# TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho – Salt Lake City, Utah

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## PLANT MATERIALS SALINITY TRIALS

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**This Technical Note provides information on two plant materials salinity trials conducted near Price and Roosevelt, Utah.**

## HASLEM SALINITY TRIAL REPORT – DUCHESNE COUNTY, UTAH

The Haslem Salinity Trial was designed to evaluate the performance of 13 accessions, some traditionally used as well as several new varieties, when grown in saline soils of Duchesne County, Utah. Many farms in the area have had a history of irrigation related problems that have resulted in severe salinity, erosion, and other agronomic limitations. Due to the soil limitations of the area, there has always been some interest in finding species or management techniques that would improve yields.

This salinity tolerance trial tested 13 different varieties or accessions:

1. Greenar intermediate wheatgrass
2. Alkar tall wheatgrass
3. RS Hoffman (natural quackgrass X bluebunch wheatgrass)
4. NewHy hybrid wheatgrass (quackgrass X bluebunch wheatgrass
5. Bozoisky Russian wildrye
6. Fawn tall fescue
7. Magnar basin wildrye
8. Hycrest II crested wheatgrass
9. SYN-A Russian wildrye
10. Tetraploid Russian wildrye
11. M5 giant wildrye X basin wildrye
12. Vinall Russian wildrye
13. Garrison creeping foxtail

The location for the plots was chosen because of the soils (a very heavy clay loam), variable levels of salinity, and access to irrigation. Before the trial, this area was an old alfalfa field with weed and salinity problems. The salinity ranged from 1.7 to 21.7 mmhos. The pH was 7.5 to 8.5; the lower values may have been a result of the buffering capabilities of gypsum. The total water holding capacity was two inches per foot. Whitetop and foxtail barley were prevalent invaders.

Plots of each species were approximately 8 feet wide and 24 feet long. All 13 accessions were planted in the same area and replicated 4 times along the saline gradient resulting in 52 total plots. For irrigation purposes, the plots were designed to fit into one set of a wheel line. The area was seeded in 1993 without fertilizer. Because the test area was an old alfalfa field with weed problems, a post emergent herbicide was used to control the volunteer alfalfa.

### Results

The intermediate wheatgrass and tall wheatgrass had the highest yields and salt tolerance, but the lowest palatability. NewHy and RS Hoffman preformed well, with high yields at lower salinity levels. Bozoisky Russian wildrye had the best performance of the wildrye varieties.

