GRASSLANDS

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STRATEGIES FOR ESTABLISHING NATIVE GRASSES

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The ideal situation for establishing any perennial grass from seed is to have well-tilled, weed seed-free soil with moisture and temperature appropriate for germination, growth, and establishment. Unfortunately, the usual scenario is a non irrigated weed-infested field or roadside. Here summarized are techniques used to establish native grasses in the Sacramento Valley and adjacent foothills north of Winters in Yolo County. Average yearly rainfall is about 17 inches. Soil types vary from class 1 silty clay loam to class 4 gravely clay loam with underlying hardpan. All areas have undergone continuous or intermittent tillage over the past 20 years. Many of the techniques used follow basic agronomic principles used to establish other perennial plantings such as permanent pasture and sod. The following is a compilation of techniques found to be effective by the author; these are not necessarily recommendations for individual situations, but may serve as guidelines.

Before discussing techniques, it is important to stress the necessity of selecting appropriate species and, perhaps, even species accessions for the site. Over 30 species of native grasses are now available from commercial growers. Soil type, rainfall, exposure, and heat, cold, and flooding tolerance are some of the environmental and climatic factors that dictate where grasses grow. Sites with poor soil are the most critical in species selection with regard to survival. Species originally on the site would be the best choices. An adaptability guide is being prepared by CNGA; this will provide essential information. A first draft should be included in an issue of *Grasslands* this year. A number of consultants as well as past articles can aid in making appropriate recommendations.

Establishment characteristics of drought-tolerant perennial grasses, both native and non native, are important to consider in order to appreciate and understand the steps required for a successful outcome. Equally important are the characteristics of the weedy annuals which, above all, are responsible for establishment failure of native grasses from seed. Seedlings of many native grasses have low vigor and slow germination and growth; this is especially true of the long-lived and highly desirable *Stipa*. *Melic*, and *Festuca* species. Some species also have a prolonged germination time. By contrast, weedy annuals have short germination time, high seedling vigor and rapid growth following the first germinating rains in the fall. Additionally, seed density of weeds is usually very high, with some estimates as high as 10,000 plants/meter^2. Due to these characteristics weedy annuals overwhelm the hardiest of the natives even when densely seeded. In large acreages, high-rate seeding can be prohibitively expensive. In short, the slow-growing native seedling needs time, moisture, and nutrients to mature into a perennial plant. Standard agricultural techniques provide the methods and tools to accomplish these goals.

Establishment from seed is not a "quick fix". Two to three years are required to develop a mature stand. In weedy areas intensive or spot management for weed control is required beyond the third year. Finally, the reader is reminded of transplant technology which will not be discussed further in this article. Small restoration sites in which rapid results are desired can be effectively planted with transplants on 12-24 inch centers as an alternative to seeding. Transplants are now available at very cost-effective prices and the results when done properly are rewarding. A list of sources is available from CNGA, and will be included in our information packet soon to be completed and mailed to all members.

HERBICIDES

Many of the management strategies described in this article involve the use of herbicides. Herbicides can provide real and cost-effective solutions to serious weed problems that plague the grassland restorationist. They should be viewed as one of the important technological advances that will help restore many altered and exotic-infested ecosystems. Integration of all available technology will be essential to achieve a goal of widespread balanced and self sustaining environments.

Proper, knowledgeable, and safe use of herbicides should always be observed. Precautions include both safety to humans and to the environment. Use herbicides according to labels and observe all restrictions in accordance with county, state, and federal regulations. Permits are required for all large scale use. Information is readily available from county agricultural commissioners' offices and agricultural extension agents. In as much as this may sound like an unrealistic ordeal, it is entirely feasible and easy for an inexperienced person to acquire the knowledge and professional assistance to use herbicides. Licensed Pest Control Advisors (PCA) and licensed Pesticide Control Operators (PCO) can be contacted through local agricultural chemical distributors. Many landscape contractors can also perform the necessary services.

In This Issue:

SEED BED PREPARATION AND INITIAL STRATEGIES TO REDUCE WEED COMPETITION.

