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EVALUATION OF PLANT SPECIES AND GRASS SEED MIXES FOR MINED LAND REVEGETATION YEAR 2 (1990) RESULTS

D. J. Helm

Research Associate, Palmer Research Center

Agricultural and Forestry Experiment Station, University of Alaska Fairbanks

INTRODUCTION

An important component of revegetation is the seed mix used for soil stabilization. Although some trials of single grass species have been performed in southcentral Alaska in the past, new grass varieties have become available. In addition, variations in composition of the seed mixes needed to be investigated for different objectives for post-mining land use. Study plots were established for the Wishbone Hill coal project to evaluate grass species and mixes to use for erosion control, suppression of undesirable species, and vegetation community diversification.

Revegetation on mined lands may have several potentially conflicting goals. The main goal is to reduce surface soil erosion. The resultant vegetation cover should be diverse (have several plant species with the cover relatively evenly spread among them) and be suitable for the desired post-mining land use. In most places in Alaska, the desired post-mining land use is wildlife habitat, especially moose browse or other woody plants. Although grass cover is important for soil stabilization, grass cover may interfere with woody plant regeneration or reduce the diversity of the resultant vegetation cover if one grass species dominates the others.

In the past, one grass cultivar, 'Arctared' red fescue (*Festuca rubra*), has dominated the grass mixtures after a few years. It produces a lot of litter which may slow natural recolonization of the site by native species. Litter may also act as a hiding place for rodents which can girdle young woody regeneration. Hence, studies were needed to determine what other plant species would grow well on disturbed sites and how they could be combined into a seed mix that would provide soil stabilization, diverse ground cover, and minimal competition with woody regeneration.

This study differed from past studies (Alaska Plant Materials Center 1987) in the Wishbone area by using disturbed soil rather than overburden as the plant growth medium. Overburden in the area has pH values in the range of 7 to 8, while surface soils have a pH range closer to 5.2. Some species, such as 'Manchar' smooth brome (*Bromus inermis*), grow well at high pH's which are typical of overburden, but are not recommended for soil conditions below pH 5.6 (Mitchell 1982), which is typical of soils in the area. Another difficulty with soil is that bluejoint (*Calamagrostis canadensis*) may regrow from buried stems (rhizomes) and seeds in the soil and overwhelm seeded grasses and woody plants. Another new feature of the present study was the alteration of the ratios of grass species within a mix to achieve diverse plant communities.

The objectives of this study were to determine:

1. The grass cultivars that would grow on low pH soils in the Wishbone Hill area.
2. A ratio of grass species within the seed mix that would improve the diversity of the resultant community.
3. A seeding rate that would allow establishment of local species and outplanted browse without jeopardizing the cover needed to stabilize the soils.

METHODS

Grass species were selected based on recommendations by investigators at the Alaska Plant Materials Center (Division of Agriculture) and the Agricultural and Forestry Experiment Station (University of Alaska Fairbanks). A seed mix was designed with equal ratios of four species: 'Arctared' red fescue (*Festuca rubra*), 'Norcoast' Bering hairgrass (*Deschampsia beringensis*), 'Nugget' Kentucky bluegrass (*Poa pratensis*), and 'Alyeska' arcticgrass (*Arctagrostis latifolia*). The ratio of Arctared to the other species was varied from 0:1 to 1:2 to 1:1 (Table 1). Additional species which were tested as monocultures and in competition with Arctared included 'Nortran' tufted hairgrass (*Deschampsia caespitosa*), 'Sourdough' bluejoint (*Calamagrostis canadensis*), and 'Gruening' alpine bluegrass (*Poa alpina*). Bluejoint is the

Table 1. Species composition of seed mixes on a relative seed count and weight basis. Rate is the equivalent seeding rate for the entire mix on a lb/acre basis.

