (accessed 6 Sep 2002). Baton Rouge (LA): National Plant Data Center.

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