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Integrated Resource Management

No. 184

The Effects of Aerial Seeding on Forage Stand Development on Montane Spruce Clearcuts – Project 3.55

This Memo reports the results (to August 1990) of one of five related research projects carried out to study the effects of cattle grazing, forage seeding rate, basal scarring, and shoot damage on forest regeneration. Progress in the other projects is reported in the following FRDA Memos: the effects of forage seeding and cattle grazing on early establishment of lodgepole pine (No. 185); response of lodgepole pine seedlings to simulated cattle damage (No. 186); the impacts of grazing pressure, stocking rates, and forage seeding on lodgepole pine seedlings (No. 187); and beef production on seeded clearcuts in southern interior British Columbia (No. 188).

INTRODUCTION

Seeding clearcuts to domestic forages is a common range improvement practice in British Columbia. Forage seeding goals for integrated forest/range management generally include: 1) providing sufficient high quality forage to meet livestock management objectives; 2) improving livestock production and management; and 3) enhancing site conditions for conifer regeneration by controlling competing native vegetation and reducing the establishment and spread of noxious weeds. Most often, seeding prescriptions are based on seed rates and the species composition of the seed mix. All of the above goals for seeding, however, depend on the actual plant densities and species composition once the stand establishes.

This study documents forage stand development on Montane Spruce clearcuts from the formulation of the prescribed seed mix to the end of the second growing season after seeding.

STUDY AREA AND METHODS

The experiment was conducted on three cutblocks making up a total area of nearly 100 ha. Two cutblocks were located near Tunkwa Lake (50 km SW of Kamloops, B.C.) and one at Helmer Lake (30 km NE of Merritt, B.C.). Both sites occur in the Very Dry Cool Montane Spruce (MSxk) biogeoclimatic subzone at 1400 m elevation. Before logging, the forest overstory consisted of lodgepole pine (*Pinus contorta*) and Engelmann spruce (*Picea engelmannii*) in approximately equal proportions. Pinegrass (*Calamagrostis rubescens*), heart-leaved arnica (*Arnica cordifolia*) and birch-leaved spirea (*Spiraea betulifolia*) characterized the understory at Tunkwa Lake. Pinegrass, heart-leaved arnica, and arctic lupine (*Lupinus arcticus*) were the principal species at Helmer Lake.

At Tunkwa Lake, Blocks 1 and 2 were clearcut in fall 1986 by Ainsworth (1987) Lumber Ltd., Savona, B.C. They were

then windrowed, burned and drag-scarified during fall 1987 using three sharkfins at 2-m spacing behind a D-7 Caterpillar tractor, to achieve a 25% mineral soil disturbance. At Helmer Lake, 25 ha of Block 3 were clearcut in 1985 by Aspen Planer's Ltd., Merritt, B.C. Another 10 ha were logged in October 1987 to accommodate the experiment. During fall 1987, the entire block was rough-piled and track- and blade-scarified and the piles were burnt after the first snowfall.

All three blocks were aerially seeded in early May 1988 with a mix including 35% (by weight) orchardgrass (*Dactylis glomerata*), 5% timothy (*Phleum pratense*), 40% alsike clover (*Trifolium hybridum*), and 20% white clover (*T. hybridum*). Seed was applied to 10-ha strips within each cutblock at rates of 3 and 12 kg/ha. An unseeded 10-ha control was left on each block. After seeding, each 10-ha area was divided into two 5-ha pastures for cattle grazing at 50 and 80% use. Twenty seed traps were located in each pasture to collect the seed and assess the aerial application. Ten 50-m transects were laid out systematically in each experimental unit and five plots were randomly located along each transect for herbaceous cover and plant density measurements. Ten plots (1 m²) were clipped in each experimental unit at the end of the grazing period to estimate the herbaceous standing crop.

RESULTS AND DISCUSSION

Many factors influence the success of forage seedings on forestlands (Fig. 1). Indeed, various combinations of these factors may result in the density and composition of the forage stand being different than expected from the seed rate and composition of the seed mix. In our study, seed rates and the composition of the prescribed seed mix were based on textbook values of long-term average seed weights for each species. When seeds were weighed to predict seed density, density averaged nearly 30% less than expected. The calculated density of orchardgrass was most affected, with a 40% reduction in the seed density expected on the ground (Table 1). Seed traps showed that even after the expected number of seeds were adjusted to account for actual seed weights, only 67% (8.1 kg/ha) of the seeds expected were trapped for the total mix at 12 kg/ha, however, 100% of the actual seed expected were trapped at the 3 kg/ha rate (Table 1). Losses at the 12 kg/ha rate likely resulted from a combination of seed drift during aerial seeding and faulty application.

