# A SEEDING TECHNIQUE TO ENHANCE SPECIES DIVERSITY[1]

Stephen G. Long[2]

The Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87) requires, in part, that coal mine operators return to mined lands a diverse plant community of the same seasonal variety which is native to the area. This may require that cool season and warm season grasses, forbs, and shrubs be established. Many seeding and planting techniques are available to operators but no single technique consistently results in the economical establishment of a wide variety of plant growth forms or seasonal variety. This paper proposes a seeding method which could, using commonly available drill-seeding equipment, attain this goal in an economical and efficient manner.

## INTRODUCTION

Reclamation and revegetation requirements for mining have become increasingly rigorous. This is particularly true with regard to coal mining legislation with passage of the "Surface Mining Control and Reclamation Act of 1977." One minor, yet signiticant passage of the Act states that an operator must establish ". . . a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area . . ." To a majority of mining operations east of the 100th meridian, this phraseology presents few, if any, additional revegetation problems other than those already of concern. This is also true in certain areas of the west where climatic conditions result in a predominance of either cool season or warm season grass species. In other areas of the west, however, vegetation communities tend to be mixed species types consisting of both cool season and warm season grass species. Forb, shrub, and in some areas, tree species also form major components of the vegetation cover.

Where both cool season and warm grass species comprise major components of the pre-mining ecosystem, both must be established on the area to be revegetated by virtue of P.L. 95-87. This is due to the ". . . same seasonal variety native to the area . . ." requirement. Attaining this objective is not a simple matter of species selection. Cool season species germinate and make greatest growth during the spring and fall of the year. Warm season species germinate and grow primarily in the late spring and summer. When seeded together by normal methods, cool season species germinate and begin growth well ahead of warm season species thereby utilizing available soil moisture. Consequently, there is often little soil moisture available for use by warm season species during the critical periods of plant germination and establishment. Both forb, shrub, and tree species can also be placed in a similar competitive disadvantage due to species requirements and growth characteristics when establishment is attempted by seeding.

## PLANTING METHODS ANALYSIS

This problem arose during the development of revegetation plans for coal mining operations in Montana and Wyoming. Cool season and warm season grasses, as well as forb and shrub species, all constituted significantly to pre-mining vegetation communities in terms of diversity. The problem was to select an economical planting technique which would reestablish, on regraded areas, all vegetation types at appropriate diversity levels identified during the pre-mining survey.

Several seeding and planting methods were analyzed to determine which technique might be used to circumvent interspecific competition for available moisture. Broadcast seeding could be used to plant a broad spectrum of species. This method has been used with success to revegetate many disturbed areas. Broadcast seeding, however, normally requires twice as much seed as drilling due to variable seed planting depths which may result in variable seed germination. In addition, given commercial seed costs,

[1] Paper presented at the 1985 Annual Meeting of the American Society for Surface Mining and Reclamation, Denver, Colorado, October 8-10, 1985.

[2] Stephen G. Long is a Principal and Reclamation/Soil Scientist with Cedar Creek Associates, Inc., P.O. Box 9557, Fort Collins, Colorado 80525.

Proceedings America Society of Mining and Reclamation, 1985 pp 278-282
DOI: 10.21000/JASMR85010278

doubling the seeding rate would have incurred a high initial per acre revegetation cost. Interspecific competition between rapidly developing cool season grasses and other species was also considered a potential disadvantage of this technique since specific seed placement cannot be made.

Conventional drill seeding was considered since it requires less seed than broadcasting. Drilling also forms small ridges which can decrease soil erodibility. In addition, drilling places seed in direct contact with the soil at a proper depth, thereby enhancing seed germination potential which is particularly important in a semi-arid climate. The primary disadvantage of conventional drill seeding is the resultant competition between species (i.e. cool vs. warm season grasses) in and between drill rows. As with broadcast seeding, this problem could lead to detrimental interspecific competition for available soil moisture. Hence, there could be a loss of diversity required for eventual bond release.

A simple variation of drill seeding was also considered. The drill could be loaded with cool season grasses alternating with other species in a divided seed box. Drilling would take place conventionally. It was reasoned that interspecific competition would be reduced in this manner. There was concern raised, however, that species would not "escape the drill rows" and an even cover would not be attained in the near future. In addition, a simple alteration of drill rows would leave areas of bare soil open initially until slower-establishing warm season grass, forb, and shrub species became established. Increased erosion could result. This technique was not considered appropriate for use.

