# E S T A B L I S H M E N T  A N D  S U R V I V A L
# O F  G R O U N D  C O V E R  P L A N T I N G S
# O N  D I S T U R B E D  A R E A S  I N  A L B E R T A

Progress Report #4

SOILS

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# DISTURBED AREAS REVEGETATION STUDY

## REPORT #4

### Introduction

This is the fourth report in this series of reports on the revegetation of disturbed non-cultivated areas in Alberta. It presents a change in emphasis from the previous reports. The first three reports dealt mainly with the vegetation using the soil zones as boundaries for the different climatic regions in the province. Coarse textured soils were separated from the finer textured ones also. In this report an attempt has been made to relate the vegetation to a group of soil factors as well as climate and to examine the soil texture in more detail. The soil properties measured in the study were pH, conductivity, sulfate, free lime, organic matter, sodium, potassium, phosphorus, and texture.

### Objectives

To determine the effect of selected soil properties on plant communities and selected species.

To see what soil properties may be of value in revegetation studies and in planning revegetation projects.

To see to what extent these soil properties must be taken into account. That is, are they likely to be important in small localized areas only, or are they likely to be important over much larger areas?

Methods

The soil samples were collected along roadside, pipeline, and powerline rights-of-way at the same time the vegetation was studied. Two soil samples were collected from each site studied. For a description of how the sites were located and studied, see progress reports one, two, and three. One sample was taken to represent the best soil at the site and one to represent the poorest soil at the site, based on vegetation cover.

The soil samples were air dried, ground, and analysed for conductivity, pH, sodium, potassium, phosphorus, sulfates, organic matter, free lime, and texture. These ananlyses were done by the Alberta Soil and Feed Testing Laboratory using their standard fertility analyses. These analyses are routinely used to evaluate the fertility status of agricultural soils. A brief discussion of these analyses has been provided to aid in understanding the data discussed in this report.

Conductivity was measured in mmhos/cm. It is a measure of the total soluble salt concentration in a soil. When the concentration of salts is high, crop growth is reduced and the soil is considered 'saline'. A conductivity of 4.0 mmhos can reduce growth by as much as 50%.

The soils were divided into three classes based on pH. Acid soils were those with a pH of less than 6, neutral soils were those with a pH in the range from 6 to 8, and basic soils were those with a pH of greater than 8.

Sodium was measured in parts per million (ppm). This

measure gives a rough measure of the potential for poor physical structure and restricted rooting in the soil. The higher the concentration of sodium in the soil, the greater the potential for poor physical structure. For this study, the soils were divided into four classes: 0-25, 26-50, 51-100, and greater than 100ppm of sodium present.

Potassium and phosphorus were measured in lbs./acre to give a measure of the available supply of these major nutrients. The levels chosen are related to the levels recommended for field crops because they were the only standards readily available. The soils were divided into three groups based on the amount of potassium present. The three groups were: less than 150 lbs./acre, 150-250 lbs./acre, and greater than 250 lbs./acre. The soils were separated into the following three groups based on the level of phosphorus present: less than 25 lbs./acre, 25-50 lbs./acre, and greater than 50 lbs./acre. In both cases, the lower group included those soils for which the phosphorus or potassium would likely be a critical limiting factor for the production of field crops. The upper group consisted of those soils with more than the amount of potassium or phosphorus recommended for field crops.

An estimate of the amount of organic matter present was made using a nine point scale. One represented the lowest and nine the highest organic matter content. The three classes used were 1-3 low, 4-6 medium, and 7-9 high organic matter content.

Free lime was estimated as the amount of calcium carbonate ($CaCO_3$) present, as measured by the amount of effervescence when

dilute hydrochloric acid (HCl) was added to a sample of dry soil. Four classes were set up, based on the nine point scale used to estimate the presence of free lime. The four classes were: soils without free lime, 1-3 low free lime, 4-6 medium free lime, and 7-9 high free lime.

A manual determination of texture was made using a 6 point scale with 1 being the coarsest and 6 the finest texture. Four classes were used: 1 very coarse, 2 coarse, 3 medium, and 4-6 fine.

The vegetation at each soil site was compared to see what effect the soil properties had on the vegetation. The ten vegetation plots at each site were selected to include as much as possible of the variation in the vegetation of the site. Since this could result in more than the two soil types sampled being included in the vegetation survey only the two vegetation plots beside the soil sampling sites were used to make the above comparisons.

Because these plots were selected to cover a range of variation and not randomly, no statistical tests could be used. All comparisons had had to be done subjectively.

The species selected for use in this report include several species likely to be of importance in revegetation studies and several important weeds. Only the species present often enough for trends to become apparent were included. Several species likely to be important in revegetation studies were excluded because they were not present in the sample plots often enough. Table 9 lists the scientific and common names of the species used in this report.

Results and Discussion

The major differences in plant communities along the rights-of-way studied were correlated with the amount of disturbance involved and the climatic zone the site was located in. Thus roadsides with the greatest amount of disturbance including seeding to agronomic species have plant communities which are very different from the surrounding native plant communities. These communities are largely composed of introduced species of grasses and legumes, weeds, and only a few plants of the native species. Table 8 gives the distribution of the important species along the three types of rights-of-way. Along powerlines where the disturbance is limited to removal of trees in forested areas and to trampling by machinery during construction and maintenance of the line the plant communities are quite similar to the native communities adjacent to the right-of-way. This is particularly true in grassland areas. In forested areas tree removal usually encourages the development of a different ground flora than is present under the tree cover. The degree of difference is related to the density of the tree cover removed. The less dense the tree cover removed the less difference between the ground cover community on the right-of-way and the ground cover community in the undisturbed forest. Pipeline rights-of-way are intermediate between powerline and roadside rights-of-way with respect to amounts of disturbance and plant community composition.

Several of the soil properties measured show differences between the various types of right-of-way including pH, free lime,

sodium, and organic matter (Table 1). Soils with free lime present were the most common along roadsides where 90% of the soils had some free lime and 50% were in the high free lime category. Along pipeline rights-of-way 55% of the soils had free lime present with 20% having high free lime. Powerline rights-of-way had 40% of their soils with free lime and 20% with high free lime.

Very few soils showed a strongly acid soil pH. The majority showed a favorable pH range for plant growth. Roadsides had the highest percentage of strongly basic soils which is a reflection of the amount of disturbance and removal of surface topsoil.

The percentage of soils with 1-25 ppm. of sodium is 60% along roadsides, 85% on pipeline rights-of-way, and 90% on powerline rights-of-way. The percentage of soils in the other three sodium classes decreases from a high in the roadside samples to a low in the powerline right-of-way samples.

With respect to organic matter, 98% of roadside soils, 80% of pipeline right-of-way, and 65% of powerline right-of-way soils fell into the low class. In both the medium and high classes a reverse trend was found.

These differences can be ascribed mainly to the different amounts of disturbance found on the three types of right-of-way. Roadsides have the largest amount of subsoil and parent material exposed because of the cutting and excavation required in highway construction and the necessity to use subsoil and parent materials

for shaping ditches and roadside slopes. As a result, roadsides have the largest percentage of soils with free lime. Pipeline rights-of-way have a lower percentage of soils with free lime because many of the samples were taken from areas on the right-of-way adjacent to the disturbed area created by trenching and burial of the pipeline. Since most of the soil parent materials in Alberta are calcereous, a large percentage of soils with free lime would be expected on sites such as roadsides where the parent material has recently been brought to the surface. On powerline rights-of-way where disturbance by digging is minimal, the lowest percentage of soils with free lime present is found.

This sort of disturbance would also increase the number of exposed soils with medium and high sodium content, and higher conductivity measurements in areas where the parent material was high in sodium or saline. Because the subsoil and parent materials are usually low in organic matter, the amount of disturbance involved also explains the distribution of medium and high organic matter soils on the three types of rights-of-way.