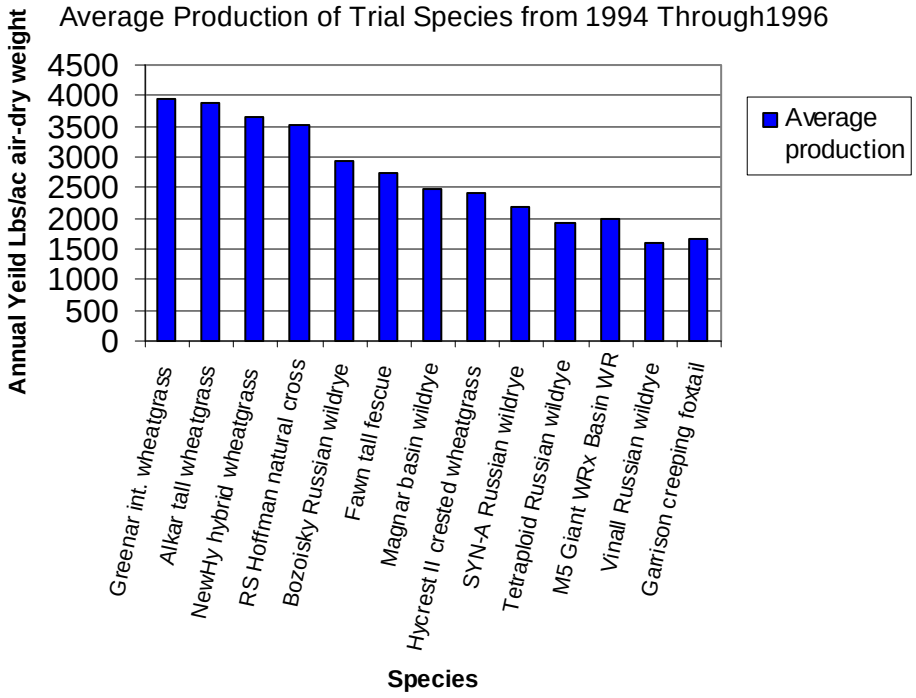
### Observations

| **Plants** | |
|---|---|
| Greenar intermediate wheatgrass | Good salt tolerance and productive, but low palatability. |
| Alkar tall wheatgrass | Tall wheatgrass had very high salt tolerance and high productivity, but low palatability. It provides good standing cover in winter. |
| RS Hoffman | Similar to NewHy in behavior, but appears to utilize nitrogen better and does not display the chlorosis traits that NewHy does. |
| NewHy hybrid wheatgrass | This plant showed high levels of salt tolerance. It had low to moderate germination rates, good seedling vigor, good palatability |

| | |
|---|---|
| | and proved to be productive at low to moderate salinity levels. At high salinity levels, survival was good, but production dropped off dramatically. It also tended to have chlorosis at all salinity levels. |
| Bozoisky Russian wildrye | This variety seeded well, and was moderately salt and drought tolerant. It greened up well in the fall for good fall forage. |
| Fawn tall fescue | Very high drought tolerance and salt tolerance. Low palatability and poor overall production. The plant did not respond well to irrigation during the growing season. |
| Magnar basin wildrye | Productive if a good stand is achieved. It has good traits for cover habitat and standing winter forage crop. However, the plant had sparse establishment and was coarse with low palatability |
| Hycrest II crested wheatgrass | This variety had good early spring and late fall green up. Salt tolerance was low, greater than 7 mmhos the plant was negatively affected. The plant had poor regrowth response to irrigation during the growing season. |
| SYN-A Russian wildrye | Performed similar to Bozoisky Russian wildrye. |
| Tetraploid Russian wildrye | Less productive and vigorous than Bozoisky Russian wildrye. |
| M5 giant wildrye X basin wildrye | This plant had poor establishment and low seedling vigor. However, after 4 years the stand appeared vigorous and it was spreading. |
| Vinall Russian wildrye | This variety did not perform well and had no advantage over Bozoisky Russian wildrye. It had poor establishment and low production. |
| Garrison creeping foxtail | This variety was negatively affected by drought and did not perform well perhaps due to less irrigation than it required. In this trial it did not appeared salt tolerant beyond 6 mmhos. |

**Table 1 – Yield data by species in air-dry pounds per acre**

| Plants | 1994 | 1995 | 1996 | Average production |
|---|---|---|---|---|
| Greenar intermediate wheatgrass | 3,600 | 5,200 | 3,000 | 3,933 |
| Alkar tall wheatgrass | 3,000 | 5,800 | 2,800 | 3,867 |
| RS Hoffman – natural cross | 4,000 | 4,000 | 2,600 | 3,533 |
| NewHy hybrid wheatgrass | 3,600 | 5,200 | 2,200 | 3,667 |
| Bozoisky Russian wildrye | 2,800 | 4,000 | 2,000 | 2,933 |
| Fawn tall fescue | 3,400 | 3,200 | 1,600 | 2,733 |
| Magnar basin wildrye | 2,000 | 3,400 | 1,000 | 2,133 |
| Hycrest II crested wheatgrass | 2,800 | 3,200 | 1,200 | 2,400 |
| SYN-A Russian wildrye | 2,000 | 2,600 | 1,000 | 1,867 |
| Tetraploid Russian wildrye | 2,000 | 2,400 | 1,400 | 1,933 |
| M5 giant wildrye X basin wildrye | 1,800 | 2,800 | 1,400 | 2,000 |
| Vinall Russian wildrye | 1,400 | 2,400 | 1,000 | 1,600 |
| Garrison creeping foxtail | 1,600 | 2,400 | 1,000 | 1,667 |




**Discussion**

With good management nearly all species evaluated do well up to 8 mmhos (similar to the tolerance of barley). On more extreme sites, the options are still limited, but NewHy, RS Hoffman, intermediate wheatgrass and Russian wildrye have potential to be used as alternatives to tall wheatgrass.

Benefits from this project are estimated to be 55 tons per year salt load reduction to the river system, 17 acre feet deep percolation reduction, and a substantial increase in crop production. Brett Prevedel and the landowner initiated the project. Howard Horton with ARS coordinated efforts and completed the planting. If there is further interest in this project, please contact Brett Prevedel at the Roosevelt, UT, NRCS Field Office.

