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An Investigation For Viable Seeds In The Surface Soils of Various Sites In A Mixed Prairie Near The Cedar Bluff Reservoir

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AN INVESTIGATION FOR VIABLE SEEDS IN SURFACE SOILS OF VARIOUS SITES IN A MIXED PRAIRIE NEAR THE CEDAR BLUFF RESERVOIR

being

A master's report presented to the Graduate Faculty of the Fort Hays Kansas State College in partial fulfillment of the requirements for the Degree of Master of Science

by

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INTRODUCTION

To the farmer who wishes to practice clean cultivation, the presence of many weed seeds in the soil presents quite a problem. If the land is fallowed it must be worked at different times during the year to eradicate certain undesirable plants which may appear in great numbers. Even though a practice such as this may be carried on for several consecutive years, weeds will still appear. Obviously, however, the total number of viable seeds may be reduced considerably or eventually exhausted. A count of the species that appeared at different intervals during the fallowing would exhibit a great change, this being due primarily to the period of seed dormancy characteristic of the species. (Chepil, 1946).

To the range man who has not destroyed the natural vegetation with farm implements, the problem is much the same provided that the stability of his range is impaired by factors such as overgrazing or extended periods of drought. Under normal conditions, competition has been too severe for the seeds to germinate and establish themselves as seedlings in any great number.

The soil contains a great many seeds which will germinate when environmental conditions permit, yet in number and proportion as compared to a placid natural vegetation, they are quite different. Factors other than competition and seed dormancy, which may affect the establishment and persistence of the plant, are the method of seed distribution, the quantity of seed produced, and the date of maturity (Chepil, 1946).

The purpose of this study was to determine what species of plants emerge from samples of surface soils taken from various sites in a mixed prairie at the Cedar Bluff Reservoir.

Some phases of this study are:

1. Weekly emergence

   When do annuals reach their peak emergence? Perennials? Which are the most abundant in a study of this type?

2. Effect of cover*

   Do areas of open cover contain more viable seeds than areas of closed cover?

3. Effect of freezing

   How do frozen samples compare to samples which were not frozen? Results in this phase of the study could have been more reliable had the duplicate samples been thoroughly mixed and then separated before one of them was subjected to freezing temperatures.

RELATED STUDIES

Albertson (1937) was the first to separate the mixed prairie association into three basic types. He found short grasses inhabiting the highlands. The hillsides were dominated by mid-grasses of little bluestem and its associates. Tall grasses characterized the ungrazed lowland areas with big bluestem being the chief dominant.

The relative drought resistance of fourteen dominant prairie grasses in their seedling state was studied by Mueller and Weaver (1942). It was found that blue grama showed the greatest drought resistance and western wheatgrass was the least able to survive

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* Cover-(Open and Closed) not referring necessarily to a high or low percentage of basal cover, though often related.

Closed cover-Where either a few or large number of grass stems characteristic of the area were present.

Open cover-Where stems of the dominant grass or grasses were absent. If any vegetation was present, it was very sparse. This also includes areas of heavy debris.

conditions of drought. Sand dropseed was not included in their study. Weaver and Mueller (1942) made an extensive investigation of the role of seedlings in the restoration of midwestern ranges from drought.

The growth and seed yields of native prairie plants near Hays, Kansas, were studied by R. Brown (1942). While the growth and seed yields of many of the native plants waned during the dry year of 1939, sand dropseed produced 172 pounds of seed per acre on a natural revegetation area. Jack rabbits and cottontails are often quite important in introducing some of the common prairie plants into disturbed areas (L. Brown, 1947).

In a study of this type, identification by use of vegetative characters must be relied upon almost exclusively. Shepherd (unpublished, 1938) made some excellent drawings of several of the common forb seedlings showing the cotyledon stage and early postcotyledonous growth. Copple and Aldous (1932) published an excellent account of the identification of certain native and naturalized grasses by their vegetative characters paying some special attention to the very young plants. "Weeds in Kansas" by Gates (1941) gives illustrations of many seedlings of both grasses and forbs. Manuals by Rydberg (1932) and Hitchcock (1950) were found to be invaluable for more detailed information of the forbs and grasses which appeared.

Closely related to the study presented here, is an excellent thesis by Lippert (1947) published by Lippert and Hopkins (1950). It is a study of the viable seeds in surface soils of the mixed prairie association in Ellis County, Kansas. The general plan of procedure in these studies was followed quite closely, though not as extensively.

Not as closely related as the above study, was a publication by Chepil (1946) in which the longevity, periodicity of germination, and the

vitality of seeds is interestingly discussed.

PROCEDURE

September 18 and October 4, 1952 were the days selected for collecting the surface soils. The sites to be sampled were chosen quite at random, but an effort was made to collect at least one set of samples each from the lowland, hilltop, and the slopes.