The goals of seedbed preparation are to decrease the weed seed bank and till the soil for seeding. Starting one year prior to seeding is ideal. A controlled burn in summer or fall decreases surface weed seeds and litter. This is followed by spring discing or tilling (March-April) before winter-growing weeds set seed. The area should be left fallow during summer and tilled or herbicided as necessary to eliminate late-germinating weeds. Another advantage of this spring-summer fallow technique is that deep soil moisture is conserved for the following fall planting. Finally, seedbed preparation may require smoothing with a land plane or scraper and roller if soil clods are large. Rolling with a ring roller provides compaction that will maintain good soil moisture following the first rains.

The seedbed is now physically ready to be seeded but control of a huge reservoir of weed seeds near the soil surface may be necessary. After germinating rains in October or November, weeds can be eliminated with glyphosphate at 8 oz/acre, very shallow harrowing or flaming. The goal is to reduce immediate weed competition without bringing weed seeds to the surface. Herbicide use or flaming is most effective. Glyphosphate is cost effective on large acreages and can be used for as little as $10/acre when applied with standard agricultural sprayers. If germinating rains are late, it may be necessary to plant before weeds have emerged, i.e. 7-10 days after germinating rains. In this case, seed can be incorporated and weed seedlings herbicided with glyphosphate prior to grass seed emergence. Germination of native grasses takes at least two weeks in late October or early November and up to 4 weeks if planted later. Planting an earlier "test" plot allows one to predict emergence of natives and thereby, timing of spray operations.

Weed identification on the site is important in planning management strategies. Annual grasses such as wild oat (*Avena fatua*), ripgut brome (*Bromus rigidus*) and annual ryegrass (*Lolium multiflorum*) are some of the most widespread and troublesome. They germinate early and grow very rapidly. High densities of other annual grasses such as soft chess (*Bromus mollis*) and annual or rattail fescue (*Vulpia myuros*), can be equally aggressive and suppressive. Selective herbicide for weed grass control is limited during establishment as native perennial grasses will also be susceptible; when grasses predominate the weed flora it is very important to adhere to the preplant strategies. Broadleaf weeds can be managed with a wide variety of selective herbicides that do not affect the grasses. Yellow starthistle (*Centaurea solstitialis*), prickly lettuce (*Latuca serriola*), mustards (*Brassica* spp.), knotweed (*Polygonum aviculare* , *P. erectum*), and many more can be effectively managed with broadleaf herbicides such as 2,4-D, MCPA, dicamba (Banvel), and triclopyr (Garlon).

SEEDING TECHNIQUES AND TIMING

The "best" time to seed is not well understood. The standard is to seed prior to mid November to maximize growth before summer dormancy, which may not occur if rains are late. In 1991 and 1992, several late December and January seedings were successful, especially on good soils. One advantage of later seeding is better control of weeds. With a later planting date, more surface weeds will germinate prior to seeding. In late December, 1991, two sites in Yolo County were seeded either by drill or broadcast-and-harrow; glyphosphate was applied 20 days later, just prior to native grass seedling emergence. Monitoring by digging up weed seeds and watching for germination is critical; as soon as a radicle begins to emerge from the native seed, it is time to spray.

Seeding between November and late December is not without risks. Wet, cold soil conditions can rot seed and a hard freeze can cause high mortality in young seedlings. This past wet winter *Stipa cernua* and *S. lepida* failed after being seeded in late November into heavy, class 1 soil. On the same site, seeded at the same time, *S. pulchra, Melica californica, Elymus glaucus,* and*Hordeum brachyantherum* germinated and were actively growing as of late February. *Poa scabrella* and *Festuca idahoensis* had intermediate success due to damp-off. The last two weeks in January are probably the best time to seed, but wet conditions may prevent access to the fields. Another risk of late seeding is the potential cessation of rains before the grass has enough growth to establish. If an area can be irrigated in the spring or soil will hold deep moisture well into June, a late January or early February seeding may be best. Newly-germinated seedlings will not be subject to a slow growth phase in December when significant mortality occurs.

