2-1901

Drought Resistant Forage Experiments at Highmore, S. D., for 1900

S.A. Saunders
South Dakota Agricultural College

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(So. Dak. Bul. No. 70.)

February, 1901. Bulletin 70.

U. S. Experiment Station, South Dakota.

In Connection With the South Dakota Agricultural College.

MILO MAIZE.

Drought Resistant Forage Experiments at Highmore, S. D., for 1900.

DEPARTMENT OF BOTANY.

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Drought Resistant Forage Experiments at Highmore, S. D., for 1900.

DEPARTMENT OF BOTANY.

D. A. SAUNDERS, Botanist.

The co-operative range grass and forage experiments at Highmore were begun in 1899 and were, in connection with the Division of Agrostology, United States Department of Agriculture, continued in 1900. Twelve varieties of perennials and fifteen of annuals were planted in 1900 which were not tried the previous year.

The following is the report of Mr. L. W. Carter who is in charge of the work:

The season of 1900 was a most peculiar one. The rainfall was the greatest for years, but the season, nevertheless, was a most unfavorable one. The winter of 1899 and 1900 was a very dry one. Only a few traces of snow came until the last of March, when eight inches fell. When this thawed it left the ground moist enough to start the grass but no rain fell until the 29th and 30th of April, when there was a rainfall of 3.20 inches. This left the ground moist enough and in fine condition to sprout seeds but it was followed by a protracted drought of about seven weeks. Only 0.47 inches of rain fell in May and none in June until the 14th. The weather was warm for the season of the year and hot winds blew part of the time. The prairies turned yellow, ponds dried up and wells began to fail. The young plants, which sprouted from the seeds sown, dried up and died. Rain came on the 14th of June and revived the grasses and grains. The drought was general over South Dakota and all grasses and grains suffered severely but the cultivated crops, like corn and potatoes, which were well tended did not seem to suffer so much but stood the drought well. Crops suffered some the last of June

but were revived on the 4th and 5th of July by a good rain. Another rain came the 15th of July but the last week of July and the first three days of August were very hot and the hot winds blew almost every day. Everything dried up except some fields of corn which were well cultivated and clean. Corn that was drilled or planted close dried up as though frosted. On the Station grounds two plats planted to corn, in rows, three feet apart and twenty inches in the row, dried out, while the Squaw corn, planted three feet eight inches by three feet, withstood the dry weather well. From the observations on corn this year, experiments in culture and moisture, conservation could be profitably carried on. During the month of August, beginning on the 4th, 7.20 inches of rain fell, and this was followed in September by 4.39 inches of rain. These late rains made a fair corn crop but spoiled all the early hay. Frost which killed the corn came the 20th of September but did not injure the grass which grew during nearly all of October.

The following table gives the rainfall:

	Snow.	Rain.
January	T	T
February	.05	.02
March	15.07	.12
April	.....	3.20
May	.....	.47
June	.....	2.53
July	.....	2.69
August	.....	7.20
September	.....	4.39

Plat A. (1) (See Plate I). A part was sown to smooth Bunch grass (*Poa lævigata*) in 1899. It started early in April but did not grow very much before dry weather set in. After the rains of June 14th and 15th it began to grow again but did not exceed six inches in height. It did not head out but thickened up and formed quite a sod. The balance of this plat was plowed up and sown to smooth Bunch grass May 15th.

The drought killed all the young plants and the ground was mowed to kill weeds. Frosts did not hurt this grass much and it was green until the 1st of November.