Two samples, approximately 7 inches square, were taken at each site. A sharp flat spade was used to cut the roots so as to keep seed loss at a minimum. If it appeared that large root systems were probably present, a deeper cut was made to leave enough soil for proper germination and growth. A total of 40 samples was taken.

Before each sample was collected, notes were made with respect to cover, amount of debris, degree and direction of slope, and the dominants in the area. Notes on the latter were taken in hope that it would help in the future identification of the seedlings. Each sample was given a number corresponding to the notes and put into a separate paper container. Each duplicate sample was given the same corresponding number but with the letter "A" following it. The samples which were quite dry due to the summer's drought were stored in a cool dry place to prevent seed germination. The were then sifted through a one-fourth inch screen to remove large stems, roots, and coarse gravel. Finer remnants were allowed to filter through to eliminate possible seed loss. At a later date, all of the samples labeled "A" were subjected to 48 hous of freezing temperature. This was preceded by 24 hours at 14 degrees centigrade.

On November 4, 1952, 15 flats, 20 by 15 inches and 4 inches in depth,

were prepared by placing in them a layer of sterile sand. The soil samples were then spread over the sand and firmly pressed to insure proper conditions for germination. Each soil sample, averaging from one-half to three-fourths inches in depth, was separated by a narrow strip of wood. Most of the flats contained 3 samples each but where large seedling counts were anticipated more space was allowed. Waterings were made by using a fine spray from a hose and later by the use of a hand bulb applicator. Care was taken so as not to wash any seeds or seedlings from the flats.

For each sample, a separate chart was constructed leaving a space for the name of the species, date of emergence, species total, and weekly total. Most of the time the seedlings could not be properly identified before the next weekly check was to be made. Consequently, painted wood toothpicks, each color representing a different week, were placed next to the seedlings present to exclude them from the next count. When growth assured proper identification, the seedling and the toothpick were removed with tweezers and the data recorded. In the event that a large number of seedlings emerged which were obviously the same species, they were given a number and all but a few were removed pending identification. This was done to eliminate competition as much as possible. As the study progressed and the remaining species of plants numbered less than 30, those remaining were transferred to clay pots. In anticipation of more rapid growth, they were subjected to 15 hours of light by natural and artificial means.

The Fort Hays Kansas State College Greenhouse, where the study was made, is maintained at a temperature not lower than 65 degrees F. with an average relative humidity of 45 per cent.

Only those plants which emerged in the first 49 days are included in this study. All surviving plants were given at least a generic classification.

RESULTS

Description of areas

The collection sites for the 40 soil samples were divided into lowland, hillside, and hilltop areas.

Lowland Areas

These areas include 4 samples taken in the big bluestem habitat, 4 in the switchgrass habitat, 4 in the western wheatgrass habitat, and 2 in a habitat of Hooker's dropseed.

Big Bluestem Habitat--Two samples were taken in open cover and two were taken in closed cover of big bluestem. The closed cover phases exhibited a heavy growth and both open and closed cover areas were under approximately 2 inches of debris. The most abundant forbs in the area were Ambrosia spp., Vernonia interior, Amaranthus spp., and Euphorbia marginata.

Switchgrass Habitat--Both open and closed cover phases were taken in the switchgrass type. Approximately 1 inch of debris covered the sampled areas with heavy growth in closed cover. The samples were taken near the above area of big bluestem and the same forbs were in abundance. Euphorbia marginata increased in this area.

Western Wheatgrass Habitat--Open and closed cover phases were taken in an area dominated by western wheatgrass. This back water area had been inundated during the 1951 floods. There was very little plant debris in the area but rabbit pellets were quite abundant. Dominant forbs in the area were Helianthus annus, Leptilon canadense, and Amaranthus spp.

Hooker's Dropseed Habitat--Only two samples both of open cover were taken in any area covered by Hooker's dropseed. This area was located on an ecotone

of big bluestem, side oats grama, and a mixture of buffalo and blue grama grasses. The most abundant forbs were Solidago spp., Ambrosia spp., Aster multiflorus, and Echinacea angustifolia.

Hillside Areas

Included in this group are 4 samples taken in the blue grama habitat, 4 in big bluestem on a gentle south facing slope, 4 in big bluestem on a steep north facing slope, 4 in an area of side oats grama, 2 from an area of buffalo grass on the upper flood plain, 2 on the weedy lower flood plain, and 2 in the little bluestem habitat.

Blue Grama Habitat--Both open and closed cover phases were taken in an area dominated by blue grama grass. The open cover samples were taken in an open rocky area which had no debris and no plant growth. Closed cover exhibited a fairly heavy growth and light debris. Side oats grama was found nearby. The most abundant forbs in the area were Thelesperma gracile, Leucelene ericoides, Ambrosia spp., and Echinacea angustifolia.