Another important factor affecting the plant community along a right-of-way is the climate of the region it is located in. In the south-eastern portion of the province, the climate is semi-arid and the Mixed Prairie Vegetation of the region reflects this. In the northern half of the province, the climate is cooler and sub-humid resulting in Boreal Forest Vegetation over most of the region. Table 7 shows the distribution of the species included in this report with respect to climate. The soil zone is used as a conveni-

ent boundary indicator for different climatic zones. The brown soil zone indicates the warmest and driest climate. The dark brown, thin black, black, degraded black, and grey wooded soil zones generally represent increasingly cooler and moister climates relative to the brown soil zone.

The large scope of this project, covering three types of disturbed areas throughtout Alberta, made it impossible to study any one area in enough detail to relate in detail plant community differences to soil properties. Climate and amount of disturbance also affect the plant communities to a large extent. Consequently, relating plant communities to soil properties can only be done with caution when using this data. The scope of the project limited the number of plots taken in any one climatic zone and on any one type of right-of-way. The size of the plots (1 $m^2$) limited the amount of information obtainable about a plant community from a small number of plots. The sites were not chosen to represent extremes of the various soil properties resulting in a small number of plots on soils with extremes of the various soil properties. This makes it of doubtful value to relate the plant communities to the soil properties without doing further research specifically designed to answer this question.

In spite of its limitations the data did indicate which species are more tolerant of a wide range in some of the soil properties measured. This information is useful in deciding which species should be used in a particular revegetation project. Tables 2-7 give the distribution of selected species with respect

to the various soil properties measured. Conductivity and sulfates were not included in the discussion because of the very small number of soils with high conductivity or a high sulfate content. Phosphorus was not included because the majority of soils samples had levels of phosphorus below the level recommended for field crops. This indicates the majority of native species should be adapted to the low levels of phosphorus usually found in Alberta soils.

pH (Table 3)

Nothing can be said about the relative abundance of any species on acid soils because of the small number of soils sampled having a pH of less than 6.

The species that were more common on basic soils than on neutral soils were Agropyron cristatum, Circium arvense, and Hordeum jubatum. Species more common on neutral soils included Epilobium angustifolium, Koeleria cristata, Rosa spp. (includes R. acicularis R. arkansana, R. woodsii), and Vicia spp. (includes V. americana V. cracca, and V. sparsifolia). Bromus inermis was more common on high pH soils along roadsides and less common on high pH soils along pipeline and powerline rights-of-way than on neutral pH soils.

The relatively small differences shown indicate that for the range of high pH soils covered by this survey (the highest pH recorded was 9.2), no special treatment of seed mixture is required. A seed mixture designed for neutral soils whould be adequate in most cases. This does not mean that soils with high or low pH levels will not need special management. Additional

research is needed to determine what pH levels will need special management.

Free Lime (Table 4)

The major difference was between soils without free lime and soils with free lime. No trends towards increasing or decreasing abundance of a species with increasing free lime was found.

The species which appear to increase with the presence of free lime are the introduced species and weeds which are more common on disturbed sites. With the exception of Epilobium angustifolium, the species which appear to decrease with the presence of free lime are native species which are more common on undisturbed sites than on disturbed sites. As noted previously, the presence of free lime in a surface sample of a soil is strongly related to the degree of mechanical disturbance and the effect of subsoil and parent materials. It is possible that the changes are due more to the mechanical disturbance than to the presence or absence of free lime. The lack of response of any species in terms of increased or decreased abundance to increasing free lime supports the suggestion that the presence of free lime is less important than the mechanical disturbance.

Sodium (Table 5)

With increasing sodium content in soils only three weed species increased in abundance. They were Agropyron repens, Hordeum jubatum, and Sonchus arvensis. One species which showed little change with increasing sodium content was Agropyron trachycaulum. Bromus inermis, Koeleria cristata, Medicago sativa, Epilobium angustifolium, Rosa

spp., and Vicia spp. decreased in abundance on soils with increasing amounts of sodium present. Circium arvense, Festuca rubra, Melilotus spp., Phleum pratense, Taraxacum officinale, Trifolium hybridum, T. pratense, and T. repens also decreased in abundance with increasing sodium. However, they reacted differently on roadsides compared to pipeline and powerline rights-of-way. Along roadsides, they were present in significant amounts on soils with greater than 25 ppm. of sodium. They were present only occasionally on soils with greater than 25 ppm. of sodium present along pipeline and powerline rights-of-way. The presence of sodium in the soil was indicated as a causal facter because these species are all present on soils with less than 25 ppm. of sodium present, along pipeline and powerline rights-of-way. This difference may also be related to the mechanical disturbance involved. Soils with a high sodium content tend to have poor physical structure which is often improved by severe mechanical mixing.

The data indicated a definite need to find species suitable for use on undisturbed soils with high sodium content.

The data only indicated one species which might be useful in the revegetation of high sodium soils, namely Agropyron trachycaulum. This means there is a need to look for other species capable of tolerating the conditions associated with high sodium soils. Saline tolerant grasses such as Puccinellia and Distichlis may be useful in this respect.

Texture (Table 6)

Texture classes 1 and 2 correspond to the 'sandy' soils of the previous reports. The remaining texture classes correspond to the

'silty'soils of the previous reports.

Achillea millefolium, Bromus inermis, Festuca rubra, Plantago major, Sonchus arvensis, and Vicia spp. were less common on the very coarse textured soils than the other soils. They showed little change in abundance in the coarse, medium, and fine textured soils. Poa spp., Taraxacum officinale, and Trifolium repens were least common in the very coarse textured soils, somewhat more common in the medium and fine textured soils. Phleum pratense, Trifolium hybridum, and T. pratense increase in abundance as the soil texture became increasingly fine. Medicago sativa followed this trend also with one exception. It had the same abundance in both the coarse and very coarse textured soils. Stipa spp.were most common on medium textured soils. On coarse and very coarse textured soils, they were somewhat less abundant and on fine textured soils much less abundant. The only species which were more abundant on the coarse and very coarse textured soils were the shrubs, Elaeagnus commutata and Rosa spp., and the herb Epilobium angustifolium.

Within the range of soils covered by this survey, there do not appear to be any special problems with respect to revegetation of fine textured soils. There is a problem with coarse and especially with very coarse soils. The low water holding capacity and fertility of coarse textured soils makes the establishment and survival of vegetation on such soils difficult. This fact is verified by the data which shows that the majority of the species included in this report are much less abundant on very coarse textured soils

than on any of the other three textural groups.

Organic Matter (Table 2)

The distribution of the species growing along roadsides cannot be related to organic matter because virtually all of the soil samples were in the low organic matter class.

On pipeline and powerline rights-of-way most of the soils with high and medium organic matter contents were in the thin black and black and degraded black soil zones. This meant those species more common in these soil zones than in the other soil zones were also more common on the medium and high organic matter soils. It is impossible to say whether this is due to the organic matter content of the soils or the climate of the soil zone. This data therefore cannot be used to discuss how the organic matter content of the soil may affect the vegetation.

Potassium (Table 7)

The species which showed increased abundance on soils low in potassium were mainly introduced species. They included Festuca rubra, Taraxacum officinale, Phleum pratense, Rosa spp., and Trifolium pratense. The last three had a higher abuncance in the 150-250 lbs./acre group of soils than in the less than 150 lbs./acre or the greater than 250 lbs./acre groups of soils in which the three species had approximately the same abundance. The species which showed a decrease in abundance with decreasing potassium in the soil were native species with one exception, Agropyron cristatum. The native species included Bouteloua gracilis, Hordeum jubatum, Koeleria cristata, and Stipa spp. A large number of the

species did not seem to be greatly affected by the amount of potassium in the soil. Achillea millefolium, Bromus inermis, Cirsium arvense, Epilobium angustifolium, Medicago sativa, Melilotus spp., Trifolium hybridum, and Vicia spp. were all included in this group. However, this data does not include any information on biomass production on soils with varying levels of potassium and it is probable that the production of biomass will be affected by the level of potassium in the soil.

This study has indicated several soil properties which should be considered when planning revegetation projects. They were sodium, texture, potassium, and, to a lesser extent, free lime. The study was not comprehensive enough to say the other properties do not need to be considered. Additional research designed to discover which of the other soil properties, including the soil organisms, need to be taken into account when revegetation projects are being planned.