**Photos Haslem Salinity Trial**

## SNOWBALL SALINITY TRIAL REPORT, EMERY COUNTY, UTAH


This trial was designed to test the drought and salt tolerance of several varieties of irrigated forage plants. The replicated plots were established in 1991 and 1992 with the cooperation of several agencies and the landowner.

This salinity tolerance trial tested 18 varieties or accessions.

1. Prairieland Altai wildrye
2. Magnar basin wildrye
3. Shoshone beardless wildrye
4. Revenue slender wheatgrass
5. San Luis slender wheatgrass
6. Tall wheatgrass
7. Monarch cicer milkvetch
8. Garrison creeping foxtail
9. Fawn tall fescue
10. NewHy Hybrid wheatgrass (quackgrass X bluebunch wheatgrass)
11. Birdsfoot trefoil
12. Festorina tall fescue
13. Forager tall fescue
14. Alsike clover
15. Matua rescuegrass or brome
16. RS Hoffman (natural quackgrass X bluebunch wheatgrass
17. Kura clover
18. SP90 Kura clover.

The trial was located near Elmo, Utah on the Richard Snowball farm. This location was chosen because the landowner was very interested in improving his pasture productivity, access to irrigation, and marginal soils. The soil are moderately to highly saline with pH ranges from 8.5 to 8.9 and electrical conductivity (EC) from 5.7 to 20 plus. The area prior to planting was bare ground or covered with salt grass. The test area was 300 x 50 feet and ran east to west. Figure 1 details the plot layout. Within the fenced trial area, three replications of 100 x 40 feet plots were delineated. In each of the replications, species 1 through 10 were seeded in randomly replicated 10 x 40 feet wide strips in the fall of 1991. The entire plot was surrounded by a 5 feet border of NewHy hybrid wheatgrass. In the spring of 1992, species 11-18 were added at the east end with no replications except for the fescues which were replicated. Most grasses were planted with a drill. A few species were planted with plugs. The seedbed was well prepared, but possibly a little

soft. The soil surface was kept damp until all the species germinated. Species in all three replications germinated well. Garrison creeping foxtail and Monarch cicer milkvetch were the last species to come up. Fertilizer, soil amendments, irrigation, and palatability tests were conducted over the seasons and both NRCS and the Emery County Extension have copies of the data.

## Results

Information about relative palatability and salt tolerance and actual yield (clipped weights) were collected for 4 years after establishment. Table 1 summarizes the results by ranking the plants.

**Table 1: Relative Salt Tolerance, Yield and Palatability by species**

| Species/Variety | Salt Tolerance | Yield | Palatability |
|---|---|---|---|
| 1. Tall wheatgrass | **1** | **2** | **16** |
| 2. Shoshone beardless wildrye | **2** | **12** | **9** |
| 3. Prairieland Altai wildrye | **3** | **13** | **17** |
| 4. Magnar basin wildrye | **4** | **14** | **15** |
| 5. Revenue slender wheatgrass | **5** | **9** | **13** |
| 6. San Luis slender wheatgrass | **6** | **11** | **14** |
| 7. NewHy hybrid wheatgrass (quackgrassX bluebunch wheatgrass) | **7** | **7** | **7** |
| 8. RS Hoffman (Natural quackgrass X bluebunch wheatgrass) | **8** | **8** | **8** |
| 9. Fawn tall fescue | **9** | **6** | **12** |
| 10. Festorina tall fescue | **10** | **4** | **10** |
| 11. Forager tall fescue | **11** | **5** | **11** |
| 12. Birdsfoot trefoil | **12** | **18** | **5** |
| 13. Monarch cicer milkvetch | **13** | **1** | **1** |
| 14. Garrison creeping foxtail | **14** | **10** | **6** |
| 15. Alsike clover | **15** | **3** | **2** |
| 16. Kura clover | **16** | **15** | **3** |
| 17. SP90 Kura clover | **17** | **16** | **4** |
| 18. Matua rescuegrass | **18** | **17** | **18** |

## Observations

### Best Production

Grasses – tall fescues, tall wheatgrass, NewHy, slender wheatgrasses (Note: slender wheatgrasses were short lived 3-5 years). The area between the drill rows were almost totally weed free.
Legumes – cicer milkvetch, alsike clover

### Best Mid-Summer Regrowth

Grasses- all fescues
Legumes – alsike clover

### Palatability

Highest – all clovers and cicer milkvetch
High - NewHy, RS Hoffman, Garrison creeping foxtail
Medium – tall fescues, Shoshone, slender wheatgrass
Lowest – tall wheatgrass and wildrye accessions

(Palatability depends on many factors including the time of year, growth stage, moisture content, etc. The above observations were based on use of a small band of sheep during mid season in 1993.)