Big Bluestem Habitat, Gentle South Facing Slope--Two open and two closed cover phases were taken in big bluestem on a gentle south facing slope. Approximately 2 inches of debris covered the area. Ambrosia spp. was very abundant with Helianthus annuus nearby.

Big Bluestem Habitat, Steep North Facing Slope--On a steep north facing slope, open and closed cover samples were taken in a community of big bluestem. Little bluestem was found above. Growth and debris was heavy. Ambrosia spp., Amorpha canescens, and Echinacea angustifolia were the chief forbs in the area.

Side Oats Grama Habitat--Open and closed cover samples were taken in an area of side oats grama. Blue grama grass was nearby. The area as a whole was quite rocky. Ambrosia spp., Psoralea tenuiflora, Gutierrezia sarothrae,

Cirsium undulatum, Ratibida columnaris, and Solidago spp. were the most abundant forbs in the area.

Buffalo Grass Habitat, Upper Flood Plain--Two samples were taken in closed cover of buffalo grass. This area was on a gentle east facing slope of the flood plain and below the water line only at flood stage. Growth of the dominant grass was heavy. Other grasses in the area were blue grama, sand dropseed, and windmill grass. The dominant forbs were Gaillardia pulchella, Ratibida columnaris, Opuntia macrorrhiza, and Leptilon canadense.

Weedy Lower Flood Plain--Two samples were taken in open cover on the lower flood plain where the buffalo grass had almost been killed out due to frequent and prolonged inundation. Only buffalo grass crowns were present in this disturbed area. The chief forbs were Chenopodium spp., Helianthus annus, Salsola pestifer, Amaranthus spp., and Euphorbia marginata. Seedlings of sand dropseed were also present.

Little Bluestem Habitat--Only two samples of open cover in little bluestem were collected. They were taken on a rocky break. There was no debris and growth was light on the shallow soil. Big bluestem, side oats grama, hairy grama, and hairy dropseed were present in the area. The most abundant forbs were Echinacea angustifolia, Scutellaria resinosa, Aster multiflorus, Psoralea tenuiflora, Petalostemon purpureus, and Morongia uncinata.

Hilltop Area

Only four samples were taken in this area. Two open and two closed cover samples in buffalo grass. The growth was not heavy with light debris in the closed cover. The open cover was taken in a small buffalo wallow which was almost completely denuded. Dominant forbs in the area were Ambrosia spp. and Gutierrezia sarothrae.

Emergence of Forbs and Grasses

During the seven weeks of study a total of 3,746 plants emerged from the 40 soil samples. Of this number, 3,032 plants were forbs of at least 40 species, and 613 plants were grasses comprising at least 18 species and including one plant of spike rush. The remaining 101 plants failed to survive and were not classified.

Both the forbs and grasses that were identified were classified as annual or perennial.

TABLE I

WEEKLY EMERGENCE OF ALL ANNUAL FORBS

	November				December			
Species	4-11	12-18	19-26	27-4	5-11	12-18	18-25	Total
Leptilon canadense	656	369	135	36	27	32	30	1285
Sophia spp.	218	237	34	14	11	4	6	524
Specularia spp.	11	235	125	26	9	4	3	413
Salsola pestifer	102	29	7	3	0	0	0	141
Plantago rhodosperma	59	25	3	0	1	5	3	96
Lepidium densiflorum	55	31	2	0	5	0	0	93
Ammannia coccinea	10	37	7	6	1	1	2	64
Plantago purshii	46	3	6	6	2	0	1	64
Lactuca ludoviciana	30	10	1	0	1	0	0	42
Silene antirrhina	3	30	7	0	0	1	0	41
Androsace occidentalis	7	27	4	2	0	0	0	40
Tithymalus arkansanus	5	9	12	5	1	1	0	33
Chenopodium spp.	4	8	4	0	0	1	0	17
Amaranthus spp.	0	3	7	0	3	2	2	17
Evax prolifera	4	2	0	0	0	0	1	7
Chamaesyce spp.	0	4	1	1	0	0	0	6
Viola rafinesquii	0	3	2	1	0	0	0	6
Croton monanthogynus	0	0	3	0	0	0	0	3
Monolepis nuttalliana	2	0	0	0	0	0	0	2
Gaillardia pulchella	1	0	1	0	0	0	0	2
Weekly Totals	1213	1062	361	100	61	51	48	2896