Recommendation for the use of the species used in this part of the study will be summarized in the Final Report.

Table 1

The Percentage of the Soils Sampled Having

Different Amounts of the Soil Properties Measured

| Soil Property | | Roadsides | Pipelines | Powerlines |
|---|---|---|---|---|
| Conductivity | <1 mmho/cm | 90 | 88 | 97 |
| | ≥1 + <4 | 9 | 10 | 3 |
| | >4 | 1 | 2 | <1 |
| pH | <6 | 2 | 0 | 6 |
| | 6-8 | 34 | 84 | 79 |
| | >8 | 64 | 16 | 15 |
| Na | 0-25 ppm | 62 | 85 | 90 |
| | 26-50 | 19 | 8 | 4 |
| | 51-100 | 12 | 2 | 3 |
| | >100 | 6 | 5 | 2 |
| $CaCO_3$ | - | 9 | 43 | 59 |
| | Low | 31 | 23 | 19 |
| | Medium | 12 | 15 | 4 |
| | High | 48 | 19 | 18 |
| Texture | 1 Very Coarse | 6 | 8 | 11 |
| | 2 Coarse | 16 | 11 | 26 |
| | 3 Medium | 35 | 54 | 38 |
| | ≥ 4 Moderately Fine to Fine | 43 | 28 | 25 |
| Organic Matter | Low | 98 | 83 | 65 |
| | Medium | 1 | 15 | 25 |
| | High | 1 | 1 | 9 |

Table 2

Distribution of Species on Soils with Different Organic Matter Content Along Pipeline and Powerline Rights-of-Way

| Species | Pipelines | | | Powerlines | | |
|---|---|---|---|---|---|---|
| Organic Matter | Low | Med. | High | Low | Med. | High |
| Number of Plots | 114 | 17 | 1 | 83 | 44 | 19 |
| Achillea millefolium | 1-41 | 0-6 | 0-1 | 1-19 | 1-22 | 1-8 |
| Agropyron cristatum | 7-22 | 0-2 | | 7-9 | 1-2 | |
| A. dasystachyum | 2-3 | | | 1-4 | 1-2 | 0-1 |
| A. repens | 0-4 | | | 1-1 | 0-3 | 0-1 |
| A. smithii | 7-8 | 2-3 | | 0-12 | 2-4 | 0-1 |
| A. trachycaulum | 10-34 | 2-1 | 1-0 | 8-9 | 0-2 | 0-2 |
| A. spp. | 1-3 | 0-2 | | 2-3 | 1-8 | 0-3 |
| Amelanchier alnifolia | 0-1 | | | 0-1 | 0-3 | 0-2 |
| Arctostaphylos uva-ursi | 0-2 | | | 1-1 | | |
| Bouteloua gracilis | 6-12 | | | 6-9 | 1-0 | |
| Bromus inermis | 18-15 | 1-1 | | 10-11 | 10-7 | 3-3 |
| Circium arvense | 1-11 | 0-3 | | 0-3 | 0-5 | 1-0 |
| Elaeagnus comutata | 0-2 | | | 0-3 | 0-3 | 0-1 |
| Elymus glauca | 0-1 | | | 3-4 | 2-2 | 0-1 |
| E. innovatus | 0-2 | | | 2-3 | 1-0 | 1-0 |
| Epilobium angustifolium | 2-8 | | | 0-3 | 1-5 | 0-3 |
| Festuca idahoensis | 2-1 | 0-1 | | 1-0 | 1-0 | |
| F. rubra | 7-4 | 1-1 | | 0-7 | 2-3 | 1-1 |
| F. scabrella | | 1-0 | | | 2-3 | 1-0 |
| F. spp. | 1-0 | 0-1 | | 1-4 | 4-0 | 1-0 |

Table 2 continued

| Species | Pipelines | | | Powerlines | | |
|---|---|---|---|---|---|---|
| Organic Matter | Low | Med. | High | Low | Med. | High |
| Number of Plots | 114 | 17 | 1 | 83 | 44 | 19 |
| Hordeum jubatum | 4-29 | | | 4-11 | 2-5 | |
| Koeleria cristata | 5-16 | 1-4 | | 3-20 | 0-10 | 0-1 |
| Lathyrus spp. | 0-5 | | | | | 0-1 |
| Ledum groenlandicum | 0-3 | | | 0-1 | | 0-1 |
| Medicago sativa | 5-6 | | | 3-2 | 0-1 | |
| Phleum pratense | 9-19 | 0-2 | | 3-6 | 3-2 | 0-2 |
| Plantago major | 0-3 | | | 0-4 | 0-1 | 0-1 |
| Poa spp. | 22-25 | 7-2 | 1-0 | 12-19 | 19-12 | 4-2 |
| Prunus virginiana | | | | 0-2 | 0-1 | |
| Rosa spp. | 4-25 | 0-2 | | 3-26 | 1-20 | 2-9 |
| Salsola kali | 0-15 | | | 1-5 | 0-1 | |
| Sheperdia canadensis | | | | 0-1 | 0-2 | 0-3 |
| Sonchus arvensis | 4-10 | | | 1-2 | 0-1 | |
| Stipa spp | 12-17 | 2-1 | | 17-13 | 3-4 | 0-1 |
| Symphoricarpos occidentalis | 2-16 | 1-2 | | 0-10 | 1-10 | 0-3 |
| Taraxacum officinale | 0-32 | 0-4 | 0-1 | 0-13 | 1-8 | 1-6 |
| Tragopogon dubious | 0-13 | 0-1 | | 2-3 | 0-1 | 0-3 |
| Trifolium hybridum | 14-8 | 0-2 | 0-1 | 1-8 | 0-3 | 0-2 |
| T. pratense | 7-9 | 0-2 | | 1-3 | 0-1 | |
| T. repens | 4-3 | | | 0-2 | 0-1 | |
| Vicia spp. | 1-19 | 0-2 | 0-1 | 1-7 | 0-11 | 0-5 |

Table 3

Distribution of Species on Soils with Different pH's Along Roadside, Pipeline and Powerline Rights-of-Way

| Species | Roadside | | | Pipeline | | Powerline | | |
|---|---|---|---|---|---|---|---|---|
| pH | <6 | 6-8 | >8 | 6-8 | >8 | <6 | 6-8 | >8 |
| Number of Plots | 4 | 66 | 123 | 111 | 21 | 7 | 119 | 20 |
| Achillea millefolium | 0-2 | 1-27 | 0-31 | 1-40 | 0-8 | 0-4 | 2-40 | 1-5 |
| Agropyron cristatum | | 7-12 | 31-27 | 6-18 | 1-6 | 1-1 | 6-7 | 1-3 |
| A. dasystachyum | | 1-1 | 1-4 | 0-3 | 2-0 | | 2-6 | 0-1 |
| A. repens | | 6-3 | 7-8 | 0-4 | | | 2-2 | 0-1 |
| A. smithii | 0-2 | 0-2 | 0-1 | 9-10 | 0-1 | 0-1 | 2-16 | |
| A. trachycaulum | | 1-4 | 0-8 | 10-28 | 3-7 | 1-0 | 4-13 | 3-0 |
| A. spp. | | | 1-2 | 1-7 | 2-6 | | 3-13 | |
| Amelanchier alnifolia | | 0-1 | | 0-1 | | | 0-6 | |
| Aratostaphylos uva-ursi | | | | 0-2 | | | | 2-0 |
| Bouteloua gracilis | | 0-1 | | 5-10 | 1-2 | 0-1 | 5-4 | 2-4 |
| Bromus inermis | 1-2 | 28-9 | 57-41 | 18-15 | 1-4 | | 19-20 | 1-0 |
| Circium arvense | | 0-9 | 0-29 | 0-10 | 1-4 | | 0-11 | 1-3 |
| Elaeagnus comutata | | 0-1 | 0-1 | 0-1 | 0-1 | | 0-7 | |
| Elymus glauca | | 0-4 | 0-1 | 0-1 | | 1-2 | 3-4 | 1-1 |
| E. innovatus | | 1-1 | 0-5 | 0-2 | | | 4-2 | 0-1 |
| Epilobium angustifolium | 0-3 | 1-12 | 0-10 | 207 | 0-1 | 0-1 | 2-9 | |
| Festuca idahoensis | | | | 1-2 | 1-0 | | 2-0 | |
| F. rubra | 0-1 | 10-22 | 26-25 | 6-4 | 2-1 | | 2-11 | 1-0 |
| F. scabrella | | | 0-1 | 1-0 | | | 2-2 | |
| F. spp. | | | | 1-0 | | | 5-3 | |
| Hordeum jubatum | 0-2 | 2-7 | 3-28 | 3-23 | 1-5 | 0-1 | 4-12 | 2-3 |
| Koeleria cristata | | 0-4 | 0-5 | 6-18 | 0-2 | 1-1 | 2-23 | 0-6 |
| Lathyrus spp. | | 0-4 | 0-5 | 0-4 | 0-1 | | 0-1 | |