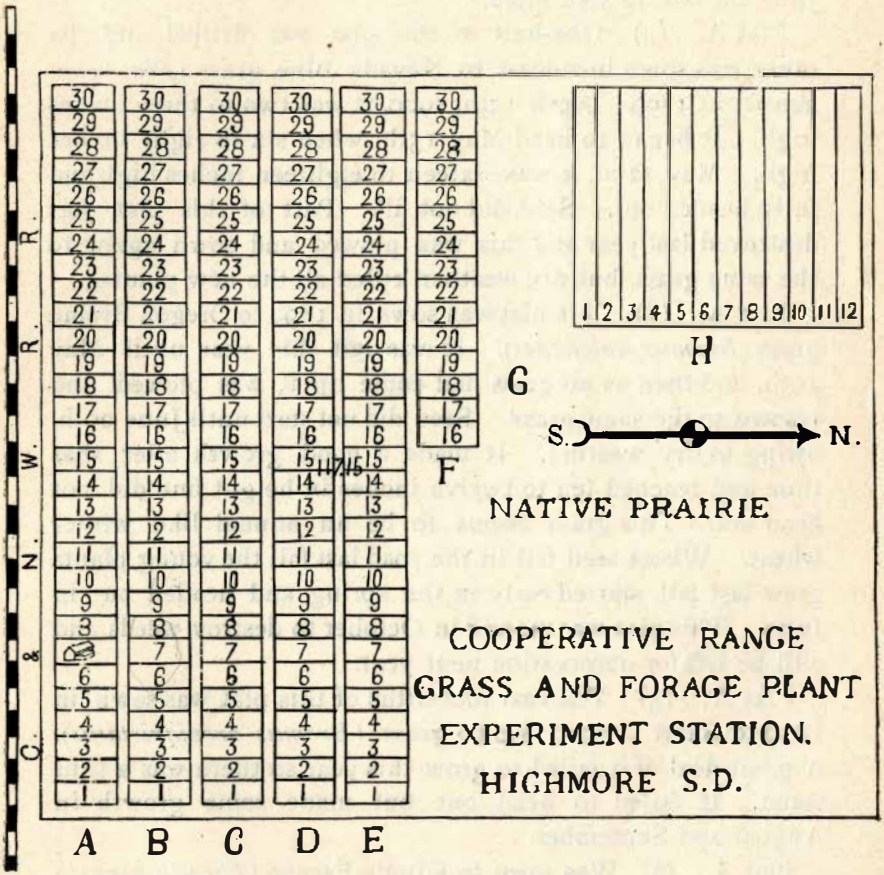

PLATE I.

Plat A. (2) The east half of this plat was sown to a Bunch grass (a form of *Poa lævigata*) in 1899. It made a good growth in May but did not head out owing to the drought. During the latter part of summer it thickened up so as to form a good sod but did not grow more than six inches high. November 1st it was still green.

Plat A. (2) The west half of this was sown to Canadian

Blue grass (*Poa compressa*) in 1899. April 14th it was up two inches high. It made a good growth early in the season. May 15th it was six to eight inches high and it headed out June 1st but no seed filled.

Plat A. (3) One-half of this plat was drilled and the other was sown broadcast to Nevada Blue grass (*Poa nevadensis*) in 1899. April 15th, 1900, it was two to three inches high. It began to head May 15th, when six to eight inches high. May 22nd, it was sixteen to eighteen inches high and fully headed out. Seed did not fill. Part of this plat was destroyed last year and this was plowed and sown again to the same grass, but dry weather killed all the new plants.

Plat A. (4) This plat was sown in 1899 to Oregon Brome grass (*Bromus unioloides*). It was left this year until May 19th, and then as no grass had come up it was plowed and resown to the same grass. Seed did not start until June 20th, owing to dry weather. It made a good growth after that time and reached ten to twelve inches in height but did not head out. This grass seems to be an annual like winter wheat. Where seed fell in the road last fall the young plants grew last fall, started early in the spring and headed out in June. This plat was mowed in October to destroy weeds and will be left for observation next year.

Plat A. (5) The east four-fifths of this plat was sown in 1899 to Short Awned Brome grass (*Bromus breviaristatus*). A great deal of it failed to grow this year so there was a thin stand. It failed to head out but made some growth in August and September.

Plat A. (6) Was sown to King's Fescue (*Festuca kingii*) in 1899. April 15th, it was two to three inches high. It came up nicely but did not make very much growth before the dry weather. It failed to head out but grew to be six inches high in September. November 1st, it was still green, apparently unhurt by the frosts.

Plat A. (7) This plat contains the seed house. Some Russian Wild Olives and Siberian Pea trees were set out on this plat last spring.

Plat A. (8) The east half of this plat was sown broadcast to Bearded Wheat grass (*Agropyrum caninum*). It started early. April 15th, it was two to three inches high, and May 15th, six inches high. It did not head out but thickened up and grew to be eight to ten inches high in August and September.

Nine and one-half yards next west of Bearded Wheat grass were sown to Feather Bunch grass (*Stipa viridula*) in 1899. The stand was thin. April 15th, it was two to three inches high and May 15th, six to eight inches high. It did not head out and did not grow any more on account of the drought. November 1st, it was six to eight inches tall and still green.

Three yards on the west side of this plat were plowed up May 16th, and sown May 17th, to *Festuca elatior*. The seed failed to germinate on account of drought.