TABLE II

WEEKLY EMERGENCE OF ALL PERENNIAL FORBS

Species	November				December			Total
	4-11	12-18	19-26	27-4	5-11	12-18	18-25	
Liatris punctata	10	1	3	6	0	1	1	22
Scutellaria resinosa	4	11	1	0	0	0	0	16
Hedeoma camporum	10	5	0	1	0	0	0	16
Callirrhoe involucrata	9	3	0	0	1	0	0	13
Ratibida columnaris	1	7	1	1	1	0	1	12
Stenosiphon linifolius	7	1	1	1	0	0	0	10
Senecio plattensis	0	5	3	1	0	0	0	9
Cogswellia orientalis	0	3	1	1	0	1	1	7
Ambrosia spp.	0	2	2	2	0	0	0	6
Verbena spp.	0	5	0	1	0	0	0	6
Solidago spp.	2	0	2	0	1	0	0	5
Gaura coccinea	0	2	1	0	0	0	0	3
Vernonia interior	0	2	0	1	0	0	0	3
Artemisia spp.	1	1	0	0	0	0	0	2
Grindelia squarrosa	1	0	0	0	0	0	0	1
Meriolix serrulata	1	0	0	0	0	0	0	1
Cirsium undulatum	1	0	0	0	0	0	0	1
Aster oblongifolius	1	0	0	0	0	0	0	1
Hymenopappus corymbosus	0	1	0	0	0	0	0	1
Paronychia jamesii	0	1	0	0	0	0	0	1
Weekly Totals	48	50	15	15	3	2	3	136

There were at least 20 perennial species emerging as compared to 20 of annual forbs. The perennials produced only approximately 4 per cent of the total number of forbs. The annuals reached their peak emergence during the first week of the study while the perennials required until the second week. Mare's tail (Leptilon canadense) was by far the most abundant plant in the study. Tansy mustard (Sophia spp.) and venus's looking-glass (Specularia spp.) rated second and third respectively. Liatris punctata was the most abundant perennial forb but its occurrence was not as widespread as the more numerous annuals.

TABLE III

WEEKLY EMERGENCE OF ALL ANNUAL GRASSES

Species	November				December			
	4-11	12-18	19-26	27-4	5-11	12-18	18-25	Total
Bromus tectorum	72	211	61	11	18	0	2	375
Festuca octoflora	10	8	5	5	3	4	3	38
Hordeum pusillum	0	6	4	6	0	0	1	17
Panicum capillare	0	3	3	2	1	00	3	12
Alopecurus geniculatus	0	0	1	1	0	0	0	2
Setaria spp.	0	0	0	0	0	2	0	2
Weekly Totals	82	228	74	25	22	6	9	446

TABLE IV

WEEKLY EMERGENCE OF ALL PERENNIAL GRASSES

Species	November				December			
	4-11	12-18	19-26	27-4	5-11	12-18	18-25	Total
Sporobolus cryptandrus	1	48	21	10	9	7	1	97
Bouteloua curtipendula	1	7	2	0	6	2	3	21
Agropyron smithii	0	0	1	2	6	1	3	13
Buchloe dactyloides	1	4	0	2	11	1	1	10
Andropogon gerardi	0	00	3	2	3	1	0	9
Chloris verticillata	2	2	0	0	0	1	1	6
Panicum virgatum	0	0	2	1	0	1	0	4
Sporobolus asper	0	0	0	1	0	0	1	2
Bouteloua gracilis	0	1	0	0	0	1	0	2
Andropogon scoparius	0	0	0	0	0	0	1	1
Schedonnardus paniculatus	1	0	0	0	0	0	0	1

Like the forbs, the annual grasses were much more abundant than the perennials. Approximately 84 per cent of the annual grasses were cheat grass (Bromus tectorum). The weedy perennial sand dropseed (Sporobolus cryptandrus) comprised approximately 60 per cent of the perennial species. In a similar study made by Lippert (1947), it was found that sand dropseed furnished 42 per cent of a total of 18,539 plants emerging from square foot samples representing 22 habitats. (See Table VI)

TABLE V

TOTAL WEEKLY EMERGENCE OF ANNUAL AND PERENNIAL FORBS AND GRASSES

Type	4-11	12-18	19-26	27-4	5-11	12-18	18-25	Total
FORBS	1261	1112	376	115	64	53	51	3032
GRASSES	88	290	104	43	47	21	20	613
DEAD-UNCLASSIFIED	28	33	21	8	3	5	3	101
WEEKLY TOTALS	1377	1435	501	166	114	79	74	3746

TABLE VI

TOTAL PLANTS PER SAMPLE, RELATIVE NUMBER IN SQ. FT., AND PER CENT OF GRASSES AND FORBS

	PRESENT STUDY			LIPPERT STUDY (1947)	
Types	Average no. plants per sample	Relative no. in sq. ft.	Per cent* of total	Avg. no. per sq. ft.	Per cent of total
FORBS	75.80	223	80.20	125	45
GRASSES	15.325	45	16.90	155	55
DEAD-UNCLASSIFIED	2.525	7	2.90		
Totals	93.65	275	100	280	100

