Practicing Safe Seed

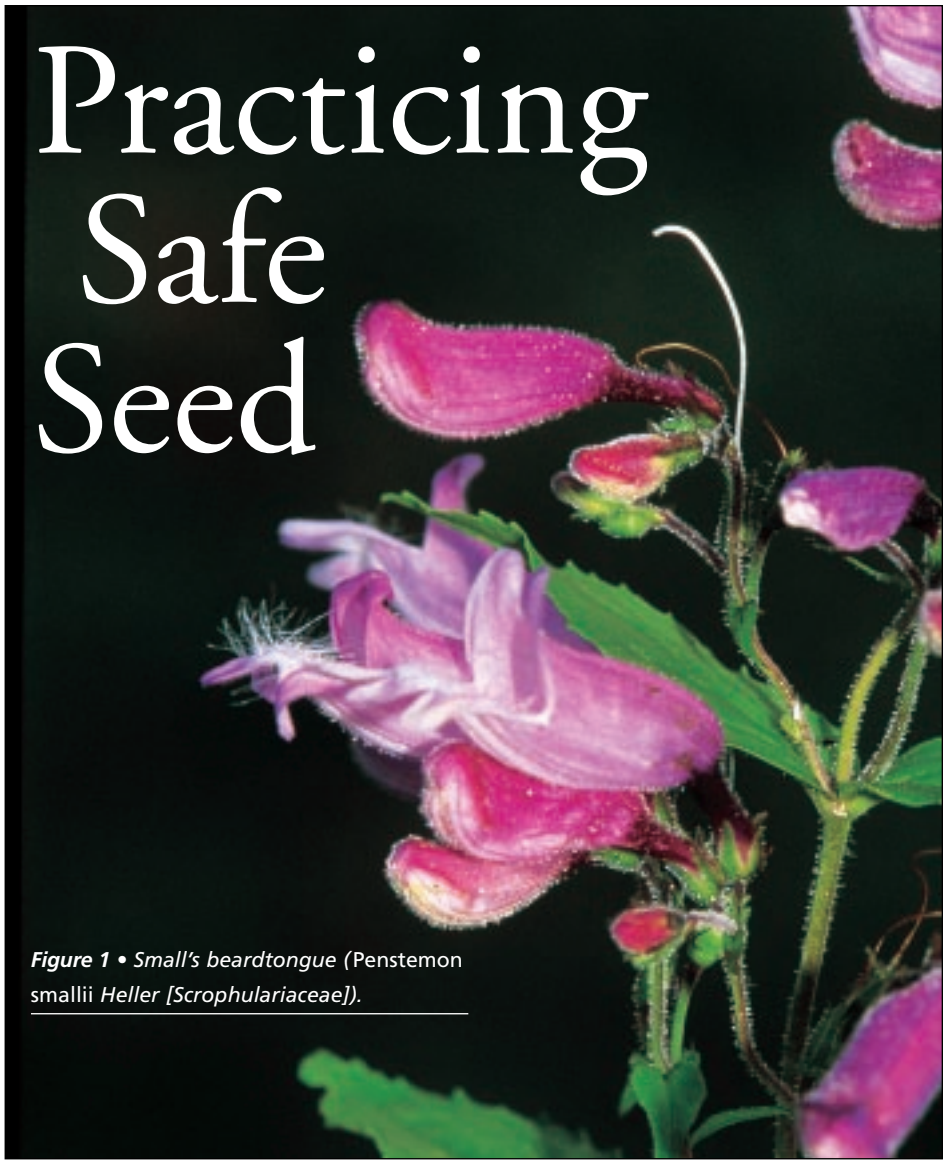

***Figure 1** • Small's beardtongue (*Penstemon smallii *Heller [Scrophulariaceae]).*

Photo by Thomas G Barnes

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ABSTRACT

Successful completion of a seeding project requires good planning and attention to detail. With this paper, I hope to educate consumers about seed-related issues that are critical to project success. Good communication between vendors and customers will help the latter develop reasonable expectations and will greatly contribute to satisfactory project completion. A thorough knowledge of weeds, plant materials, seed certification, seed testing, planting guidelines, and common industry practices will greatly assist in writing bid specifications that can prevent disappointment.