Seeding techniques depend on terrain, size of the area and seeding equipment available. The two basic techniques we use are broadcast seeding and precision drilling. Hydroseeding and spreading of native grass straw can be effective. The details of seeding techniques will be covered in a subsequent issue. Long awns of many native grass seeds (*Stipa, Hordeum, Elymus, Bromus, Aristida*) may cause bridging in standard seeding equipment. Many standard range drills as well as broadcast seeders are not satisfactory unless additional mechanical agitation is supplied. Equipment designed to handle fluffy, "chaffy" seeds is available for most large acreage seeding (Truax, Inc., Great Plains Manufacturing, Inc.). For small areas, hand-broadcasting, followed by shallow harrowing or cultipacking is effective. No-till technology will dominate large-scale seeding in the near future. No-till drills are designed to seed directly into untilled soil, providing that compaction isn't significant. Ground work cost and soil erosion are reduced and precision drills plant more accurately, requiring less seed.

A CASE STUDY

A no-till planting was performed this year in a Central Valley, retired agricultural field dominated by wild oat, foxtail barley (*Hordeum leporinum*), and brome. The soil had not been tilled or grazed for more than 10 years and a deep layer of thatch was present. A hot late summer burn removed the thatch and glyphosate was applied after the first germinating rains. A Truax drill was used to plant in late November, followed by a second glyphosate spray before native seeds germinated. As of late February there was a good stand of native seedlings and few weeds. A heavy layer of charred wild oat seed provided evidence of the burn's effectiveness. Native *Brodiaea* in many swales had not been affected.

An alternative method used in the Carmel Valley (Stromberg, Menke and Kephardt), employed a sprayer directly mounted on the drill. Planting and spraying were performed simultaneously. An advantage to this method is that the herbicide spray pattern can be adjusted to narrow bands covering the drilled seed, eliminating weed competition for the native seedlings. Unsprayed bands can conserve desirable seed banks, provide livestock forage that would decrease grazing pressure on native seedlings, and might provide a microclimate enhancing seedling survival. Initial results of this trial will be available this summer.

CONTINUED WEED MANAGEMENT

YEAR 1: By March , grass seedlings should be up and growing but so will a new flush of weeds. Many of these weeds may be insignificant or, perhaps, even be desirable forbs, but others could pose threats to establishment. Starthistle, bull thistle (*Cirsium vulgare)*, and mustard will grow quickly and if abundant, can overtop and eliminate slow-growing perennials. Knotweed is a very common low-growing annual that starts germinating in late February. If not controlled, it may smother perennial seedlings by June. Late-germinating grasses such as annual ryegrass, oats, canary grass (*Phalaris minor*), and others can do the same. The management options include selective herbicides, wick herbicides, and mowing. In range situations grazing is also an option.

Selective herbicide spraying for broadleaf weeds is most effective when the weeds are small, generally by mid March. Perennial grasses must be past the 3- leaf stage before application. Most effective broadleaf herbicides are restricted-use chemicals. Wick application of glyphosphate consists of wiping a concentrated solution on the tops of tall weeds while leaving shorter perennials untouched. The wick is an absorbent material or rope that is in contact with a reservoir of herbicide solution. This technique works especially well with weedy grasses but can also be used for broadleaf weeds. Hand-held wick applicators are available through many garden suppliers. Tractor-mounted wick applicators for large acreages are available from distributors of agricultural spray equipment.

Mowing, either alone or in combination with herbicides, can give excellent control of late-season weeds, depending on weed type, density and location. Some species, such as annual ryegrass, starthistle, and introduced annual wild barley can produce seed heads low to the ground following mowing. Mowing alone has been successful in cooler coastal areas (Kephardt and Kaplow, personal communication), but we have experienced mixed results in the Central Valley, and little success when weeds are dense. Mowing in late March and April reduces the height of weeds, giving young perennials access to light. Mowing should not be lower than 3-4 inches. If mowing alone is used, a second mowing is usually needed in May or early June. Haying (cutting and baling) the site removes annual weed seed that would contribute to the soil seed bank as well as biomass that would shade growing perennials.