	Species Composition by Relative Seed Counts							SpeciesComposition by Weight (%)							Rate (lb/acre)
	Arctared	Nugget	Alyeska	Norcoast	Sourdough	Nortran	Alpine	Arctared	Nugget	Alyeska	Norcoast	Sourdough	Nortran	Alpine	
Heavy Mix w/all species	2	2	2	2				49	13	15	23				37.2
Arctared:all 1:2	1	2	2	2				32	17	20	30				32.1
Heavy Mix w/out Arctared		2	2	2					25	30	45				25.4
Light Mix w/all species	1	1	1	1				49	13	15	23				18.6
Light Mix w/out Arctared		1	1	1					25	30	45				12.7
Arctared	2							100							36.4
Nugget		2							100						9.4
Alyeska			2							100					11.4
Norcoast				2							100				17.2
Sourdough					2							100			5.5
Sourdough:Arctared 2:1	1				2			77				23			15.8
Nortran						2							100		17.2
Nortran:Arctared 2:1	1					2		52					48		23.6
Alpine							2							100	9.4
Alpine:Arctared 2:1	1						2	66						34	18.4
Control (nothing seeded)															

dominant local grass. It can regenerate from rhizomes in the soil as well as the planted seed.

In order to maintain constant plant densities for comparisons, the heavy seed mix contained approximately 51,000 seeds/m^2 (20,600,000 seeds/acre). The light rate was one-half that. The mass of each species to be included in the mix was calculated by dividing the seed rate (number of seeds/area) by the number of seeds per pound which was obtained from *A revegetative guide for Alaska* (Alaska Rural Development Council 1983) or researchers' estimates.

The vegetation was cleared and the soil stripped from the study site and temporarily stockpiled (less than one day) in mid-June (Helm 1990). The soil was respread over the area shortly after clearing and disked to prepare a seed bed. The area was fenced before seeding. The plots were lightly raked to improve seed bed preparation. Each plot was divided into three strips: unfertilized, unfertilized but with five rooted willow cuttings, and fertilized. The cuttings were planted to assess any differences in competition from grasses on the browse plants. Seed was broadcast by hand in early July 1989 when weather conditions were still dry. Fertilizer (20:10:10) was spread by hand on the third of the plot to be fertilized. No buffer zone was included, but measurements were made at least 20 centimeters from the edge.

Cover estimates by plant species were made in late August 1990, at the end of the second growing season. Three observations were made in each strip (unfertilized, woody plants unfertilized, fertilized) of each plot (seed mix) with a point frame containing five pins spaced 20 cm (8 in) apart, resulting in cover recordings for 15 points in each strip or 45 points per plot. A pin was dropped at each point and all plant species hit by that pin were recorded. The number of points hit was converted to a percentage cover for each species and categories of forbs (broad-leaved herbaceous species), grass-likes, shrubs, and trees. All species observed in a plot, whether they were hit by a pin or not, were also recorded.

RESULTS

The grass species which provided the most grass cover by itself at the end of two growing seasons was Nortran (87% cover in monoculture) (Table 2). Nortran also grew well in a mix with Arctared. The mix that appeared to have the most seeded cover after two years was the Arctared:all species at 1:2. This latter mix provided 97% total cover of vascular plants, 22% cover of local species including 14% cover of bluejoint. Only 2% of the ground was bare.

The control, where no grasses were seeded, had 76% vascular plant cover including 47% bluejoint cover; only

Table 2. Cover (%) of categories of plant species at the end of the second growing season, August 1990. Mixes are arranged in decreasing order of total vascular plant cover.

Seed Mix	Total Vascular	Seeded	Local[1]	Blue-joint	Bare
Arctared:all 1:2	97	91	22	15	2
Heavy Mix w/out Arctared	89	84	19	13	6
Nortran	88	87	7	2	5
Sourdough:Arctared 2:1	88	57	54	41	9
Nortran:Arctared 2:1	87	83	13	6	7
Alpine:Arctared 2:1	84	73	27	16	8
Sourdough	84	35	85	75	7
Heavy Mix w/all species	83	72	21	11	12
Light Mix w/ all species	78	64	39	31	12
Nugget	78	27	66	39	9
Norcoast	76	67	25	13	13
Control	76	00	76	47	7
Arctared	73	67	15	4	16
Light Mix w/out Arctared	73	56	34	19	19
Alpine	68	59	23	11	23
Alyeska	65	10	59	44	27

[1] Local species are those that regenerated from the propagule bank (seeds or rhizomes) or were wind borne.