Field sampling in May 1988 confirmed that mineral soil cover averaged 25% over the three cutblocks. Despite this level of disturbance, percent establishment for individual species and the total mix was lower at both seeding rates than was expected based on the density of seed trapped. Indeed,

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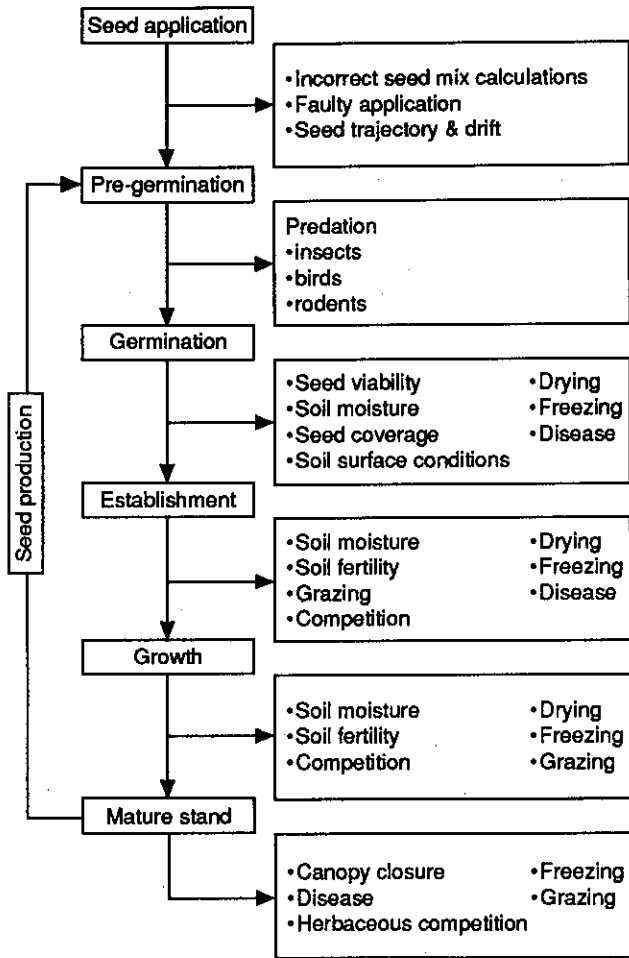


FIGURE 1. Factors affecting forage seeding success on forestland.

TABLE 1. Expected and actual seed densities and rates averaged over three cutblocks at Helmer and Tunkwa lakes in 1988

	Prescribed seed rate (kg/ha)	Expected seed density (seeds/m ²)		Actual seed trapped May 1988	Seed rates based on expected seed densities (kg/ha)	
		Presc.	Actual		Presc.	Actual
Orchardgrass	3	150	90	99	2.0	3.3
	12	610	370	295	5.8	9.6
Timothy	3	40	30	26	2.0	2.6
	12	160	110	63	4.7	6.9
Clover	3	290	220	224	2.3	3.1
	12	1160	900	569	5.9	7.6
Total mix	3	480	340	349	2.2	3.1
	12	1930	1380	927	5.8	8.1