* Percentage approximate

Cover Comparisons on Lowland, Hillsides, and Hilltop

Data compiled from notes made during sample collections and emergence results are from 32 samples and are presented in the following tables (7 through 12 inclusive). The remaining 8 samples were not considered worthy comparisons. (See description of areas page 6)

TABLE VII

COMPARISONS OF THE NUMBER OF SEEDLINGS OF FORBS FOUND IN CLOSED AND OPEN COVER IN LOWLAND AREAS

TYPE	Big Bluestem		Switch grass		Western wheat		Total
No. of samples	4		4		4		12
ANNUAL SPECIES	CLOSED	OPEN	CLOSED	OPEN	CLOSED	OPEN	
Leptilon canadense	31	42	17	62	121	160	433
Specularia spp.	5	51	32	51	2	179	320
Sophia spp.	5	16	63	23	1	32	140
Plantago rhodosperma	2	3	8	79	0	0	92
Silene antirrhina	0	0	0	40	0	0	40
Androsace occidentalis	9	0	0	4	5	13	31
Plantago purshii	0	0	0	1	1	22	24
Tithymalus arkansanus	5	1	1	5	2	4	18
Chenopodium spp.	0	0	3	5	0	7	15
Lactuca ludoviciana	6	1	1	1	4	2	15
Lepidium densiflorum	0	1	1	1	3	2	8
Ammannia coccinea	0	0	2	2	0	1	5
Chamaesyce spp.	0	0	0	0	3	0	3
Amaranthus spp.	0	0	0	0	1	0	1
Totals	63	115	128	274	143	422	1145
Total closed 334							
Total open 811							
PERENNIAL SPECIES							
Callirhoe involucrata	0	3	1	3	0	3	10
Vernonia interior	1	1	1	0	0	0	3
Ambrosia spp.	0	0	0	3	0	0	3
Solidago spp.	0	2	0	0	0	0	2
Artemisia spp.	0	1	0	0	0	0	1
Hedeoma camporum	0	0	1	0	0	0	1
Grindelia squarrosa	0	0	0	0	0	1	1
Cogswellia orientalis	0	0	0	0	0	1	1
Totals	1	7	3	6	0	5	22
Total closed 4							
Total open 18							

TABLE VIII

COMPARISONS OF THE NUMBER OF SEEDLINGS OF GRASSES FOUND IN CLOSED AND OPEN COVER IN LOWLAND AREAS

(See Forbs Table 7)

TYPE	Big bluestem		Switchgrass		Western wheat		Total
No. of samples	4		4		4		12
ANNUAL SPECIES	CLOSED	OPEN	CLOSED	OPEN	CLOSED	OPEN	
Bromus tectorum	5	1	7	5	253	53	324
Festuca octoflora	0	1	0	2	0	0	3
Hordeum pusillum	1	0	0	0	0	2	3
Panicum capillare	0	0	1	0	0	0	1
Totals	6	2	8	7	253	55	331
Total closed 267							
Total open 64							
PERENNIAL SPECIES							
Sporobolus cryptandrus	0	5	3	2	13	20	43
Agropyron smithii	0	0	0	0	4	9	13
Andropogon gerardi	0	0	0	0	0	9	9
Panicum virgatum	0	0	2	2	0	0	4
Buchloe dactyloides	1	2	0	0	00	0	3
Bouteloua curtipendula	0	0	0	3	0	0	3
Sporobolus asper	0	1	0	0	0	0	1
Andropogon scoparius	0	0	0	0	1	0	1
Eleocharis macrostachya*	0	0	0	0	1	0	1
Totals	1	8	5	7	19	38	78
Total closed 25							
Total open 53							

* a grass-like rush

Data presented in tables 7 and 8 representing plant emergence from 12 soil samples, show the lowland areas to be heavily polluted with viable seeds. Areas of open cover were much more productive, especially when the annual forbs were considered.

The lowland western wheatgrass type produced all of the Agropyron smithii, Andropogon gerardi, and Andropogon scoparius that appeared in the study. (See description of areas page 6)