Interseeding of cool season species into an established stand of warm season species, or vice versa, was also evaluated. This method of stand establishment is often used for range restoration. This technique was rejected since it would require planting into an establishing stand of vegetation. It was believed that a level of disruption which could not be tolerated on established sod could occur that would be detrimental to a newly planted area. It would also have required the mining companies to extend the bond period for another year on all reclaimed areas.

Hand planting plugs or seedlings is an excellent method of establishing species on mined lands and, if conducted in the proper manner, can result in a high success rate. This method, however, is labor intensive, expensive, and available planting materials are primarily limited to shrub and tree species. This was not considered (in and of itself) a viable method of revegetating the proposed permit areas.

## TECHNIQUE DEVELOPMENT AND SELECTION

The preceding analysis indicated that there were many planting techniques available which would promote production, cover, and density success on mined areas. The question of diversity still appeared largely unanswered.

In evaluating revegetation techniques for other types of sites, a technique termed "double-drilling" is often suggested by the SCS for planting grassed waterways. The method consists of planting a drainageway with two conventional passes of the drill each pass planting one-half the seed mixture. The second pass would be seeded at a diagonal to the direction of water flow.

It appeared that this technique, with a few modifications, could theoretically be used to limit the problem of interspecific competition. The use of this technique would retain the favorable characteristics of drill seeding. Therefore, the following "double drilling" specifications were developed for use on both proposed permit areas.

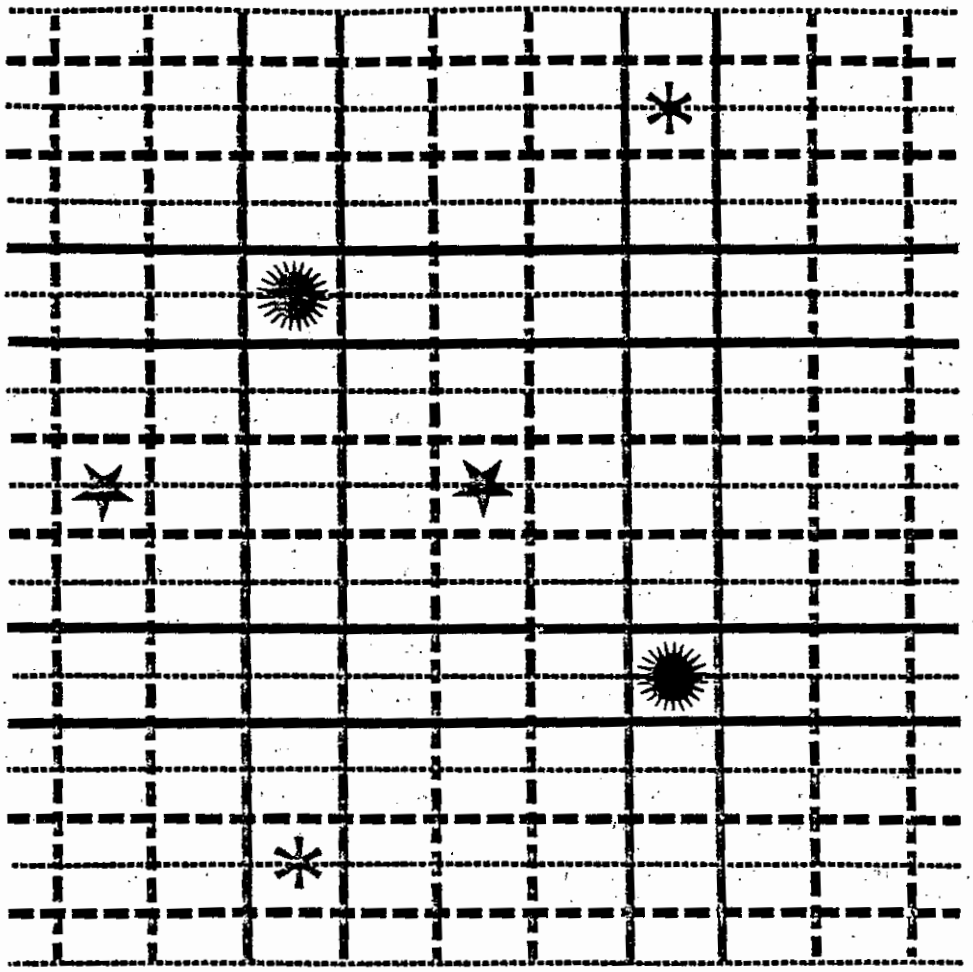
The selected seed mixture containing the appropriate amounts of cool season grasses, warm season grasses, forbs, and shrubs would be loaded into the seedbox of the drill. The seedbox would be modified so that each spout was connected to an individual compartment. The seed box would be loaded such that cool season grasses were put into the first two compartments. Warm season grasses, forbs, and shrubs would be put in the second two compartments. This alternation would continue for the remaining compartments. The drill spouts would then be set to reflect the seeding depth requirements for the species involved. Drill row spacing would be set at eight inches. Rice hulls or any other appropriate substance could be added to compartments as necessary to aid in seed metering. A seedbox agitator would be employed to reduce seed settling.