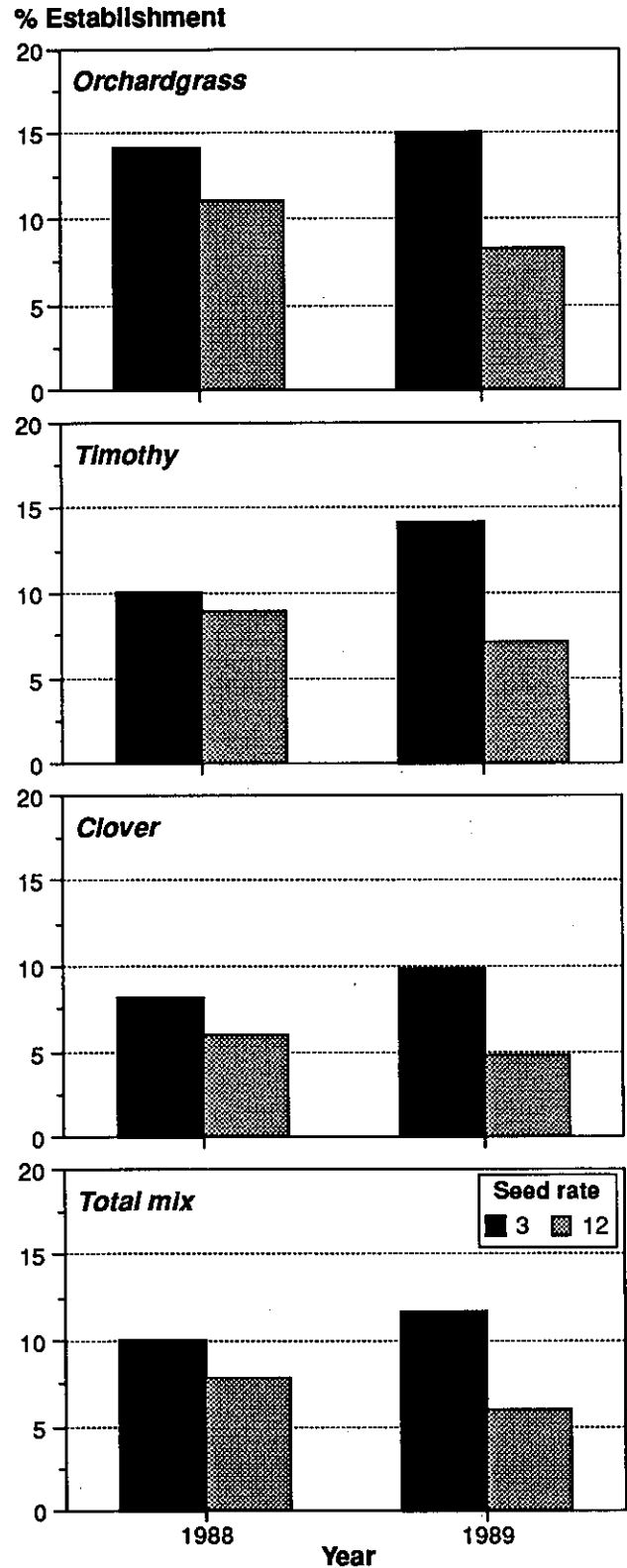


FIGURE 2. Percent establishment of seeding based on actual seed rates.

only orchardgrass exceeded 10% establishment in 1988 (Fig. 2). Establishment of the total mix at the 12 kg/ha rate averaged only 78% of the 3 kg/ha rate. The reason for these establishment differences between the two seed rates may be attributed to: 1) there being only a finite area with soil conditions suitable for establishment regardless of the amount of seed applied; and 2) increased competition among seedlings at the higher seeding rate.

Establishment, as reflected through plant density, was higher by 1989 than in 1988 for all species at the 3 kg/ha rate. This suggests that viable dormant seeds remained in the seed bank over winter (Fig. 2). At the 12 kg/ha rate, however, density of orchardgrass, timothy, clover and the total mix declined in 1989 compared to 1988. This indicates that the combined mortality from all sources — such as intra- and interspecific competition, seed predation, moisture stress, and freezing — exceeded recruitment into the seeded stand. Even though densities for all species increased between the 3 and 12 kg/ha seeding rates, seeding at the 12 kg/ha rate produced only about twice as many plants initially (Table 2).

Total vegetative cover increased from about 2% in May 1988 to more than 40% in August 1988, especially on the areas seeded at 12 kg/ha. By August 1989, total cover equalled nearly 75%. Other than for lupine, cover of all species and species groups increased between 1988 and 1989 (Table 3). Orchardgrass, timothy, clover, and total grass cover also increased in response to seeding rate. Pinegrass, fireweed, and total shrub cover were higher in the unseeded areas than in the seeded areas, indicating that the seedlings were controlling the cover of these species (Table 3).

Total standing crop equalled 300 kg/ha by August 1988 (Fig. 3). Even though total cover at the 12 kg/ha rate was nearly double that on the area seeded at 3 kg/ha, there were no differences ($p < 0.05$) in August 1988 in total standing crop among the three seeding rates. By August 1989, however, standing crop at the 12 kg/ha rate nearly tripled the production in the control pastures (Fig. 3).