Table 3 continued

| Species | Roadside | | | Pipeline | | Powerline | | |
|---|---|---|---|---|---|---|---|---|
| pH | <6 | 6-8 | >8 | 6-8 | >8 | <6 | 6-8 | >8 |
| Number of Plots | 4 | 66 | 123 | 111 | 21 | 7 | 119 | 20 |
| Ledum groenlandicum | | | | 0-3 | | | 0-2 | |
| Medicago sativa | | 4-10 | 8-29 | 4-5 | | | 1-2 | 1-1 |
| Melilotus spp. | | 1-18 | 12-20 | 7-9 | 0-1 | | 1-7 | 0-2 |
| Phleum pratense | 0-1 | 12-5 | 7-34 | 9-17 | 0-3 | | 6-8 | 0-3 |
| Plantago major | | 0-6 | 0-9 | 0-3 | | | 0-4 | |
| Poa spp. | 0-1 | 12-21 | 26-22 | 29-22 | 1-5 | 1-1 | 30-20 | 4-4 |
| Prunus virginiana | | | | | | | 0-2 | 0-1 |
| Rosa spp. | | 2-11 | 2-15 | 2-20 | 2-7 | 1-3 | 3-47 | 0-4 |
| Salsola kali | | | | 0-10 | 0-5 | | 1-5 | 0-1 |
| Sheperdia canadensis | | 0-1 | 0-1 | | | | 0-5 | 0-1 |
| Sonchus arvensis | | 1-11 | 0-25 | 4-6 | 0-4 | | 1-2 | |
| Stipa spp. | | | | 12-14 | 2-4 | | 16-16 | 4-2 |
| Symphoricarpos occidentalis | | 1-1 | 0-2 | 3-14 | 0-4 | 1-0 | 1-23 | |
| Taraxacum officinale | | 4-31 | 6-65 | 0-32 | 0-5 | 0-1 | 2-21 | 0-4 |
| Tragopogon dubious | | 0-1 | 0-4 | 0-10 | 0-5 | | 1-4 | 1-1 |
| Trifolium hybridum | 1-1 | 7-21 | 8-37 | 12-9 | 2-2 | | 1-13 | |
| T. pratense | | 6-13 | 6-36 | 7-10 | 0-1 | | 1-4 | |
| T. repens | 0-1 | 6-7 | 3-12 | 3-3 | 1-1 | | 0-3 | |
| Vicia spp. | 0-1 | 0-12 | 0-15 | 0-21 | 1-1 | | 1-23 | 0-1 |

TABLE 4

Distribution of Species on Soils With Varying Amounts of
Free Lime Present along Roadside, Pipeline and Powerline Rights-of-way.

| Species | Roadside | | | | Pipelines | | | | Powerlines | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Free Lime | - | Low | Med. | High | - | Low | Med. | High | - | Low | Med. | High |
| Number of Plots | 20 | 60 | 25 | 88 | 58 | 30 | 21 | 24 | 97 | 18 | 9 | 22 |
| Achillea millefolium | 0-6 | 0-23 | 0-8 | 1-23 | 0-18 | 0-17 | 1-8 | 0-5 | 0-34 | 1-8 | 0-1 | 2-6 |
| Agropyron cristatum | 2-1 | 4-16 | 5-6 | 27-16 | 3-9 | 1-4 | 1-6 | 2-5 | 4-7 | 0-1 | 1-1 | 3-2 |
| A. dasystachyum | 0-1 | 1-2 | | 1-2 | 0-1 | 0-1 | 1-1 | 1-0 | 1-4 | 0-1 | | 0-2 |
| A. repens | 1-3 | 9-1 | 0-2 | 2-2 | 0-2 | | 0-2 | | 2-3 | | | |
| A. smithii | | 0-1 | | 0-2 | 8-5 | 0-3 | 1-2 | 0-1 | 2-14 | 0-3 | | |
| A. trachycaulum | | 0-3 | 0-3 | 1-6 | 6-14 | 6-6 | 0-8 | 1-7 | 5-8 | 0-3 | 1-2 | 1-0 |
| A. spp. | 0-1 | 0-2 | 0-2 | 2-5 | 1-5 | | | 1-1 | 1-14 | | | |
| Amelanchier alnifolia | 0-1 | | | | | | | 0-1 | 0-6 | | | |
| Arctostaphylos uva-ursi | | | | | 0-1 | 0-1 | | | | 0-1 | 0-1 | 1-0 |
| Bouteloua gracilis | | | 0-1 | | 3-7 | 0-2 | 1-1 | 2-2 | 7-7 | 0-1 | | 0-1 |
| Bromus inermis | 10-1 | 22-16 | 14-5 | 40-28 | 9-3 | 8-7 | 3-5 | 1-1 | 12-13 | 3-2 | 2-2 | 6-3 |
| Circium arvense | 0-4 | 0-11 | 0-1 | 0-19 | 0-4 | 0-3 | 0-2 | 2-5 | 1-7 | 0-3 | | 0-1 |
| Elaeagnus comutata | | | | 0-2 | | 0-1 | 0-1 | | 0-5 | 0-1 | | 0-1 |
| Elymus glauca | 0-1 | 0-3 | | 0-1 | | | 0-1 | | 4-6 | 0-1 | 1-0 | |
| E. innovatus | | 1-4 | 0-1 | 0-1 | 0-1 | | 0-1 | | 4-2 | | 0-1 | |
| Epilobium angustifolium | 1-4 | 0-14 | 0-3 | 0-2 | 1-5 | 1-1 | 0-2 | 0-1 | 1-8 | 0-1 | | 1-1 |
| Festuca idahoensis | | | | | 1-1 | | | 1-1 | 1-0 | | | 1-0 |
| F. rubra | 1-5 | 12-15 | | 23-21 | 3-1 | 1-2 | 1-1 | 3-1 | 2-4 | 1-3 | 0-1 | 0-3 |
| F. scabrella | | | | 0-1 | 1-0 | | | | 2-2 | | | |
| F. spp. | | | | | 1-0 | | | | 4-2 | 2-0 | 0-1 | 1-1 |