**Best Irrigated Grasses**

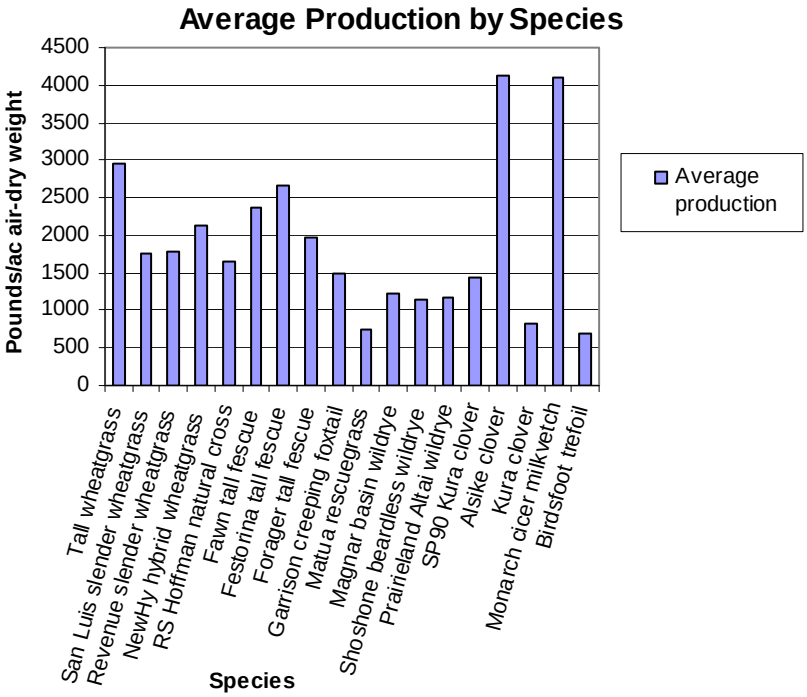
NewHy – Well suited for good to fair soils, easy to establish, and spreads to a heavy stand. Somewhat drought (14 inch + MAP) and very salt tolerant. Good early and late season production and fair regrowth in mid season. Very palatable even in later growth stages

Forager tall fescue – Good yields, easy to establish with good salt and drought tolerance. Good midseason regrowth. Better palatability that older varieties of tall fescue.

Garrison – For best production plenty of water and good fertility is required. It will tolerate dry periods from mid to late growing season. It will not tolerate EC levels much above 10. It is very palatable and likes significantly more water that it received in this study.

## Discussion

Most accessions germinated readily in all of the replications; however, the slender wheatgrass accessions, tall fescue, and NewHy were outstanding with very thick stands established. Tall wheatgrass had the highest tolerance to salinity, the highest production for a grass, but was near the lowest in palatability of the species tested. Much of the data indicate that varieties that were the most salt tolerant were also the lowest in palatability. However, NewHy and RS Hoffman grasses preformed well; being tolerant of salts with moderate production and moderate palatability. Cicer milkvetch and alsike clover had very high yields and were very palatable, but their low tolerance of saline conditions makes them difficult to recommend for use under extremely saline soils conditions.




In the less saline soils (replication 1) weed competition negatively affected establishment. Negative impact from the weeds was reduced through mowing and the irrigation regime. The plots were mowed twice at 3-4 inch height. Unfortunately the mowing treatments severely reduced the wildrye plots productivity. The most prevalent weed was kochia with salt grass, sunflower, bindweed, nightshade, and Russian thistle present.