Plat A. (9) Sown to Giant Rye grass (*Elymus condesatus*) in 1899. April 15th, it was two to three inches high, leaves broad and bright green; and May 15th, twelve to eighteen inches high. It did not grow thereafter but all dried up and died. It started again in August and grew to be four to six inches high. The leaves were all killed by frost September 20th.

Plat A. (10) This plat was sown broadcast to six lots of Slender Wheat grass (*Agropyron tenerum*) in 1899. April 15th, there was a good stand three to four inches high and May 15th, it stood eight inches high. It did not head out but cured on the ground in June. It began to grow again in July. November 1st, it was six inches high and curing on the ground.

Plat A. (11) This plat was drilled to Slender Wheat grass (*Agropyron tenerum*) in 1899. It headed out June 1st, but seed did not fill. This plat stood the dry weather better than the one sown broadcast. November 1st it was eight to ten inches high and curing on the ground.

Plat A. (12) This was sown in 1899 to Wild Timothy (*Muhlenbergia racemosa*). It made a thin stand by May

15th, when it was two to three inches high. It was mowed July 20th, to kill weeds. It then began to thicken up and grow in August and headed out in September. It was killed by frost September 20th.

Plat A. (13) This plat was sown broadcast in 1899 to Curly Mesquite (*Hilaria cenchroides*), Blue Grama (*Boutelοua oligostachya*) and King's Fescue (*Festuca kingii*). A very thin stand was obtained May 15th; it was just coming up but too thin to keep weeds down. It did not make much growth even after the rains began.

Plat A. (14) This was sown in 1899 to Blue Grama (*Bouteloua oligostachya*). A thin stand was obtained May 15th. It was just starting and June 15th it all dried up. August 15th it became very weedy, but began to grow again. November 1st it was two to three inches high and curing on the ground.

Plat A. (15) This was sown in 1899 to Mixed Grama grasses. April 15th it was just coming up. May 15th it was thin and weedy and two to three inches high. It dried up in June but began to grow in August. It was mowed in August to kill weeds.

Plats A. (16, 17, and 18) Were plowed up and sown to a number of grasses. Owing to the drought the seeds failed to germinate and the ground was cleaned of weeds during August.

Plat A. (16) Was sown to Bromus erectus (*Bromus kalmii*), Bromus tectorium and Agropyron pseudorepens.

Plat A. (17) Was sown to Orchard grass (*Dactylis glomerata*).

Plat A. (18) Was sown to a mixture of Washington Blue grass (*Poa sp*), Wild Timothy (*Muhlenbergia racemosa*), Nevada Blue grass (*Poa nevadensis*) and Smooth Brome grass (*Bromus inermis*).

Plat A. (19 and 20) These plats were sown broadcast in 1899 to Turkestan Alfalfa (*Medicago sativa var. Turkestanica*). These plats wintered in fine condition and, although there was no snow all winter, none of it winter-killed.

It started early in April. May 15th it was six to eight inches high. It did not grow after June 1st until August when it started again and grew until frost killed it. October 1st it was ten to twelve inches high.

Plats A. (22, 23 and 24) Were sown to Western Wheat grass (*Agropyron spicatum*) in 1899. It made a good growth but did not head out. May 15th it was four to six inches high, and September 15th, six to eight inches and thickening up. November 1st it was still green but curing on the ground.

Plats A. (21 and 25 to 29) Were sown to smooth Brome grass (*Bromus inermis*) in 1899. April 15th it was three to four inches tall, good stand and bright green color. It dried up in June and only a little of it headed out. It began to grow again in August and November 1st it was uninjured by frost and from twelve to eighteen inches tall.

Plat B. (1) Was broken last year and plowed deep and planted to potatoes and cultivated so as to be in good condition for next year.

Plat B. (2) Was plowed and planted to Squaw corn May 22nd. It was up May 27th. Some of the seed did not sprout until June 20th. Grew to be four feet high and ripened September 1st.

Plat B. (3) Was drilled to millets June 21st, as follows: twenty-two rows on west side, Japanese Barnyard Millet. (Seed from Division of Agrostology). It was up June 26th. August 1st it was 12 to 16 inches tall and drying up some, but it has withstood the weather pretty well. August 15th it was two feet high and growing nicely. September 15th, it was four to five feet high and ripe. This has proven itself one of our best forage plants this year.

The next forty-one rows were drilled to White Russian Broom Corn Millet (No. 1387. Seed from Section of Seed and Plant Introduction). It was up June 26th, and by August 1st twelve to fourteen inches, and drying up fast, but beginning to head out. September 1st it was eighteen to twenty-four inches tall. Not a very good variety although the seed ripened.