TABLE IX

COMPARISONS OF THE NUMBER OF SEEDLINGS OF FORBS FOUND IN OPEN AND CLOSED COVER IN HILLSIDE AREAS

TYPE	Blue grama[1]		Big bluestem[2]		Sideoats grama[3]		Big bluestem[4]		Total
No. of samples	4		4		4		4		16
ANNUAL SPECIES	OP.	CL.	OP.	CL.	OP.	CL.	OP.	CL.	
Leptilon canadense	78	103	99	68	20	58	57	55	538
Sophia spp.	8	18	75	36	7	25	80	92	341
Lepidium densiflorum	6	18	7	0	6	16	0	0	53
Lactuca ludoviciana	0	0	7	6	0	3	5	3	24
Plantago purshii	1	8	12	0	0	0	0	0	21
Specularia spp.	14	1	0	0	0	0	0	0	15
Tithymalus arkansanus	1	7	1	0	0	0	2	0	11
Amaranthus spp.	0	0	7	4	0	0	0	0	11
Plantago rhodosperma	0	0	0	0	0	4	0	0	4
Croton monanthogynus	0	0	0	0	0	0	2	1	3
Viola rafinesquii	0	0	3	0	0	0	0	0	3
Chamaesyce spp.	0	0	2	0	0	0	0	0	2
Monolepis nuttalliana	0	0	0	0	2	0	0	0	2
Androsace occidentalis	0	0	0	0	0	0	1	0	1
Totals	108	155	213	114	35	106	147	151	1029
Total open 503									
Total closed 526									
PERENNIAL SPECIES									
Scutellaria resinosa	6	3	0	0	0	0	0	0	9
Liatris punctata	0	3	2	0	0	4	0	0	9
Senecio plattensis	0	0	1	0	0	0	5	3	9
Verbena spp.	0	0	5	0	0	0	0	0	5
Gaura coccinea	2	1	0	0	0	0	0	0	3
Ambrosia spp.	0	0	0	0	0	0	0	2	2
Solidago spp.	0	0	0	0	0	0	0	1	1
Aster oblongifolius	0	0	0	0	0	0	1	0	1
Cirsium undulatum	0	0	0	0	0	1	0	0	1
Callirrhoe involucrata	0	0	1	0	0	0	0	0	1
Ratibida columnaris	0	0	1	0	0	0	0	0	1
Meriolix serrulata	0	1	0	0	0	0	0	0	1
Totals	8	8	10	0	0	5	6	6	43
Total open 24									
Total closed 19									

1, 2, and 3 were collected on a gentle south facing slope.
4 was collected on a steep north facing slope.

TABLE X

COMPARISONS OF THE NUMBER OF SEEDLINGS OF GRASSES FOUND IN OPEN AND CLOSED COVER IN HILLSIDE AREAS

(See Forbs Table 9)

TYPE	Blue grama[1]		Big bluestem[2]		Sideoats grama[3]		Big bluestem[4]		Total
No. of samples	4		4		4		4		16
ANNUAL SPECIES	OP.	CL.	OP.	CL.	OP.	CL.	OP.	CL.	
Bromus tectorum	0	0	12	2	1	0	0	0	15
Hordeum pusillum	0	0	0	0	0	0	10	4	14
Panicum capillare	0	0	0	1	0	2	4	4	11
Setaria spp.	0	0	1	0	0	0	0	0	1
Totals	0	0	13	3	1	2	14	8	41
Total open 28									
Total closed 13									
PERENNIAL SPECIES									
Sporobolus cryptandrus	0	1	10	18	0	0	0	0	29
Bouteloua curtipendula	1	5	0	3	0	4	0	3	16
Chloris verticellata	0	1	0	5	0	0	0	0	6
Schedonnardus paniculatus	1	0	0	0	0	0	0	0	1
Buchloe dactyloides	0	1	0	0	0	0	0	0	1
Bouteloua gracilis	0	0	0	0	0	1	0	0	1
Sporobolus asper	0	0	0	0	0	0	0	1	1
Totals	2	8	10	26	0	5	0	4	55
Total open 12									
Total closed 43									

1, 2, and 3 were collected on a gentle south facing slope.
4 was collected on a steep north facing slope.

Data presented in tables 9 and 10 representing plant emergence from 16 soil samples, indicate a much lower viable seed count on hillside areas compared to areas in the lowland (Tables 7 and 8). There was a marked increase in the number of Sophia spp. appearing and Lepidium densiflorum (pepper grass), which was absent in the lowland, was quite prevalent on the hillsides. The big bluestem type[2] produced the greatest total number of plants in the hillside comparisons. Open cover produced fewer plants than did closed cover. (See description of areas page 7)

TABLE XI

COMPARISONS OF THE NUMBER OF SEEDLINGS OF FORBS AND GRASSES FROM FOUR SAMPLES FOUND IN OPEN AND CLOSED COVER OF THE BUFFALO GRASS IN AN UPLAND AREA