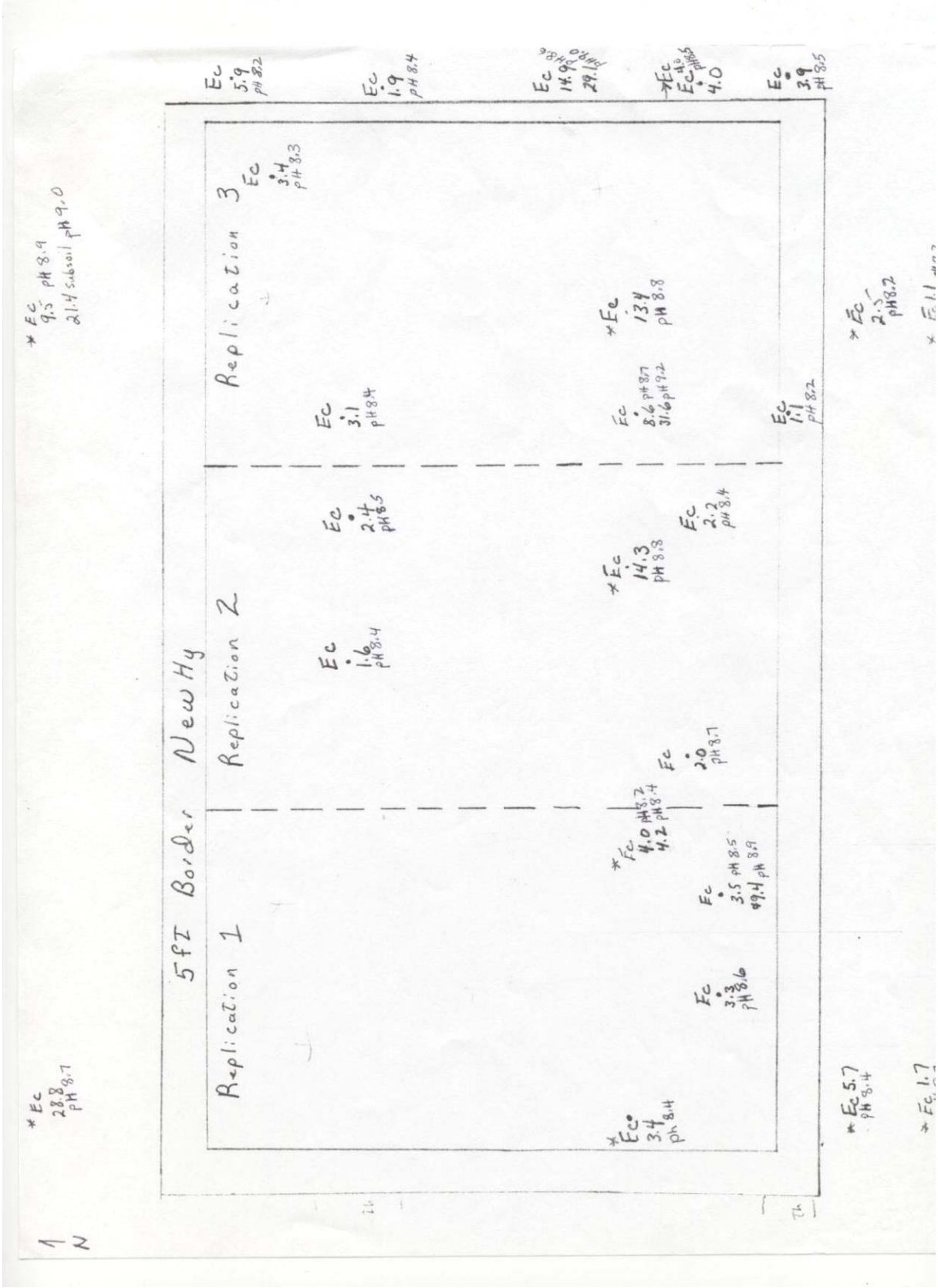
Most years the plots received 30 inches or more of applied irrigation. However in 1994, there was a drought, with only 55% of normal irrigation water available. Including the natural precipitation and the irrigation water, only 23.3 inches of water were applied. The data shows that both slender wheatgrass accessions produced very well under drought conditions (Table 2) indicating good drought tolerance. Also, observations were made that the sprinkler irrigation helped to improve the pH levels in the root zone. Fertilizers were used; Live Earth product was also applied the first year and in the fall of 1992 nitrogen was applied. There was a very evident beneficial effect where the powdered Live Earth product was used. The data showed a 14% increase in yield for slender wheatgrass to a 47% increase in yield for Fawn tall fescue where the Live Earth product was applied.