KEY WORDS: certified seed, seed production, seed quality, seed testing

NOMENCLATURE: Hitchcock and Cronquist (1973); Barkworth and others (1983); Whitson and others (1999)

Maximizing establishment of plants from seeds begins before purchasing seeds. Selecting the right seed mix, choosing quality seeds, writing clear specifications, and implementing appropriate application methods with reasonable time lines should be finished before you go to bid. Going to bid before these steps are completed risks encountering a corrupted bidding process, costly delays, and poor performance.

SELECT THE RIGHT SEED MIX

Promoting vigorous growth requires selecting the right seeds for soil, climate, aspect, and goals of each unique project. Avoid generic seed mixes that companies claim will do well regardless of soil type or elevation. Ask the sales staff about potential incompatibilities among species within the seed mix. Such incompatibilities may include the presence of both deep and surface-seeded species, both expensive diminutive species and cheap aggressive species, and seeds that will separate from each other in a drill rendering erratic coverage. Be wary of dealers who always have every locally endemic ecotype you want—it is my experience that all seed companies have limitations in this area.

In formulating a seed mix, soil conditions and climate should drive all other decisions. Check soil types, soil depth, nature of the substrate, aspect of the land, slope, drainage, temperature extremes, precipitation and its seasonal distribution, snow cover, and elevation. Match soil characterization with plant requirements—as a check, look to see what's already growing on the site and use that as a further basis for a seed mix.

It may seem odd to deal with weeds in early planning stages, however, some weed control is frequently required long before any seeds are planted. Weed control on your site will hinge on 3 factors: 1) weed seeds already in your soils; 2) weed seeds entering from external inputs like seeds and mulch; and 3) most importantly, the level of competitive growth created by the species selected for planting. Pre-existence of common weeds such as kochia (*Kochia scoparia* (L.) Schrad. [Chenopodiacea]) or Russian thistle (*Salsola iberica* Sennen [Chenopodiacea]) will not usually compromise seeding results unless present in

very high numbers, whereas the presence of just a few spotted knapweed (*Centaurea maculosa* Lam. [Asteraceae]) plants may require pre-treating soil for weed control. If possible, check growth on your site from previous years to ascertain the types of weeds and their abundance. If nothing is growing on site, find out why before going any further. Absence of any growth may indicate soil toxicity.

CHOOSE QUALITY SEEDS

Once an "ideal" seed mix is selected, go to the marketplace and see if seeds are available in the quantities envisioned within your required time frame. To select species and cultivars for a project, special attention should be devoted to the adaptation of seeds to your site. Some species, such as cool-season grasses, are often adapted to a broad range of elevations, climates, and soil types. However, many species of forbs and shrubs are extremely narrow in their range of adaptation to both climate and soil type. Do not try to force poorly adapted seeds into projects. Find out before you go to bid if adapted species are available in the seed market. If not, either drop that species from your mix or undertake a local seed collection. Be wary of dependence on very scarce seeds unless you are prepared to purchase them immediately or unless the vendor will hold them for you.

The use of certified seeds for any project deserves consideration. Certified seeds are usually of higher quality than uncertified. Generally, higher quality seeds are purer (less debris and fewer weed seeds), have greater germination potential and better seedling vigor, and have a longer storage-life. Certified seeds reduce the risk of introducing alien species. They also help establish a chain of accountability that is important in bringing out the best in vendors and contractors. In seeding specifications, the term "certified seed" is ambiguous and frequently misused so bids should state "blue-tagged certified seed" to reduce confusion. Require the blue tags to be on the bags, or with a blend, require the blue tags of individual constituents be sent with the mix. Mixes cannot be certified and many hand-collected species are not certified or source-identified as a matter of practicality. Blue-tagged certified seed status does not exist for most native shrubs, wildflowers, and for many native grasses. Blue-tagged certified seeds are usually more expensive than common seeds, therefore requiring certified seeds to be evaluated on a job-by-job basis. For example, certified 'Rosana' western wheatgrass (*Pascopyrum smithii* (Rydb.) A. Love [Poaceae]) frequently contains some cheatgrass (*Bromus tectorum* L. [Poaceae]), while native western wheatgrass from some areas is cheatgrass-free.