The last eight rows on the east were drilled to Red Veronezh Millet, No. 2796. This is a red Broom Corn Millet. The seed was grown here last year. It was drilled June 21st and up June 26th; July 15, six to eight inches high and beginning to head out. August 1st it had almost dried up, the heads not filling. The dry weather has about killed the whole of it.

Plat B. (4) This plat was drilled to Samarkand and French Alfalfa in rows one foot apart with a garden drill. The first thirty-eight rows on the west side of the plat were drilled to Samarkand or Turkestan Alfalfa, No. 1,295. The east side of the plat was drilled to French Alfalfa (Seed from Section of Seed and Plant Introduction). June 20th both varieties were up; June 28th the plant was cultivated with a wheel hoe. September 1st it was twelve to fourteen inches high and mowed to kill weeds. No difference could be seen this year.

Plats B. (5, 6, 7 and 8) Were sown in 1899 to Turkestan Alfalfa (*Medicago sativa var. Turkestanica*). They wintered in good shape and by April 14th were one to two inches high. By May 15th they were eight to ten inches and beginning to dry up. They did not grow after May 15th, and were mowed July 10th. They began to grow again in August, and by September 15th were twelve to sixteen inches high. Plat B (5) was mowed September 20th. The weight of the dry forage was 275 pounds, or at the rate of 1,100 pounds per acre.

Plat B. (9) Was sown broadcast to Turkestan Alfalfa, No. 991, May 3rd, 1900, at the rate of 28 pounds per acre. It was up May 10th. It suffered from dry weather the first part of June and last part of July. August 1st it was six to eight inches tall and drying up badly. September 1st it was twelve to fourteen inches tall and was killed by frosts September 20th.

Plat B. (10) Was drilled to Australian Salt Bush (*Atriplex semibaccatal.* Seed from Division of Agrostology) May 10th on the following plan: Eleven rows on the west

side, pressed in; eleven rows in the center, seed covered one-half inch; eleven rows on the east side, seed planted one inch deep. The seed did not sprout until June 20th. Only a few plants came on the west side; about fifty per cent. of a stand in the center and twenty-five per cent. of a stand on the east side. August 1st, the plants were six to eight inches high and from one to two feet across. September 1st, they were twelve to fourteen inches high and from two to three feet across. Frost did not seem to affect it much. It was green October 1st, but November 1st it was all dead.

Plat B. (11) Was drilled to Bitter Vetch (Flat Pea, No. 1175, *Lathyrus sativus*) May 11th, in rows thirty inches apart, six inches apart in the row. They were up May 20th and ripe August 1st. At one foot high it stood the dry weather well. After August 4th the suckers began to grow and became two to four feet long but did not ripen the seeds.

Plat B, (12) Was drilled to Milo Maize (seed from Division of Agrostology) in rows thirty inches apart. Twenty rows on west side was Yellow Milo Maize, drilled May 11th and up May 20th; July 2nd, two feet high; August 1st, four feet high; headed out August 18th, five to six feet high; cut September 11th; weighed November 3rd; 990 pounds or at the rate of 6,336 pounds per acre. Twelve rows on east side of plat were drilled to White Milo Maize. It grew more leafy and more suckers than the yellow variety. It was drilled May 11th; sprouted and up May 20th; August 1st, four feet high; August 18th, four and one-half to five feet high; very thick. After the 18th it grew very fast but did not head out. September 15th it was eight to ten feet high and cut for fodder. Two rows were left for seed but they did not head out and were killed by frost. The forage weighed, November 3rd, 1,190 pounds, or at the rate of 12,693 pounds per acre. (See title page.)

Plat B. (13) Was drilled to Common Brown Egyptian Corn or Dhoura (seed from Division of Agrostology) May 11th, in rows thirty inches apart. It came unevenly, giving 50 per cent. of a stand. It was up May 20th and by

August 18th was four feet high and heading out; September 1st, four and one half to five feet high; cut September 11th; weighed, November 3rd, 780 pounds, or at the rate of 3,120 pounds per acre. (See Plate II)

PLATE II—AMBER CANE.

Plat B. (14) Was drilled to Wisconsin Amber Cane (seed for east fourteen rows raised here last year, for twenty rows on the west from Division of Agrostology) May 11th, in rows thirty inches apart. Some came up May 20th and some June 20th; 50 per cent. of a stand; thinner on west side; August 18th, six to seven feet high, heading out; September 11th ripe and cut; weighed, November 3rd, 740 pounds, or 2,950 pounds per acre.