COVER	CLOSED	OPEN	Total
FORBS			
ANNUAL SPECIES			
Salsola pestifer	0	141	141
Leptilon canadense	32	67	99
Ammania coccinea	5	54	59
Specularia spp.	9	10	19
Plantago purshii	18	0	18
Lepidium densiflorum	7	6	13
Sophia spp.	5	0	5
Viola rafinesquii	0	3	3
Androsace occidentalis	1	0	1
Silene antirrhina	0	1	1
Chamaesyce spp.	0	1	1
Gaillardia pulchella	0	1	1
Totals	77	284	361
PERENNIAL SPECIES			
Hedeoma camporum	5	5	10
Cogswellia orientalis	4	1	5
Liatris punctata	2	2	4
Stenosiphon linifolius	3	0	3
Artemisia spp.	0	1	1
Solidago spp.	1	0	1
Ratibida columnaris	1	0	1
Totals	16	9	25
GRASSES			
ANNUAL SPECIES			
Bromus tectorum	12	16	28
Festuca octoflora	24	0	24
Alopecurus geniculatus	0	2	2
Totals	36	18	54
PERENNIAL SPECIES			
Buchloe dactyloides	6	0	6
Sporobolus cryptandrus	2	1	3
Bouteloua curtipendula	1	0	1
Totals	9	1	10

Data presented in table 11 representing plant emergence results from only 4 soil samples, show the upland to be more heavily infested with viable seeds (especially [illegible]) than the hillside, but less than the

lowland. The Russian thistle (Salsola pestifer) made its only occurrence in the entire study in the buffalo wallow open cover. Hedeoma damporum was the dominant perennial forb in this upland area and almost all of the total number in the study occurred in this area. A good share of the total of Festuca octoflora occurred here also.

Again, the forbs were more numerous than the grasses with open cover producing three times the number furnished by the closed cover.

TABLE XII

TOTAL SEEDLING EMERGENCE FROM SAMPLES OF COVER COMPARISONS

COVER	OPEN	CLOSED
FORBS		
ANNUAL SPECIES	1598	937
PERENNIAL SPECIES	51	39
Totals	1649	976
GRASSES		
ANNUAL SPECIES	110	316
PERENNIAL SPECIES	66	77
Totals	176	393
TOTAL (Forbs and Grasses)	1825	1369

The lowland areas produced an average of 140 plants per sample, hillsides 72 plants per sample, and the upland an average of 112 plants per sample.

Remainder of the Study Not Included in the Cover Comparisons

These samples include four taken on the flood plain (2 upper and 2 lower), two taken in open cover of Hooker's dropseed, and two taken in little bluestem open cover. (See description of areas pages 6 and 8)

TABLE XIII

SEEDLING EMERGENCE FROM SAMPLES TAKEN ON THE FLOOD PLAIN

	UPPER	LOWER
FORBS		
ANNUAL SPECIES		
Leptilon canadense	161	14
Sophia spp.	11	1
Evax prolifera	7	0
Lepidium densiflorum	5	5
Plantago purshii	1	0
Gaillardia pulchella	1	0
Amaranthus spp.	0	4
Chenopodium spp.	0	2
Totals	186	26
PERENNIAL SPECIES		
Stenosiphon linifolius	2	0
Liatris punctata	1	0
Hymenopappus corymbosus	1	0
Totals	4	0
GRASSES		
ANNUAL SPECIES		
Bromus tectorum	1	0
Totals	1	0
PERENNIAL SPECIES		
Sporobolus cryptandrus	1	4
Bouteloua curtipendula	1	0
Totals	2	4

Large counts were anticipated in samples from the lower flood plain though the results did not bear it out. However, an indication of its disturbed condition is evidenced by the fact that only weedy species emerged. A large number of seeds of Chenopodium spp. were present on the soil at the time the collecting was done and whether they were not viable or remained dormant is not known.

All of the Evax prolifera that occurred in the study came from the samples from the upper flood plain.

TABLE XIV

SEEDLING EMERGENCE FROM SAMPLES TAKEN IN HOOKER'S DROPSEED

	Total
FORBS	
ANNUAL SPECIES	
Specularia spp.	59
Leptilon canadense	39
Sophia spp.	25
Androsace occidentalis	7
Lepidium densiflorum	6
Tithymalus arkansanus	4
Lactuca ludoviciana	3
Amaranthus spp.	1
Total	144
PERENNIAL SPECIES	
Ratibida columnaris	10
Hedeoma camporum	5
Callirrhoe involucrata	2
Ambrosia spp.	1
Verbena spp.	1
Cogswellia orientalis	1
Solidago spp.	1
Total	21
GRASSES	
ANNUAL SPECIES	
Festuca octoflora	11
Bromus tectorum	7
Total	18
PERENNIAL SPECIES	
Sporobolus cryptandrus	17
Bouteloua gracilis	1
Total	18

TABLE XV

SEEDLING EMERGENCE FROM SAMPLES TAKEN IN LITTLE BLUESTEM

	Total
FORBS	
ANNUAL SPECIES	
Lepidium densiflorum	3
Sophia spp.	1
Leptilon canadense	1
Total	5
PERENNIAL SPECIES	
Liatris punctata	8
Scutellaria resinosa	7
Stenosiphon linifolius	5
Paronychia jamesii	1
Total	21
GRASSES	
ANNUAL SPECIES	
Setaria spp.	1
Total	1

The count emerging from the two samples taken in little bluestem was extremely low. The soil was very poor and a fairly large relative number of those that did emerge did not survive to be identified.