Table 4 Continued

| Species | Roadsides | | | | Pipelines | | | | Powerlines | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Free lime | - | Low | Med. | High | - | Low | Med. | High | - | Low | Med. | High |
| Number Plots | 20 | 60 | 25 | 88 | 58 | 30 | 21 | 24 | 97 | 18 | 9 | 22 |
| Hordeum jubatum | 1-1 | 1-11 | 2-7 | 1-16 | 3-11 | 0-3 | 2-7 | 0-8 | 3-9 | 1-2 | 1-3 | 1-2 |
| Koeleria cristata | 0-1 | 0-1 | 0-4 | 0-3 | 2-15 | 3-0 | 0-3 | 1-2 | 2-23 | 0-1 | 0-4 | 1-3 |
| Lathyrus spp. | 0-2 | 0-3 | 0-2 | 0-1 | 0-2 | 0-1 | 0-1 | 0-1 | 0-1 | | | |
| Ledum groenlandicum | | | | | 0-2 | 0-1 | | | 0-2 | | | |
| Medicago sativa | 1-4 | 3-12 | 1-6 | 7-17 | 1-3 | 2-2 | | 2-1 | 1-2 | | 1-0 | 1-1 |
| Melilotus spp. | 0-3 | 2-18 | 3-9 | 8-29 | 3-3 | 1-1 | 3-4 | 0-2 | 0-4 | 0-1 | 1-3 | 0-1 |
| Phleum pratense | 4-2 | 8-7 | 2-4 | 6-26 | 0-7 | 7-6 | 2-2 | 1-5 | 6-5 | 0-2 | 0-1 | 0-3 |
| Plantago major | 0-1 | 0-7 | 0-5 | 0-2 | 0-3 | | | | 0-2 | | | 0-2 |
| Poa spp. | 3-5 | 11-13 | 6-8 | 18-20 | 15-8 | 6-10 | 6-5 | 3-5 | 26-12 | 6-4 | 1-0 | 2-9 |
| Prunus virginiana | | | | | | | | | 0-2 | | | 0-1 |
| Rosa spp. | 1-6 | 1-7 | 0-1 | 2-12 | 3-8 | 1-10 | 1-4 | 0-7 | 3-35 | 2-6 | 0-2 | 1-12 |
| Salsola kali | | | | | 0-6 | 0-2 | 0-2 | 0-5 | 1-6 | | | |
| Sheperdia canadensis | | 0-1 | | 0-1 | | | | | 0-1 | 0-3 | | 0-2 |
| Sonchus arvensis | 0-4 | 1-10 | 0-5 | 0-14 | 3-2 | 0-2 | 0-5 | 1-2 | 0-2 | | 0-1 | 1-0 |
| Stipa spp. | | 1-0 | | | 9-10 | 2-1 | 1-4 | 2-4 | 17-12 | 1-2 | 2-0 | 0-4 |
| Symphoricarpos occidentalis | 1-1 | | 0-1 | 0-1 | 3-8 | 0-3 | 0-4 | 0-3 | 1-15 | 0-6 | | 0-2 |
| Taraxacum officinale | 2-7 | 4-30 | 2-10 | 2-51 | 0-7 | 0-17 | 0-8 | 0-5 | 0-15 | 0-3 | 0-1 | 0-8 |
| Tragopogon dubious | 0-1 | | | 0-4 | 0-9 | | 0-3 | 0-2 | 1-4 | 0-1 | | 1-1 |
| Trifolium hybridum | 0-9 | 8-22 | 1-5 | 7-23 | 4-3 | 6-2 | 0-5 | 4-1 | 1-5 | 0-2 | 0-3 | 0-3 |
| T. pratense | 2-3 | 2-17 | 3-5 | 5-24 | 2-1 | 2-7 | 1-1 | 2-2 | 1-2 | | | 0-2 |
| T. repens | 0-3 | 5-7 | 2-1 | 1-9 | 1-0 | 2-3 | | 1-1 | 0-2 | 0-1 | | |
| Vicia spp. | 0-4 | 1-8 | 0-3 | 0-4 | 0-9 | 1-6 | 0-4 | 0-2 | 1-12 | 0-5 | | 0-7 |

Table 5

Distribution of Species on Soils With Various Amounts of Sodium Present along Roadside, Pipeline and Powerline Rights-of-Way

| Species | Roadsides | | | | Pipelines | | | | Powerlines | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sodium in ppm. | <25 | 26-50 | 51-100 | >100 | <25 | 26-50 | 51-100 | >100 | <25 | 26-50 | 51-100 | >100 |
| Number of Plots | 121 | 37 | 23 | 12 | 115 | 11 | 1 | 5 | 132 | 4 | 6 | 4 |
| Achillea millefolium | 1-43 | 0-10 | 0-6 | 0-1 | 1-42 | 0-3 | 0-1 | 0-2 | 3-45 | 0-2 | 0-2 | |
| Agropyron cristatum | 28-24 | 6-9 | 2-2 | 2-5 | 6-22 | 1-2 | | 0-1 | 6-9 | 1-0 | 0-1 | 1-1 |
| A. dasystachyum | 1-3 | 1-1 | 0-2 | | 2-3 | | | | 2-7 | | | |
| A. repens | 5-5 | 4-2 | 3-2 | 1-1 | 0-4 | | | | 2-3 | | | |
| A. smithii | 0-1 | 0-2 | | | 8-7 | 1-3 | 0-1 | | 1-17 | | 1-0 | |
| A. trachycaulum | 1-10 | 0-1 | | 0-1 | 10-29 | 2-4 | 0-1 | 0-1 | 5-9 | 1-2 | 1-1 | 1-1 |
| A. spp. | 2-5 | 0-2 | | 0-2 | 1-6 | 1-0 | | | 2-11 | | 0-2 | 1-0 |
| Amelanchier alnifolia | | 0-1 | | | 0-1 | | | | 0-5 | | 0-1 | |
| Arctostaphylos uva-ursi | | | | | 0-2 | | | | 0-2 | | | |
| Bouteloua gracilis | 0-1 | | | | 6-10 | 0-2 | | | 5-9 | 1-0 | 1-0 | |
| Bromus inermis | 50-34 | 19-8 | 11-6 | 6-4 | 19-15 | 2-1 | | | 21-16 | 0-2 | 0-2 | 2-0 |
| Circium arvense | 0-19 | 0-5 | 0-7 | 0-6 | 2-13 | 0-1 | | | 1-13 | 0-1 | | |
| Elaeagnus comutata | 0-1 | | 0-1 | | 0-2 | | | | 0-7 | | | |
| Elymus glauca | 0-5 | | 0-1 | | 0-1 | | | | 5-7 | | | |
| E. innovatus | 0-3 | 1-0 | 0-2 | 0-1 | 0-2 | | | | 4-3 | | | |
| Epilobium angustifolium | 1-20 | 0-1 | 0-2 | | 2-6 | 0-1 | | 0-1 | 2-11 | | | |
| Festuca idahoensis | | | | | 2-2 | | | | 2-0 | | | |
| F. rubra | 15-29 | 11-8 | 7-5 | 3-1 | 8-5 | | | | 3-10 | | | 0-1 |
| F. scabrella | | | 0-1 | | 1-0 | | | | 2-2 | | | |
| F. spp. | | | | | 1-0 | | | | 7-4 | | | |