Drilling would commence using two passes over the area to be seeded, planting one-half the total seeding rate on each pass. The first pass would be made over the disturbed areas at an angle from the vertical of the slope. The second pass would be made between the rows of the cover crop mulch and along the contour such that ridges formed by the second drilling operation would aid in water erosion control. The continuity of drill rows created by the first drilling pass would be obliterated by the second pass decreasing the erosion potential created by the initial (non-contour) operation.

## POSITIVE AND NEGATIVE ASPECTS OF THE TECHNIQUE

This drilling technique will produce a pattern of microplots (see Figure 1) approximately the dimension of the spacing of two drill rows in which a nucleus of warm season grasses, forbs, and shrubs alternate with a nucleus of cool season grasses. An area comprised of all species intergrades between these microplots. Interspecific competition between rapidly developing species and more slowly developing species can potentially be avoided over the majority of

Figure 1.-- **Double-Drilling Technique**



**LEGEND**

- Cover Crop
- Cool Season Grasses
- Warm Season Grasses, Forbs, Shrubs
- Cool Season Grass Concentration
- Warm Season Grass, Forb, Shrub Concentration
- Intergradation of Cool Season Grasses, Warm Season Grasses, Forbs, and Shrubs

the planted area thereby enhancing planting success and species diversity. In addition, due to microplot configuration, there should be sufficient amounts of rapidly developing species planted throughout the disturbed area to aid in soil stabilization. Other apparent advantages to this technique are:

- o less seed is required than with broadcast seeding;
- o seed is placed at the desired depth in intimate contact with the soil to make most efficient use of available moisture in arid climates;
- o the technique is less expensive than hand planting plugs or seedlings;
- o seeding can occur during recognized planting seasons;
- o seed is evenly distributed and the drill row configuration is essentially eliminated;
- o seeding is completed in one season; and,
- o the configuration which results (microplots) virtually assures that significant levels of warm season grass, forb, and shrub species would be encountered during random vegetation aampling for bond release.

Double-drilling also appears to be an economical method of planting. Labor and equipment costs for conventional one-pass drilling could be estimated at $50 per acre for bonding purposes. Costs for broadcast seeding, a commonly used technique, would be less per acre. Seed mixture costs for drill seeding, when planting cool and warm season grasses, forbs, and shrubs, can range from $150 to $350 or more per acre. By using the "rule-of-thumb" of doubling the drill seeding rate for broadcast seeding, seed mixture costs would correspondingly double. Given that a second pass of the drill during double-drilling would add $50 to the cost of seeding per acre, double drilling becomes a less expensive method of seeding than broadcasting when considering labor, equipment, and seed mixture costs.

The major negative aspect of this technique is the disturbance to the mulch (or small grain cover crop) existing on the disturbed area at the time of seeding. The disturbance caused by the drill pass made on the contour can be minimized if planting takes place between the rows of mulch. The non-contour pass will disturb the existing mulch materials but it is believed that the integrity of the materials can be maintained.

## CONCLUSIONS

By virtue of current legislation, coal companies must establish on mined lands vegetation of the same seasonal variety as existed prior to disturbance. Several methods are currently available for seeding disturbed areas but none appear to be totally dependable in terms of promoting seasonal variety. The technique of "double-drilling" appears to have the capability of meeting this challenge. Though not yet proven in the field to this author's knowledge, this technique has been reviewed and accepted by three regulatory authorities as a seeding method which could potentially create an acceptable degree of diversity. Other reviewers versed in the problems and complexities of revegetation have also recognized the potential merits of this technique. Where an operator is faced with the problem of establishing both cool season and warm season grasses, as well as forbs or shrubs on disturbed lands, this technique could be implemented to meet this challenge.