**Table 2 – Yield data by species in Air-dry lbs/ac.**

| Plants | 1991 | 1992 | 1993 | 1994 | Average production |
|---|---|---|---|---|---|
| Tall wheatgrass | 2,430 | 6,515 | 1,444 | 1,464 | 2,963 |
| Fawn tall fescue | 2,335 | 3,873 | 1,842 | 1,385 | 2,359 |
| San Luis slender wheatgrass | 871 | 2,159 | 1,380 | 2,587 | 1,749 |
| Revenue slender wheatgrass | 1,238 | 2,609 | 924 | 2,326 | 1,774 |
| NewHy hybrid wheatgrass | 1,374 | 4,124 | 1,312 | 1,673 | 2,121 |
| RS Hoffman wheatgrass | na | | | 1,646 | 1,646 |
| Festorina tall fescue | na | 2,307 | 4,170 | 1,490 | 2,656 |
| Forager tall fescue | na | 1,640 | 2,802 | 1,437 | 1,960 |
| Garrison creeping foxtail | 894 | 2,543 | 1,440 | 1,045 | 1,481 |
| Matua rescuegrass | na | 708 | winterkill | 784 | 746 |
| Magnar basin wildrye | 882 | 1,090 | 1,800 | 1,124 | 1,224 |
| Shoshone beardless wildrye | 773 | 1,709 | 726 | 1,359 | 1,142 |
| Prairieland Altai wildrye | 637 | 1,479 | 1,230 | 1,333 | 1,170 |
| Berseem clover (annual) | na | 1,450 | na | na | 1,450 |
| Alsike clover | na | 940 | 6,462 | 4,986 | 4,129 |
| Kura clover | na | | | 836 | 836 |
| Monarch cicer milkvetch | 526 | 1,203 | 9,381 | 5,279 | 4,097 |
| Birdsfoot trefoil | na | | | 679 | 679 |

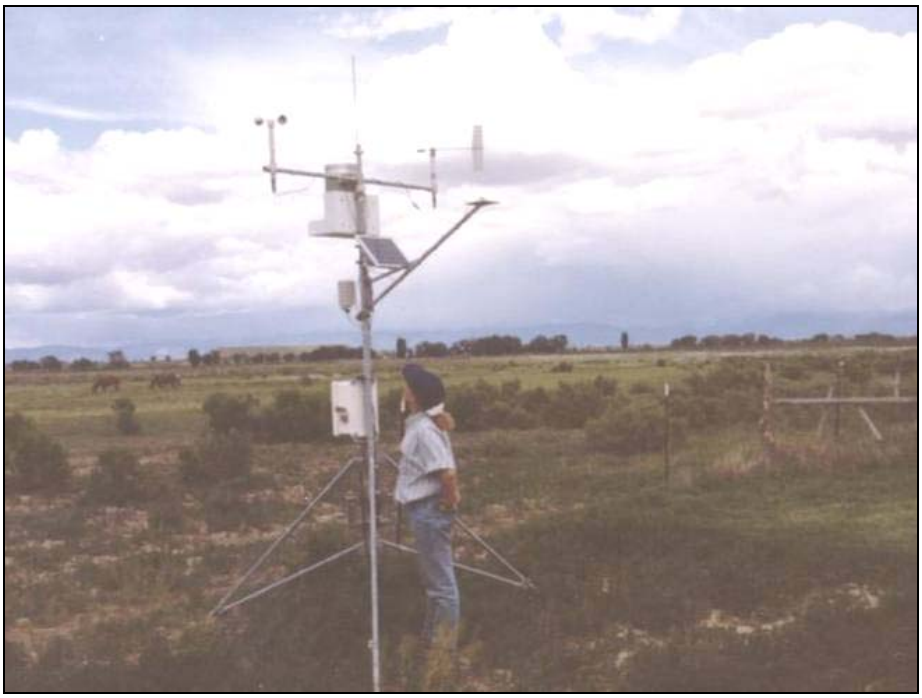
Tony Beals (NRCS), Dennis Worwood (Emery Co. Ext. Agent) and the landowner initiated the project. Howard Horton with ARS coordinated efforts and completed the planting. If there is further interest in this project, please contact Tony Beals at the Price NRCS Field Office.

**Figure 1: Plot Layout of Snowball Study**



## Photos for Snowball Trial

**Close-up of slender wheatgrass and its weed control attributes**



**Weather station donated by BOR gathered local weather data for use in evaluating the salinity trial**