Table 5 continued

| Species | Roadsides | | | | Pipelines | | | | Powerlines | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sodium in ppm. | <25 | 26-50 | 51-100 | >100 | <25 | 26-50 | 51-100 | >100 | <25 | 26-50 | 51-100 | >100 |
| Number of Plots | 121 | 37 | 23 | 12 | 115 | 11 | 1 | 5 | 132 | 4 | 6 | 4 |
| Hordeum jubatum | 4-19 | 0-9 | 1-3 | 0-6 | 4-15 | 0-10 | | 0-4 | 4-10 | 0-1 | 0-4 | 2-1 |
| Koeleria cristata | 0-7 | 0-2 | | | 4-19 | 1-0 | 0-1 | 1-0 | 3-28 | 0-2 | 0-1 | |
| Lathyrus spp. | 0-7 | | 0-2 | | 0-5 | | | | 0-1 | | | |
| Ledum groenlandicum | | | | | 0-3 | | | | 0-2 | | | |
| Medicago sativa | 9-17 | 1-10 | 2-6 | 0-2 | 4-6 | 1-0 | | | 1-2 | | 1-0 | 1-1 |
| Melilotus spp. | 7-27 | 3-11 | 1-12 | 1-1 | 7-8 | 0-2 | | | 1-7 | 0-1 | | 0-1 |
| Phleum pratense | 11-26 | 4-8 | 3-3 | 1-2 | 9-18 | | | 0-1 | 6-10 | | | 0-1 |
| Plantago major | 0-7 | 0-3 | 0-3 | 0-2 | 0-3 | | | | 0-3 | | | 0-1 |
| Poa spp. | 16-31 | 8-7 | 7-3 | 7-3 | 29-24 | 0-1 | | 1-2 | 31-20 | 0-4 | 4-0 | 0-1 |
| Prunus virginiana | | | | | | | | | 0-2 | | 0-1 | |
| Rosa spp. | 3-15 | 0-5 | 0-5 | 1-1 | 2-17 | 1-1 | 1-0 | 0-1 | 6-32 | 0-2 | 0-1 | |
| Salsola kali | | | | | 0-12 | 0-2 | | 0-1 | 1-5 | | 0-1 | |
| Sheperdia canadensis | 0-2 | | | | | | | | 0-6 | | | |
| Sonchus arvensis | 0-9 | 0-11 | 0-5 | 1-7 | 28 | 2-1 | | 0-1 | 1-1 | | | 0-2 |
| Stipa spp. | 1-0 | | | | 11-17 | 2-1 | 1-0 | | 18-18 | 1-0 | 0-1 | |
| Symphoricarpos occidentalis | 0-3 | 0-1 | | | 3-17 | | 0-1 | | 1-21 | 0-1 | 0-1 | |
| Taraxacum officinale | 6-54 | 2-21 | 2-12 | 0-9 | 0-36 | 0-1 | | | 1-21 | 0-1 | 0-1 | |
| Tragopogon dubious | 0-3 | | | | 0-13 | 0-1 | | | 2-6 | | | |
| Trifolium hybridum | 15-33 | 5-12 | 2-8 | 1-6 | 14-11 | | | | 1-12 | | | 0-1 |
| T. pratense | 7-29 | 2-8 | 3-8 | 0-4 | 7-11 | | | | 1-3 | | | 0-1 |
| T. repens | 5-9 | 2-7 | 1-3 | 0-1 | 4-3 | | | | 0-3 | | | |
| Vicia spp. | 1-17 | 0-2 | 0-3 | | 1-21 | 0-1 | | | 1-22 | | | |

Table 6

Distribution of Species on Soils of Different Textures Along Roadside, Pipeline and Powerline Rights-of-way

| Species | Roadsides | | | | Pipelines | | | | Powerlines | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Texture[1] | 1 | 2 | 3 | ≥4 | 1 | 2 | 3 | ≥4 | 1 | 2 | 3 | ≥4 |
| Number of Plots | 15 | 34 | 69 | 74 | 10 | 14 | 63 | 35 | 14 | 50 | 55 | 26 |
| Achillea millefolium | 1-7 | 0-14 | 0-19 | 0-18 | 0-2 | 0-5 | 1-24 | 0-17 | 0-3 | 1-20 | 1-19 | 1-7 |
| Agropyron cristatum | 4-1 | 5-4 | 9-19 | 20-15 | 1-1 | 0-2 | 5-14 | 1-7 | 0-1 | 1-2 | 2-5 | 5-3 |
| A. dasystachyum | | 0-2 | 1-1 | 1-2 | 0-1 | 1-1 | 1-1 | 1-0 | | 1-3 | 1-3 | 0-1 |
| A. repens | 1-1 | 1-1 | 7-4 | 4-3 | | 0-1 | 0-1 | 0-2 | | 1-1 | 1-2 | |
| A. smithii | | | 0-3 | | 1-0 | 1-0 | 6-11 | | 0-1 | 0-8 | 1-7 | 1-1 |
| A. trachycaulum | | | 1-6 | 0-6 | 1-4 | 0-1 | 10-17 | 2-14 | 0-1 | 2-5 | 5-3 | 1-4 |
| A. spp. | | 0-2 | 2-1 | 0-6 | | 0-2 | 0-3 | | 0-3 | 1-5 | 1-1 | 1-5 |
| Amelanchier alnifolia | | | | 0-1 | | | 0-1 | | 0-2 | 0-4 | | |
| Arctostaphylos uva-ursi | | | | | | | | 0-2 | 1-0 | | | 1-0 |
| Bouteloua gracilis | | | 0-1 | | 0-3 | 0-2 | 5-7 | 1-0 | 2-1 | 2-2 | 2-4 | 1-2 |
| Bromus inermis | 8-3 | 22-7 | 26-24 | 31-18 | 3-1 | 3-1 | 8-9 | 7-5 | 1-3 | 9-4 | 10-8 | 3-5 |
| Circium arvense | 0-1 | 0-4 | 0-18 | 1-14 | 0-1 | 0-1 | 0-4 | 1-8 | | 0-1 | 1-7 | 0-6 |
| Elaeagnus comutata | 0-1 | | 0-1 | | 0-1 | | 0-1 | | 0-1 | 0-4 | 0-1 | 0-1 |
| Elymus glauca | 0-1 | | 0-3 | 0-1 | | | 0-1 | | 0-3 | 1-2 | 3-2 | 1-0 |
| E. innovatus | | 0-1 | 1-0 | 0-5 | | 0-1 | | 0-1 | | 1-1 | 2-0 | 1-2 |
| Epilobium angustifolium | 0-4 | 0-3 | 1-9 | 0-7 | 0-1 | 0-2 | 2-3 | 0-2 | 0-2 | 0-2 | 1-4 | 0-3 |
| Festuca idahoensis | | | | | | 1-0 | 0-2 | 1-0 | | | 1-0 | 1-0 |
| F. rubra | 2-4 | 6-8 | 16-18 | 12-11 | | | 4-4 | 4-1 | | 1-6 | 2-2 | 0-3 |

1 1 - Very Coarse 2 - Coarse, 3 - Medium, ≥4 - Moderatly fine to fine textured soils.

Table 6 Continued

| Species | Roadsides | | | | Pipelines | | | | Powerlines | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Texture | 1 | 2 | 3 | ≥4 | 1 | 2 | 3 | ≥4 | 1 | 2 | 3 | ≥4 |
| Number of Plots | 15 | 34 | 69 | 74 | 10 | 14 | 63 | 35 | 14 | 50 | 55 | 26 |
| Festuca scabrella | | | 0-1 | | | 1-0 | | | | 2-1 | 0-1 | 1-0 |
| F. spp. | | | | | | 1-0 | | | 0-1 | 2-2 | 3-2 | 2-0 |
| Hordeum jubatum | 0-2 | 1-8 | 3-13 | 1-14 | 0-1 | 0-2 | 3-21 | 1-5 | 1-0 | 2-4 | 1-7 | 2-5 |
| Koeleria cristata | 0-1 | 0-2 | 0-3 | 0-3 | 0-1 | 0-1 | 4-15 | 2-3 | 0-5 | 1-10 | 1-12 | 1-5 |
| Lathyrus spp. | | 0-1 | 0-4 | 0-3 | | 0-1 | 0-2 | 0-2 | | | | 0-1 |
| Ledum groenlandicum | | | | | | | 0-1 | 0-2 | | | 0-1 | 0-1 |
| Medicago sativa | 0-4 | 2-8 | 5-10 | 5-17 | 0-2 | 1-0 | 2-2 | 2-2 | | 0-1 | 1-0 | 2-2 |
| Melilotus spp. | 0-5 | 2-9 | 3-18 | 8-19 | 1-0 | 1-2 | 2-7 | 3-1 | | 0-3 | 1-6 | |
| Phleum pratense | 0-1 | 5-8 | 5-13 | 7-18 | | 1-1 | 4-11 | 4-8 | | 1-6 | 5-1 | 0-3 |
| Plantago major | | 0-5 | 0-9 | 0-1 | | | 0-1 | 0-2 | | 0-2 | | 0-2 |
| Poa spp. | 2-8 | 4-11 | 18-15 | 14-10 | 1-3 | 4-2 | 15-8 | 8-14 | 0-1 | 14-13 | 18-7 | 6-6 |
| Prunus virginiana | | | | | | | | | 0-2 | | 0-1 | |
| Rosa spp. | 1-3 | 0-6 | 0-9 | 3-8 | 1-4 | 0-3 | 2-13 | 1-8 | 2-4 | 2-21 | 2-20 | 1-11 |
| Salsola kali | | | | | 0-1 | | 0-10 | 0-4 | | 0-3 | 0-8 | 0-5 |
| Sheperdia canadensis | | | 0-2 | | | | | | | 0-4 | 0-2 | |
| Sonchus arvensis | 0-1 | 0-8 | 0-8 | 1-16 | 0-1 | 1-1 | 2-7 | 1-1 | | 0-1 | 1-0 | 0-2 |
| Stipa spp. | | | 1-0 | | 2-0 | 2-2 | 10-13 | 0-3 | 1-2 | 7-9 | 9-4 | 4-3 |
| Symphoricarpos occidentalis | | | | | 0-4 | 0-3 | 3-10 | 0-1 | 0-1 | 1-10 | 0-10 | 0-5 |
| Taraxacum officinale | 1-7 | 2-16 | 5-37 | 2-35 | 0-2 | 0-3 | 0-24 | 0-9 | | 2-9 | 0-11 | 0-7 |
| Tragopogon dubious | | 0-1 | | 0-4 | 0-2 | 0-1 | 0-8 | 0-3 | | 0-3 | 2-2 | 0-1 |
| Trifolium hybridum | 0-7 | 1-11 | 7-24 | 8-17 | | 0-2 | 8-3 | 7-5 | | 1-4 | 0-4 | 0-5 |
| T. pratense | 0-2 | 3-11 | 3-17 | 6-19 | | 0-1 | 4-5 | 4-5 | | 0-2 | 1-1 | 0-1 |
| T. repens | 0-1 | 2-4 | 5-9 | 1-6 | | | 2-1 | 2-3 | | | 0-2 | 0-1 |
| Vicia spp. | | 0-2 | 0-8 | 0-8 | 0-1 | 0-5 | 0-8 | 1-8 | | 0-9 | 1-12 | 0-5 |