Effects of freezing

TABLE XVI

WEEKLY SEEDLING EMERGENCE FROM FROZEN AS COMPARED TO UN-FROZEN SAMPLES

	4-11	12-18	19-26	27-4	5-11	12-18	18-25	Total
FROZEN	753	750	250	72	60	40	45	1970
UN-FROZEN	624	685	251	94	54	39	29	1776
Weekly Totals	1377	1435	501	166	114	79	74	3746

Though results could have been more accurate if duplicate samples had been mixed and then separated before one of the samples was frozen, it is

of interest that the frozen samples produced the greatest number of plants and that frozen samples reached their peak emergence during the first week while those that were not frozen required until the second week to reach their peak.

DISCUSSION AND SUMMARY

The purpose of this study was to determine what viable seeds are present in surface soils in various areas in a mixed prairie.

Forty 7-inch square samples were sliced by the use of a sharp flat spade. Notes were made concerning dominant plants in the area, the lay of the land, cover, debris, and various other essential data. Duplicate samples were taken at every collecting site and placed in separate labeled paper containers. Each sample was filtered through a one-fourth inch mesh screen to remove large plant remnants and coarse gravel. One-half of the samples (20) were subjected to 48 hours of freezing temperature.

On November 4, 1952, sterile sand was placed in 15 flats, each measuring 20 by 15 inches and 4 inches in depth. The soil samples were poured over the flat and separated by narrow strips of wood. Each sample was firmly pressed to insure good conditions for germination. Waterings were begun on the same day. Emergence counts were made each week for seven weeks. As the plants were identified, they were removed from the flats along with the painted toothpick which indicated the week of emergence. When large numbers of plants of the same species emerged, all but a few were removed and allowed to grow until they could be positively identified.

A total of 3,746 plants emerged in 49 days. Forbs numbered 3032 plants or approximately 80 per cent, grasses and one grass-like plant produced 613 plants or approximately 17 per cent, and 101 plants or approximate-

ly 3 per cent failed to survive and were not classified.

Annual forbs of at least 20 species produced 2,896 plants, reaching their peak emergence during the first week of the study. The perennial forbs of at least 20 species numbering only 136 plants reached their peak emergence during the second week.

Annual grasses of at least 6 species produced 446 plants, reaching their peak emergence during the second week. The perennial grasses of 12 species, including one plant of spike rush, produced 166 plants with maximum emergence occurring during the second week.

Leptilon canadense (hare's tail) proved to be a prolific seeder by providing 35 per cent of the total surviving plants, 44 per cent of the annual forbs, and occurring in 39 of the 40 soil samples. Annual forbs, Sophia spp. and Specularia spp., second and third ranking in total number of plants produced, occurred in 35 and 20 soil samples respectively.

Liatris punctata, the most abundant perennial forbs, comprised approximately 16 per cent of the perennial forbs with 22 surviving plants emerging from 8 soil samples and centering in the 2 samples collected in the little bluestem type. Scutellaria resinosa and Hedeoma camporum each comprised approximately 11 per cent of all the perennial forbs.

Bromus tectorum provided approximately 85 per cent of the annual grasses with 306 plants of a total of 375 emerging from 4 samples of the western wheatgrass type in the lowland. Approximately 58 per cent of the perennial grasses was produced by the weedy sand dropseed (Sporobolus cryptandrus) . One-third of the individuals of this species emerged from 4 samples taken in the lowland western wheatgrass type.

The seeds of the climax perennials were found to be few in number.

Conspicuous by its absence in this study, was sticktight (Lappula occidentalis) which Lippert (1947) found occurring in all of the 22 habitats of his study.

Thirty-two soil samples were used in cover comparisons. It was found that open cover was the most productive of seeds with 1,825 surviving plants, while closed cover furnished 1,369 plants.

Should the limiting factor be removed in open cover, the ground would be quickly covered by germination and growth of the seeds already present in the soil. Should a disturbance occur in closed cover, it would also be quickly repopulated by seeds present in the soil.

The greatest number of plants emerged from a lowland area in the western wheatgrass type. The four samples taken in this area averaged 238 plants per sample. The least number of plants per sample was produced from 2 samples taken on the lower flood plain. An average of 15 plants per sample occurred here. Two samples taken in the little bluestem type were only slightly more productive.

There was some relation between emergence results and notes taken on composition of the area sampled.

At least 25 species were represented in 4 samples of the upland buffalo grass type. At least 22 species appeared in both the 4 soil sampled from the lowland western wheatgrass type and the 4 samples from the lowland switchgrass type.

Freezing of the soil samples evidently stimulated a greater and earlier germination.

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