Vendors' test results should be interpreted with established tolerances in mind and an understanding of factors that could skew results. Red flags on a seed test would be absence of key species in a mix (especially the rare and expensive ones), large presence of cheap or unordered species, presence of noxious weed seeds, or significant deviations between advertised purity and germination test results. Tests are intended to be statements of probability and should be interpreted with care. If discrepancies appear on seed tests, ask your vendor for an explanation before you form an opinion. Many issues in seed testing undermine the definitive results that we would all like to see, but in spite of these issues, testing is the only way to ensure compliance over the broad spectrum of vendors and contractors. Common seeds with high purity and germination tend to yield fairly uniform analysis results while trashy uncommon seeds tend to vary greatly from 1 test to another. Sometimes, it is as much an art as a science to know which test variations are significant, but a good seed laboratory can help you interpret the results.

When seeds arrive, check labels and weights for accuracy, origins, and test dates. Check bags for stems, mildew or signs of dampness, tears, insects, and any other factors than could interfere with germination or flowability through seeding equipment. If you choose to have seed tested yourself, draw samples and send them to a seed laboratory. Use the proper method for sampling or call a state seed inspector for assistance. Seed tests measure purity, germination, and weed or crop content. Standard operating procedure should at least include sending the delivered seeds to a laboratory for a noxious weed test, which is rapid and inexpensive. If at all possible, seeds of individual species should be sampled and tested before they are mixed with other species. If a problem arises, it is much easier to pinpoint an individual offending seed lot and negotiate a solution than after seeds have been mixed.

For many native species, particularly shrubs and forbs, germination requirements and protocols have not been established. Consequently, some seeds should not be germinated but should be submitted for a tetrazolium (TZ) test instead. The TZ, which verifies seed viability by detecting respiration, is much faster than a germination test, which may take 30+ d. Very hard-seeded or dormant species such as snowberry (*Symphoricarpos albus* (L.) Blake [Caprifoliaceae]) or beardtongue (*Penstemon* Mitch spp. [Scrophulariaceae]) should always be tested by TZ because actual germination is apt to be low regardless of viability (Figure 1).

WRITE CLEAR SPECIFICATIONS

As requirements for reclamation and restoration seeding projects continue to grow along with the demand for local ecotypes, be aware that the seed industry may only supply several of the hun-

Photo by Lawrence W Lass

*Figure 2 • Ensure mulching material is free of weed seeds, especially aggressive weeds like yellow starthistle (*Centaurea solstitialis *L. [Asteraceae]).*

dreds of species that grow on your site. Many species collections originate from areas that may be unsuitable for your site or your goals. Ask reputable authorities, since the capability and needs of each species vary significantly. If the job requires unusual species or large quantities, call reputable seed companies and inquire about availability, quality, and suitability. If you will need seeds for which supplies may be problematic, broadcast your prospective need to as many dealers as possible to inform them of your anticipated demand. You may have to delay your plans to allow for a season or two of seed collection. If enough dealers agree that it is possible to supply species and quantities as planned, then proceed with formulating your bid package. If you discover that a species you desire is unavailable, then designate an acceptable substitution before going to bid. Specify the conditions under which the substitution will be allowed.