Table 7

Distribution of Species on Soils with Different Levels of Potassium along Roadside, Pipeline, and Powerline Rights-of-Way

| Species | Roadsides | | | Pipelines | | | Powerlines | | |
|---|---|---|---|---|---|---|---|---|---|
| Level of Potassium (lbs/acre) | <150 | 150-250 | >250 | <150 | 150-250 | >250 | <150 | 150-250 | >250 |
| Number of pltos | 7 | 28 | 158 | 3 | 4 | 93 | 10 | 14 | 122 |
| Achillea millifolium | 0-4 | 0-9 | 1-47 | 1-0 | 0-1 | 0-47 | 1-3 | 1-7 | 1-39 |
| Agropyron cristatum | 1-1 | 2-4 | 35-34 | 1-1 | | 6-22 | | | 8-11 |
| A. dasystachyum | | 0-1 | 2-4 | | | 2-4 | 0-1 | 1-2 | 0-4 |
| A. repens | | | 13-9 | | | 0-4 | 0-1 | | 2-2 |
| A. smithii | | | 0-3 | | | 9-11 | | | 2-17 |
| A. trachycaulum | | | 1-12 | 0-2 | | 13-33 | 0-1 | 0-3 | 8-9 |
| A. spp. | | 1-1 | 1-8 | | | 2-6 | | | 3-14 |
| Amelanchier alnifolia | | | 0-1 | | | 0-1 | 0-1 | | 0-5 |
| Arctostaphylos uva-ursi | | | | | | 0-2 | | | 1-1 |
| Bouteloua gracilis | | | 0-1 | | | 6-12 | | | 7-9 |
| Bromus inermis | 1-4 | 11-6 | 74-42 | 1-0 | | 20-16 | 1-1 | 3-2 | 19-17 |
| Cirsium arvense | | 0-4 | 0-33 | 0-2 | | 2-12 | 1-0 | 0-2 | 0-12 |
| Elaeagnus comutata | | | 0-2 | | | 0-2 | | | 0-7 |
| Elymus grauca | | | 0-5 | | | 0-1 | 0-1 | 1-1 | 4-5 |
| Elymus inovatus | | | 0-6 | | | 0-2 | | 1-2 | 3-1 |
| Epilobium angustifolium | 0-2 | 0-5 | 1-16 | | | 2-8 | | | 2-10 |
| Festuca idahoensis | | | | | | 2-2 | | | 2-0 |
| F. rubra | 2-2 | 6-7 | 28-32 | 2-0 | 1-0 | 5-5 | | 1-5 | 2-7 |
| F. scabrella | | 0-1 | 0-0 | | | 1-0 | 0-1 | | 2-1 |
| F. spp. | | 2-0 | | | | 1-0 | 1-0 | 1-1 | 5-3 |

Table 7 continued

| Species | Roadsides | | | Pipelines | | | Powerlines | | |
|---|---|---|---|---|---|---|---|---|---|
| Level of Potassium (lbs./acre) | <150 | 150-250 | >250 | <150 | 150-250 | >250 | <150 | 150-250 | >250 |
| Number of plots | 7 | 28 | 158 | 3 | 4 | 93 | 10 | 14 | 122 |
| Hordeum jubatum | | 0-6 | 5-31 | 0-2 | | 4-27 | | 0-1 | 6-15 |
| Koeleria cristata | | | 0-9 | | | 6-20 | 0-1 | 0-2 | 3-29 |
| Lathyrus spp. | | 0-1 | 0-4 | | 0-1 | 0-4 | | | 0-1 |
| Ledum groenlandicum | | | | | 0-1 | 0-2 | 0-1 | | 0-1 |
| Medicago sativa | | 0-7 | 12-33 | 2-1 | | 3-5 | | 0-1 | 3-2 |
| Melilotus spp. | 0-2 | 0-7 | 13-42 | | | 7-10 | 0-1 | 0-3 | 1-5 |
| Phleum pratense | 0-2 | 2-6 | 17-32 | 0-2 | 0-3 | 9-15 | | 0-5 | 6-6 |
| Poa spp. | 1-2 | 5-6 | 32-36 | 1-2 | | 29-35 | 1-3 | 3-9 | 31-13 |
| Prunus virginiana | | | | | | | 0-1 | 0-1 | 0-1 |
| Salsola kali | | | | | | 0-15 | | | 1-6 |
| Sonchus arvensis | | 0-4 | 1-29 | | | 4-10 | | 0-1 | 1-2 |
| Stipa spp. | | | 1-0 | | | 14-18 | | 1-0 | 19-18 |
| Symphoricarpos occidentalis | | 0-1 | 1-2 | | | 3-18 | 0-2 | | 1-21 |
| Taraxacum officinale | 0-4 | 1-14 | 9-78 | 0-3 | 0-2 | 0-32 | 0-1 | 0-9 | 2-17 |
| Tragopogon dubious | | | 0-5 | | | 0-14 | | 0-1 | 2-5 |
| Trifolium hybridum | 0-1 | 1-7 | 15-51 | 1-3 | 2-1 | 11-7 | | 1-4 | 0-9 |
| T. pratense | 1-2 | 0-8 | 11-39 | 1-0 | 0-1 | 6-10 | | 0-5 | 1-1 |
| T. repens | 0-1 | 1-2 | 7-17 | | | 4-3 | | | 0-3 |
| Vicia spp. | | 0-3 | 1-16 | 0-1 | 0-1 | 1-20 | 0-2 | 0-7 | 1-15 |