Plat B. (16) Was drilled May 10th to Hairy or Sand Vetch, (*Vicia villosa*, seed from Section of Plant Introduction in 1899) in rows thirty inches apart, six inches apart in the row. The seed failed to germinate and the ground was cleaned.

Plat B. (17) Was drilled for west sixteen rows to March Rape, (seed from Division of Agrostology) May 10th, in rows thirty inches apart. It was up May 22nd and by June 15th

it was four inches high. It stalked up and looked like mustard. The east side sixteen rows, Dwarf Victoria Rape, (seed from J. A. Salzer Seed Company in 1899) was drilled May 10th and up May 22nd; June 15th, four inches high; grew fast after August 4th; August 18th, two feet high, very rank growth; September 1st, cut and weighed green at the rate of 26,880 pounds per acre. September 20th single plants weighed twenty-three pounds. (See Plate III.)

PLATE III—RED ORENBURG MILLET.

Plats B. (18 to 30) The plats were plowed, dragged, planked and sown to grasses. The drought killed all the young plants.

Plats B. (25 to 30) One and one-half acres were sown to Smooth Brome grass, (*Bromus inermis* seed from South Dakota Experiment Station). There is 10 per cent. of a stand

on these plats of Smooth Brome grass. September 1st it was six to eight inches tall.

Plat C. (1) Was raw prairie broken last year, plowed deep and planted to potatoes and cultivated so as to be ready for next year.

Plats C. (2 and 3) Were sown broadcast April 30th to Goose Wheat. (Seed from Minnesota Experiment Station). It was up May 5th and made a good growth at first, but the dry weather killed all the stools and the Russian thistles came in thick. It was mowed August 15th and ruined by rain so it could not be threshed. It would not have yielded more than four to five bushels per acre.

Plats B. (4 and 5) Were sown to early oats May 1st and killed by the dry weather the first part of June.

Plats B. (6 and 11) Were sown to Russian Speltz May 3rd, at the rate of sixty pounds per acre. (Seed from South Dakota Experiment Station, Brookings). It was sown broadcast and pulverized in and then dragged. It was up May 9th and made a good growth and seemed to stand the dry weather well. It headed out July 1st, but the heads were very short. After the rain of July 4th the stools came on and headed out so that it ripened unevenly. It was mowed August 15th and the yield estimated at four to five bushels per acre.

Plat C. (12) East six yards was sown broadcast to Yaroslaf Speltz No. 2789 and the remainder of plat to Russian Buckwheat No. 2801. Sown May 14th. Dry weather killed all the young plants and the ground was cleaned.

Plat C. (13) Was drilled May 15th to a number of imported wheats, oats, barley and speltz, also nine rows bitter vetch 1175, two rows horse beans (*vicia faba*) and six rows white soy beans. This plat was very foul with pigeon grass and Russian thistle. The dry weather killed all the young plants and plat was cleaned.

Plat C. (14) Was sown broadcast to Red Orenburg Broom Corn Millet No. 2960. This is a heavily seeded millet with a close, compact head. It was sown May 23rd and was up June 18th; July 30th, twelve to fourteen inches high,

beginning to head. After the rain of August 4th the stool came on and headed out, which made the millet very uneven. This millet is rather low, but stood the dry weather much better than any of the other broom corn millets except the black Voronezh. (See Plate IV).

PLATE IV—TAMBOV MILLET.

Plat C. (15) Was sown broadcast May 23rd to Tamboy Broom Corn Millet No. 2794, and was up June 20th. This is a red broom corn millet. August 15th it was about two feet high. It was badly damaged by the hot winds the last week in July. It was cut with a binder September 6th. The seed was badly mixed with pigeon grass seed.

Plat C. (16) Was sown broadcast May 23rd to Red Russian Broom Corn Millet, No. 2797. It was up June 20th. No difference could be seen between this and the preceding plat.

Plat C. (17) Was sown broadcast May 23rd to a white variety of Kursk Millet (*Chætochloa italica*) No. 2798. I was up June 20th; August 1st, eight to twelve inches high. After the rain of August 4th it made a good growth and headed out thirty to thirty-six inches high.

Plat C. (18) Was sown broadcast May 23rd to a red variety of Kursk Millet (*Chætochloa italica*) No. 2798. This was a very rank grass and stood the dry weather and hot winds the best of the foxtail millets. It was up June 20th and by August 1st twelve inches high; headed out August 20th, thirty-six inches high. (See Plate V).