Grazing the establishing grassland in spring of the first year can help reduce fast-growing competitive annual grasses. It both mows and removes potential thatch and when animals are managed properly, results can be very successful.

YEAR 2: Second-year management is still a battle against annual weeds. Weed seeds remain in the soil and many are viable for many years. Yearling native grasses don't yet have the competitive biomass to inhibit weed growth. Management practices include pre-emergent herbicides, post-emergent herbicides, mowing, grazing, and, possibly, fire. Pre-emergents prevent seed germination and seedling establishment. Applied in fall to a first-year stand of native grasses, pre-emergents can aid weed control. Pre-emergent use is especially important where annual ryegrass, ripgut brome, foxtail barley, and wild oat have been previously present in high density for a number of years. There are many pre-emergents available and we are in the process of testing their efficacy for native grasses. First-year native grasses, unlike second- and third-year stands can be easily injured and it is important to use the proper material. Oreyzalin (Surflan) has been used successfully in many of our trials and we are comfortable recommending its use at 2#/acre for the native species listed in this article. First-year *P. scabrella* and *M. californica* demonstrate reduced tolerance to Surflan, but will grow through it. Chlorsulfuron (Telar) is another useful product that is effective for annual ryegrass control even after germination. *H. brachyantherum* and *H. californicum* are sensitive to Telar; do not use it if these species are in a seed mix. *Stipa, Elymus, Aristida,* and *Agropyron* are very tolerant of Telar. Seedling *Melica* and *Poa* sustain some injury, but second-year plants are minimally affected. Telar is a potent broadleaf agent, and although useful for controlling many broadleaf weeds such as starthistle and mustard, should not be used adjacent to desirable woody vegetation.

Pre emergent herbicide use has tradeoffs that need to be considered, especially when using those with activity over a wide range of species, such as Oreyzalin. Seed that is produced by the establishing native grasses will not germinate and gaps in the planting will remain. Similarly, reseeding or additional seeding will not be possible. If the restoration site has a seed bank of native annuals, pre emergents may be contraindicated. Every site and project needs to be evaluated in order to decide what practices are appropriate.

Post emergent herbiciding, mowing, and grazing during the second year are similar to the first. Trained persons with 4 gallon backpack sprayers can cover large areas and eliminate hot spots of weeds while not effecting surrounding flora. Warm season perennial weeds such as Johnsongrass (*Sorghum halepense*) and bermudagrass (*Cynodon dactylon*) can be controlled by spot spraying.

Fire is a post establishment management tool that has exceptional value. Our native grasslands evolved with fire and established perennial grasses rebound after fire while weed seed is destroyed. Midwestern prairie restorationists rely heavily on fire as a management tool. Frequency and timing are important questions to answer in our California bioregions. We have burned stands of *Elymus glaucus*, *Hordeum brachyantherum,* and *Stipa pulchra* in September. Young *Hordeum* plants may have been damaged in some of the hottest areas. Established plants of all 3 species rebounded with what appeared to be enhanced vigor. The burn research at Jepson Prairie clearly illustrates the value of fire. We plan to use fire regularly in many of our established plantings.

YEAR 3: A frequently-asked question is how long newly established, weedy sites require intensive management before they become self-sustaining. Right now we don't know, but a reasonable guess would be 3-6 years. Periodic management will always be required. Certainly, intensive herbicide use will not be necessary over time, but grazing, mowing, and burning will always be essential.

Species used in the Central Valley in the author's studies included: *Elymus glaucus, Hordeum brachyantherum, H. californicum, Stipa pulchra, S. cernua, Poa scabrella, Melica californica, Leymus triticoides, Aristida hamulosa, Festuca idahoensis, Agropyron trachycaulum* var. *majus, Sitanion jubatum,* and *Bromus carinatus.*

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