Table 8

Distribution of Species among the Soil Zones and between Roadsides, Pipelines and Powerlines

| Species | Brown | Dark Brown | Thin Black | Black | Degraded Black | Grey Wooded | Roadsides | Pipelines | Powerlines |
|---|---|---|---|---|---|---|---|---|---|
| Number of Plots | 104 | 62 | 60 | 67 | 55 | 123 | 193 | 132 | 146 |
| Achillea millefolium | 0-20 | 1-12 | 0-17 | 2-23 | 0-23 | 2-62 | 1-60 | 1-48 | 3-49 |
| Agropyron cristatum | 27-32 | 11-8 | 7-14 | 3-6 | 2-8 | 3-6 | 38-39 | 7-23 | 8-11 |
| A. dasystachyum | 0-2 | 0-1 | 1-0 | 2-3 | 1-2 | 2-7 | 2-5 | 2-4 | 1-7 |
| A. repens | | 0-3 | 1-1 | 12-6 | 1-2 | 1-4 | 13-9 | 0-4 | 2-3 |
| A. smithii | 7-14 | 3-7 | 1-7 | 0-3 | | | 0-3 | 9-11 | 2-17 |
| A. trachycaulum | 13-31 | 4-7 | 0-4 | 2-4 | 1-2 | 2-12 | 1-12 | 13-35 | 8-13 |
| A. spp. | 1-4 | 3-2 | 0-6 | 1-8 | 0-3 | -4 | 2-9 | 2-6 | 3-14 |
| Amelanchier alnifolia | | 0-1 | 0-3 | 0-4 | | | 0-1 | 0-1 | 0-6 |
| Arctostaphylos uva-ursi | | | 1-0 | 0-1 | | 0-2 | | 0-2 | 1-1 |
| Bouteloua gracilis | 10-20 | 3-2 | | | | | 0-1 | 6-12 | 7-9 |
| Bromus inermis | 21-13 | 18-10 | 22-16 | 22-19 | 22-11 | 26-19 | 86-52 | 21-16 | 23-20 |
| Circium arvense | 1-5 | 0-8 | 0-21 | 1-18 | 0-5 | 1-8 | 0-37 | 2-14 | 1-14 |
| Elaeagnus comutata | | 0-2 | 0-1 | 0-2 | | 0-6 | 0-2 | 0-2 | 0-7 |
| Elymus glauca | | | | 0-2 | 0-3 | 5-8 | 0-5 | 0-1 | 5-7 |
| E. innovatus | | | | 0-1 | 1-2 | 4-8 | 0-6 | 0-2 | 4-3 |
| Epilobium angustifolium | | 0-2 | 1-3 | | 1-5 | 3-31 | 1-23 | 2-8 | 2-10 |
| Festuca idahoensis | | | 1-0 | 3-2 | | | | 2-2 | 2-0 |
| F. rubra | 1-8 | 1-2 | 10-4 | 10-6 | 8-16 | 17-21 | 36-41 | 8-5 | 3-12 |
| F. scabrella | | | 1-1 | 1-1 | | 1-1 | 0-1 | 1-0 | 2-2 |
| F. spp. | 0-1 | | 2-1 | 3-1 | 1-0 | 2-1 | | 1-0 | 7-4 |
| Hordeum jubatum | 4-27 | 4-10 | 1-11 | 1-8 | 3-7 | 2-19 | 5-37 | 4-29 | 6-16 |

Table 8 Continued

| Species | Brown | Dark Brown | Thin Black | Black | Degraded Black | Grey Wooded | Roadsides | Pipelines | Powerlines |
|---|---|---|---|---|---|---|---|---|---|
| Number of Plots | 104 | 62 | 60 | 67 | 55 | 123 | 193 | 132 | 146 |
| Koeleria cristata | 5-34 | 3-9 | 0-11 | 1-4 | | 0-2 | 0-9 | 6-20 | 3-31 |
| Lathyrus spp. | | | | 0-1 | 0-6 | 0-7 | 0-5 | 0-5 | 0-1 |
| Ledum groenlandicum | | | | | 0-2 | 0-3 | | 0-3 | 0-2 |
| Medicago sativa | 3-2 | 3-9 | 4-7 | 0-16 | 6-10 | 4-5 | 12-40 | 5-6 | 3-3 |
| Melilotus spp. | 2-10 | 8-5 | 3-7 | 2-9 | 2-15 | 3-26 | 13-51 | 7-10 | 1-9 |
| Phleum pratense | 0-1 | 0-6 | 3-13 | 9-10 | 9-14 | 13-27 | 19-40 | 9-20 | 6-11 |
| Plantago major | | | | 0-3 | 0-9 | 0-10 | 0-15 | 0-3 | 0-4 |
| Poa spp. | 12-14 | 16-9 | 22-5 | 28-14 | 10-9 | 15-45 | 38-44 | 30-37 | 35-25 |
| Prunus virginiana | | 0-1 | | 0-1 | | 0-1 | | | 0-3 |
| Rosa spp. | 3-11 | 3-13 | 0-10 | 1-18 | 2-12 | 5-44 | 4-26 | 4-27 | 6-55 |
| Salsola kali | 1-19 | 0-2 | | | | | | 0-15 | 1-6 |
| Sheperdia canadensis | | | | | | 0-8 | 0-2 | | 0-6 |
| Sonchus arvensis | 3-2 | 1-10 | 0-8 | 0-14 | 0-5 | 2-7 | 1-33 | 4-10 | 1-3 |
| Stipa spp. | 21-24 | 12-1 | 2-5 | 0-5 | 0-1 | | 1-0 | 14-18 | 20-18 |
| Symphoricarpos occidentalis | 2-7 | 1-13 | 0-11 | 1-10 | 1-0 | 0-3 | 1-3 | 3-18 | 1-23 |
| Taraxacum officinale | 0-5 | 0-15 | 0-22 | 3-33 | 4-27 | 5-58 | 10-96 | 0-37 | 2-27 |
| Tragopogon dubious | 2-15 | 0-5 | 0-3 | 0-2 | | | 0-5 | 0-14 | 2-6 |
| Trifolium hybridum | | 0-3 | 0-14 | 6-16 | 10-16 | 15-34 | 16-59 | 14-11 | 1-13 |
| T. pratense | | | 0-9 | 3-9 | 6-17 | 11-29 | 12-49 | 7-11 | 1-4 |
| T. repens | | | 0-3 | 1-8 | 7-6 | 4-9 | 8-20 | 4-3 | 0-3 |
| Vicia spp. | 0-3 | 0-3 | 0-6 | 1-8 | 2-10 | 0-35 | 1-19 | 1-22 | 1-24 |

TABLE 9

SCIENTIFIC AND COMMON NAMES OF SPECIES MENTIONED IN THIS REPORT

| Scientific Name | Common Name |
|---|---|
| Achillea millefolium | Common Yarrow |
| Agropyron cristatum | Crested Wheat Grass |
| A. dasystachyum | Northern Wheat Grass |
| A. repens | Quack Grass |
| A. smithii | Western Wheat Grass |
| A. trachycaulum | Slender Wheat Grass |
| A. spp. | Wheat Grass |
| Amelanchier alnifolia | Saskatoon-berry |
| Arctostaphylos uva-ursi | Bearberry |
| Bouteloua gracilis | Blue Gamma Grass |
| B. inermus | Smooth Brome |
| Circium arvense | Canada Thistle |
| Elaeagnus commutata | Silver Willow, Wolf Willow |
| Elymus glaucus | Smooth Wild Rye |
| E. inovatus | Hairy Wild Rye |
| Epilobium angustifolium | Fireweed |
| Festuca idahoensis | Bluebunch Fescue, Idaho Fescue |
| F. rubra | Red Fescue |
| F. scabrella | Rough Fescue |
| F. spp. | Fescue |

Table 9 - continued

| Scientific Name | Common Name |
|---|---|
| Hordeum jabatum | Foxtail Barley |
| Koeleria cristata | June Grass |
| Lathyrus spp. | Pea Vine |
| Ledum groenlandicum | Labrador Tea |
| Medicago sativa | Alfalfa |
| Melilotus spp. | Sweet Clover |
| Oryzopsis hymenoides | Indian Rice Grass |
| Phleum pratense | Timothy |
| Plantago major | Common Plantain |
| Poa. spp. | Blue Grass |
| Prunus virginiana | Choke Cherry |
| Rosa spp. | Wild Rose |
| Salsola kali | Russian Thistle |
| Sheperdia canadensis | Buffalo Berry |
| Sonchus arvensis | Perennial Sow Thistle |
| Stipa spp. | Needle Grass |
| Symphoricarpos occidentalis | Buckbrush |
| Taraxacum officinale | Dandelion |
| Tragopogon dubious | Goatsbeard |
| Trifolium hybridum | Alsike Clover |
| T. pratense | Red Clover |
| T. repens | White Clover |
| Vicia spp. | Vetch |