Ambiguity or conflicts in every part of the seeding process should be resolved before any contracts are let. Here is an all-too-frequent scenario that compromises revegetation results. A designer, engineer, or consultant specifies an impossible-to-find species or an unrealistic quantity of a species in a seed mix and sends it out to bid. Contractors or vendors, knowing the species is unavailable, bid that species cheap expecting that an inexpensive substitute will be allowed in the end. Then, 2 d before seeding, the contractor calls the engineer, complains that seeds are unavailable but smooth brome (*Bromus inermis* Leyss. [Poaceae]) or annual ryegrass (*Lolium multiflorum* Lam. [Poaceae]) will do just as well. The presence of ambiguity in any contract tends to favor the least conscientious fulfillment of that contract. A common factor in such scenarios is lack of communication between designers and those implementing the project and the 2 most common reasons for lack of communication are professional chauvinism and lack of experience. This is just 1 example of many that I could use to illustrate a basic theme that frequent and comprehensive communication between designers, vendors, and applicators creates realistic goals, clear expectations, and rigorous oversight.

Clear specifications should exist in any solicitation. Specifications must include pure live seed (PLS) percentage, the total quantity required, and the species' current scientific name, rather than a common name like "goldenrod." Any requirements such as copies of germination test reports, testing dates, specific origins, weed content, or species prohibitions should be stated. Also include minimum acceptable purity and germination (or TZ) percentages, desired bag weight, and any requirement for certified seeds. Specify delivery dates, testing procedures, and whether seed should be mixed or palletized. Ask about additional costs such as delivery, mixing, bag charges, sales tax, or inoculation fees for legume seeds.

IMPLEMENT APPROPRIATE APPLICATION METHODS

All external inputs such as hay-mulch, topsoil, fill, and machinery should be evaluated for contaminants. Hay-mulch is notorious for harboring noxious weed seeds. Mulch should be sifted for weed seeds to be sent to a seed lab for identification. If your fill material or mulch contains yellow starthistle (*Centaurea solstitialis* L. [Asteraceae]), it's too late to practice safe seed! Machinery should be clean before entering the site because mud on vehicles harbors weed seeds and is one of the top three vectors for seed dispersal, along with hay and animals (Figure 2).

Enough time must be incorporated into the project plan to allow all participants to do their jobs well. Compressed time lines are one of the most common causes of poor results. For instance, if a seed dealer orders in seeds for a project but doesn't have time to inspect or replace them if necessary before delivery, your chances of receiving substandard seeds increase. Allow a 2-wk minimum delivery time, especially if you have a difficult seed mix with many unusual species. If samples are to be sent for testing, give yourself enough time to get results back before you plant. At all stages allow time for negotiation, adjudication, or re-ordering in the event of a worst-case scenario.

Seeding dates should reflect the needs of seedling establishment. Plan your job around the needs of the seeds. As a general rule-of-thumb, your seedlings should emerge at least 6 wk before the temperature climbs above 30 °C (86 °F). So if you find a project running late into the spring, delay seeding until fall. Seeds often will remain in the ground awaiting proper conditions to germinate, but if they germinate late and die in summer, you will lose your seedbank. For cool-season grasses, forbs, and shrubs, the optimal time for seeding in temperate climates is usually in the fall, after the soil cools below germination temperature but before spring rains arrive. Some species are more forgiving than others, so the nature of your seed mix can greatly influence the window of opportunity, as can aspect, soil type, or probability of summer rain.

Some vendors have programs that can quickly determine species-specific seeding rates, which help reveal imbalances in the seed mix. Rates can vary depending on seeding method, applicator proficiency, and site condition. Seeding failure can occur from lack of oversight of the seed applicator. Seeds should usually be planted into a firm seedbed in which your shoe heel leaves no more than a 6-mm (0.25-in) indentation. Check seed depth as it is being placed into the ground to ensure optimal seed placement. Multiple depths may be required for seeding, and the seeding contractor should have equipment capable of planting at 2 depths for, say, grasses and legumes. Be sure drill-row orientation minimizes the threat of erosion and that amendments or straw have been properly incorporated.

Even under the best of plans applied in the best possible way, future rainfall events will determine the extent of your success or failure. So, as a last measure, consider prayer as an integral part of seeding success!

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