7% was bare. The control plot had at least as much total cover (non-bare ground) as each seed mix (Table 2). Seven of the 15 seed mixes resulted in less cover than the control. In other words, proper selection of seed mix is instrumental in reducing potential soil erosion.

Most grass mixes were able to suppress at least some of the undesirable bluejoint growth, resulting in lower bluejoint cover than occurred in the control plot. The least amount of bluejoint after two years resulted with Nortran, Nortran:Arctared 2:1, Arctared, and alpine bluegrass.

Fertilization resulted in more vascular plant cover, seeded grass cover, local species, and bluejoint and less bare ground when compared with the unfertilized strips within each plot (Table 3). However, the fertilization appeared to favor bluejoint over other local species and the seeded grass species. Seeded cover increased only from 48% to 64% while bluejoint cover almost doubled from 18% to 35% when fertilizer was applied.

DISCUSSION

Grass species or seed mixes have been identified which will grow reasonably well for the first two years under the soil conditions in the Wishbone Hill area and the weather conditions of 1989 - 1990. Additional species and mixes have been identified which may grow but are not as aggressive and will permit more local species to colonize the area. Mixes containing Nortran as a major component grew well in the first two years. These would be good mixes for soil stabilization and for suppression of bluejoint. However, they may also suppress other desired local species. Norcoast, a cultivar of a more coastal hairgrass species, provided less cover, but grew reasonably well and might be expected to permit more native colonization. Arctared also provided good cover and suppression of bluejoint but resulted in more bare ground than the control. In contrast, species such as Alyeska produced little cover (10%), and seeded cover was not significantly greater than the control (0%).

One problem with the main mix of four species was that two of the four recommended grass species did not grow well. This reduced the effective seeding rate to approximately half of the planned rate. Based on these first two years of data, a mix consisting of Nortran, Arctared, Norcoast, and alpine bluegrass in about equal quantities (or possibly slightly higher for the alpine bluegrass) should be useful for soil stabilization. The rate could be decreased where more local colonization was desired, especially if bluejoint did not present a major problem. A different mix may be more appropriate on other soils or with different weather conditions.

Fertilization can also be used to manage species composition, at least in the first two years. It resulted in increased plant cover, although this improvement was reduced with mixes that provided good seed cover. Although effects of fertilization increased cover of local species, much of this cover was bluejoint, especially where the seeded species did not grow well.

Long-term recommendations need at least three, preferably five years, of data and possibly a repeat of the study under different weather conditions. Once good

Table 3. Cover (%) of vegetation categories in response to fertilization at end of second growing season, August 1990.

Category	Total Vascular	Seeded	Local[1]	Bluejoint	Bare
Fertilized	91	64	45	35	3
Not fertilized	71	48	29	18	20

[1] Local species are those that regenerated from the propagule bank (seeds or rhizomes) or were wind borne.

ground cover is established where moderate grazing or mowing do not occur, litter may accumulate over the years and retard plant growth and recolonization by native species. Nutrients may be used from the soil and not replaced. Thus lower nutrient regimes may develop over time. Nutrient levels will definitely decrease on the fertilized strips over time.

In summary, Arctared red fescue, Nortran tufted hairgrass, Norcoast Bering hairgrass, and Gruening alpine bluegrass grew reasonably well on these low pH (5.2) soils under early-season drought conditions. Variations in species ratios within a mix and rates of seed mix application could be used to alter composition of the resultant plant community. Different weather conditions from these may result in different plant responses.

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Agricultural and Forestry Experiment Station
School of Agriculture and Land Resources Management
University of Alaska Fairbanks
James V. Drew, Dean and Director