Proportions of all plant species in the trapped mix were different than those in either the prescribed mix (calculated according to long-term average seed weights) or the actual mix

TABLE 2. Densities of seeded forage species in 1988 and 1989 averaged over three cutblocks

Species	Year	Densities (plants/m ²) by actual seed rate		
		0 kg/ha	3 kg/ha	12 kg/ha
Orchardgrass	1988	0.0	14.0	32.8
	1989	0.1	15.0	23.7
Timothy	1988	0.0	2.6	5.6
	1989	0.0	3.7	4.4
Clover	1988	0.0	18.2	34.3
	1989	0.1	22.0	27.3
Total mix	1988	0.1	34.8	72.7
	1989	0.2	40.7	55.4

(calculated according to weighed and counted seed numbers) (Table 4). Similarly, stand composition of the seeded species did not reflect the composition of either the prescribed or actual seed mix. In 1988, both orchardgrass and timothy were higher than in the prescribed seed mix and expected composition. The proportion of clover in the stand, however, was lower than expected.

TABLE 3. Percent cover of grasses, herbs, and shrubs among seeding treatments in 1988 and 1989

Species	Year	% Cover by seed rate (kg/ha)		
		0	3	12
Orchardgrass	1988	>0.1	5.5	12.4
	1989	0.3	14.9	19.4
Timothy	1988	0.0	1.5	2.6
	1989	0.2	5.2	4.8
Pinegrass	1988	10.0	3.3	2.7
	1989	15.1	5.4	3.4
Total grass	1988	11.1	11.3	19.3
	1989	18.6	28.8	29.6
Clover	1988	>0.1	9.1	12.9
	1989	0.8	27.2	31.9
Fireweed	1988	3.2	2.9	3.6
	1989	9.9	5.4	4.0
Lupine	1988	4.4	0.5	2.0
	1989	3.3	0.8	1.5
Total forb	1988	16.3	23.0	32.4
	1989	33.6	47.2	49.4
Total shrub	1988	3.8	2.1	2.1
	1989	9.1	3.7	3.6
Total cover	1988	31.2	36.4	53.8
	1989	61.4	79.7	82.6

Standing crop (kg/ha)

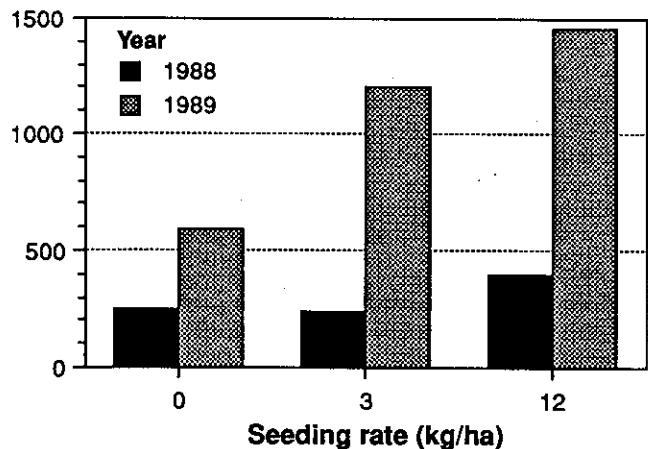


FIGURE 3. Standing crop of grasses and forbs in relation to forage seeding rate.

TABLE 4. Composition of domestic species in seed mix and the forage stand from seed mix formulation, until August 1989

Seed rate (kg/ha)	Composition of seed mix			Seed traps May 1988 (% no. seed)	Vegetation composition based on density (% no. plants)	
	Presc. (% wt)	Presc. (% no. seed)	Actual (% no. seed)		Aug. 1988	Aug. 1989
Orchardgrass						
3	35	31.0	27.0	28.4	40.0	36.6
12	35	31.0	27.0	31.8	45.2	43.6
Timothy						
3	5	8.5	8.2	7.4	8.6	9.8
12	5	8.5	8.2	6.8	8.2	7.3
Clover						
3	60	60.5	64.8	64.2	51.4	53.6
12	60	60.5	64.8	61.4	46.6	49.1
Total mix						
3	100	100.0	100.0	100.0	100.0	100.0
12	100	100.0	100.0	100.0	100.0	100.0

CONCLUSIONS

- Prescriptions for species composition and forage seed rates should be calculated according to the actual seed weights in the mix rather than long-term average seed weights.
- Seeding prescriptions should be based on the desired composition and density of the forage stand.
- Prescriptions for seed mixes and rates should be developed on a site association basis and evaluated according to their capability of producing forage and their interactions with conifers.

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