PLATE V—RAPE.

Plat C. (19) Was sown broadcast May 23rd to Black Voronezh Millet (*Panicum miliaceum*) No 2795. It was up June 20th and stood the drought well, growing to be thirty inches

tall. Seeds black, large and heavy. This millet is grown for seed but is not so good for hay. It headed out August 15th and was cut September 6th, when ripe.

Plat C. (20 to 30 inclusive) Were broken up and sown broadcast to common millet to keep the weeds down.

Series D. This series was broken up and planted under the direction of Professor Saunders and Professor Shaw of Minnesota. Some experiments in green manuring were to be tried but owing to the dry weather the green manure did not grow.

Plats D. (1 to 21) Were planted to White Dent corn and Squaw corn. The White Dent corn did not come very good and was poor. The Squaw Corn stood the dry weather well and made good fodder, about one ton per acre. When all the other varieties of corn were dried up the last of July the Squaw corn was apparently uninjured.

Plats D. (22 and 23) Were planted to eight varieties of corn as follows: Triumph, Mercer, North Dakota, Red Flint, Silver Dent, Silver Mine, Minnesota No. 13, and Mastadon. All these dried out badly the last week in July and although they got green again after the rain of August 4th, there were no ears on the plats.

Plat D. (24) Left vacant to be harrowed and cultivated.

Plats D. (25 and 26) Were sown broadcast to common millet, one plat to be mowed and the other plat plowed under when twelve inches high. It was sown May 12th; the seed did not come and ground had to be mowed to kill weeds.

Plat D. (27) Was drilled May 12th, to Squaw Corn, rows one foot apart, to be plowed under when one foot high. Corn did not sprout until June 20th, and plat had to be mowed to kill weeds.

Plat D. (28) Was drilled to Bitter Vetch, No. 1175, in rows one foot apart to be plowed under when one foot high. The seed did not grow until June 20th.

Plat D. (29) Was sown broadcast May 12th, to Sweet Clover to be plowed under when one foot high. All of these

last plats dried out. The seed did not sprout and the weeds had to be mowed to keep the ground clean.

Series E was broken up and sowed broadcast to common millet to keep the ground clean.

Series F was laid out from Plat 16 to 30. Plats 16, 17, 18 and 19, one acre, were on ground that had not been plowed for eight years and it was very weedy in places, and in spots the Wheat grass had started. These plats were pulverized each way, sown broadcast with fourteen pounds of Bromus Inermis and then dragged. The dry weather kept the seed from sprouting until June 20th. September 1st, quite a stand showed and it will be watched with much interest to see if the smooth Brome grass will capture the land.

Almost every farmer here has some land under fence which has been broken and a grass which would quickly cover such ground would be very desirable.

Plats F. (20 to 30) Were broken in June so as to be ready for next year.

A series lettered H. was laid off along the north end of the west side of the grounds. The series is forty rods wide and the plats are four rods by forty, making one acre each. Plats H, (4 and 5) were manured with forty loads of manure and then harrowed to get the manure down to the soil and spread it. A great difference could be seen in the amount of grass on the plats manured. The increase was at least thirty per cent.

Plat H. (6) Was scarified and sown to Bromus Inermis.

Plat H. (7) Was scarified and sown to Poa Nevadensis.

Plat H. (8) Was scarified and sown to Festuca Kingii.

Plats H. (9, 10, 11 and 12). These plats were scarified and left to be sowed in the spring.

The most promising grasses so far tried are the Smooth Brome (*Bromus inermis*), the Western Wheat grass (*Agropyron spicatum*) and the Nevada Blue grass (*Poa nevadensis*).

For strongly alkaline soils the Australian Salt bush and the Mealy Salt bush will be of considerable value. The Mealy Salt bush matures its seed in an ordinary season while

the Australian Salt bush does not; both, however, must be treated as annuals in South Dakota.

The Japanese Barnyard Millet gave the highest yield of the best quality of forage. Although not considered drought resistant it stood the droughts well and made a good growth as soon as the drought was broken.

Black Voronezh, a variety of Broom Corn Millet, is the most promising seed millet.

Rape made a good growth in 1900 but the exceptionally heavy late rains were uncommonly favorable to it. If it can be depended on to give as largea yield in ordinary seasons it will be one of the most valuable annual crops.

The canes proved more drought resistant than the corns, White Milo Maize, a non-saccharine variety, giving the largest yield. The season, however, was exceptionally favorable to the canes and unusually unfavorable to the growth of corns.