Saskatchewan AgriARM Applied Research Management

Wheatland Conservation Area Inc.
Swift Current, SK.

Forage Establishment Strategies for Recently Developed Salt Tolerant Forages

Project #20130407

Start Date: April 1, 2014
End Date: Feb 10, 2016

ADOPT 2015

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Final Report

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Identification and Reclamation of Saline Soil Using Perennial Forages

Final Report

Project Objectives

The objective of this project is to demonstrate two recent findings from Dr. Harold Steppuhn, Salinity Researcher, AAFC Salt Lab. First objective is to demonstrating new varieties of salt tolerant forages like AC Saltlander, Halo Alfalfa, and Bridgeview alfalfa, and second, to determine if it is necessary to increase the seeding rates of these newer salt tolerant varieties in saline areas, similar to the increased seeding recommendations of the traditional forages seeded in saline areas to insure an adequate forage stand.

Project Rationale

The excessive rainfall and snow melt we have experienced over the past few years has resulted in saturated rooting zones and leaching, factors that contribute to soil salinity. With these soil conditions prevalent, there is potential for salinity to expand both in area and severity. Saline areas are a significant concern for Saskatchewan producers and are often difficult to understand and reclaim.

Saline areas are areas of the field that contain salts in the soil at concentrations that affect the growth and production of agricultural crops in Saskatchewan. One practice that has been recommended in the past, is to seed perennial forages at increased seeding rates into the affected area. This has occurred with mixed results because of the lack of salt tolerant perennial forages and the high cost of forage seed.

AC Saltlander has recently been registered, and new salt tolerant alfalfa varieties have been developed. AC Saltlander is a perennial grass species that is quite salt tolerant and adapted to saline areas of the field and has good palatability and forage quality for cattle. Seed cost for these forages are high so efficiencies must be found when planting this forage. Traditionally, seeding rates are increased in saline area to insure an adequate stand, however, this increases costs. Preliminary finding from Dr. Harold Steppuhn show little differences in establishment when seeding rates of AC Saltlander are reduced from 10 lbs per acre to 5 lbs per acre. This is likely due to their inherent tolerance to salinity and their ability to establish in saline conditions. This raises the question "do we need to increase the seeding rates of these salt tolerant forages to maintain adequate forage stands in saline areas"? It is hypothesized that we do not. When perennial forages

are established on saline areas, these areas become economically productive. As well, weeds like kochia and foxtail barley are chocked out, reducing the weed seed bank that can spread to other areas of the field.

Methods

This is the second year of a two year project, with year one dedicated to establishment and year two looking more at forage yield and saline tolerance. An area was identified with a good salinity gradient ranging from none saline to severe. An EM38 was used to map the area. The treatments were seeded in strips down the saline gradient. Traditionally, seeding rates are increased in saline area to insure an adequate stand, however, recent findings show little differences in establishment when seeding highly salt tolerant varieties, therefore, we seeded the forages at two rates, 5 and 10 lbs per acre the as follows:

1. AC Saltlander (salt tolerant) at 5 lbs/ac
2. Smooth Brome at 5 lbs/ac
3 . Halo alfalfa (salt tolerant) at 5 lbs/ac
4. Bridgeview alfalfa (saline tolerant) at 5 lbs/ac
5. Rangelander alfalfa at 5 lbs/ac
6. AC Saltlander (salt tolerant) at 10 lbs/ac
7. Smooth Brome at 10 lbs/ac
8. Halo alfalfa (salt tolerant) at 10 lbs/ac
9. Bridgeview alfalfa (saline tolerant) at 10 lbs/ac
10. Rangelander alfalfa at 10 lbs/ac
11. AC Saltlander / Halo alfalfa mix at 5 lbs/ac
12. AC Saltlander / Halo alfalfa mix at 10 lbs/ac

Plot Size: 250' long x 12' wide.

Burnoff: June 6, 2014 Pre-seed burnoff with RT 540 @ .5 l/ac

Seeding: June 11, 2014.
Forage plot drill; double disk openers (6 openers x 12" row spacing)

Fertility: None applied

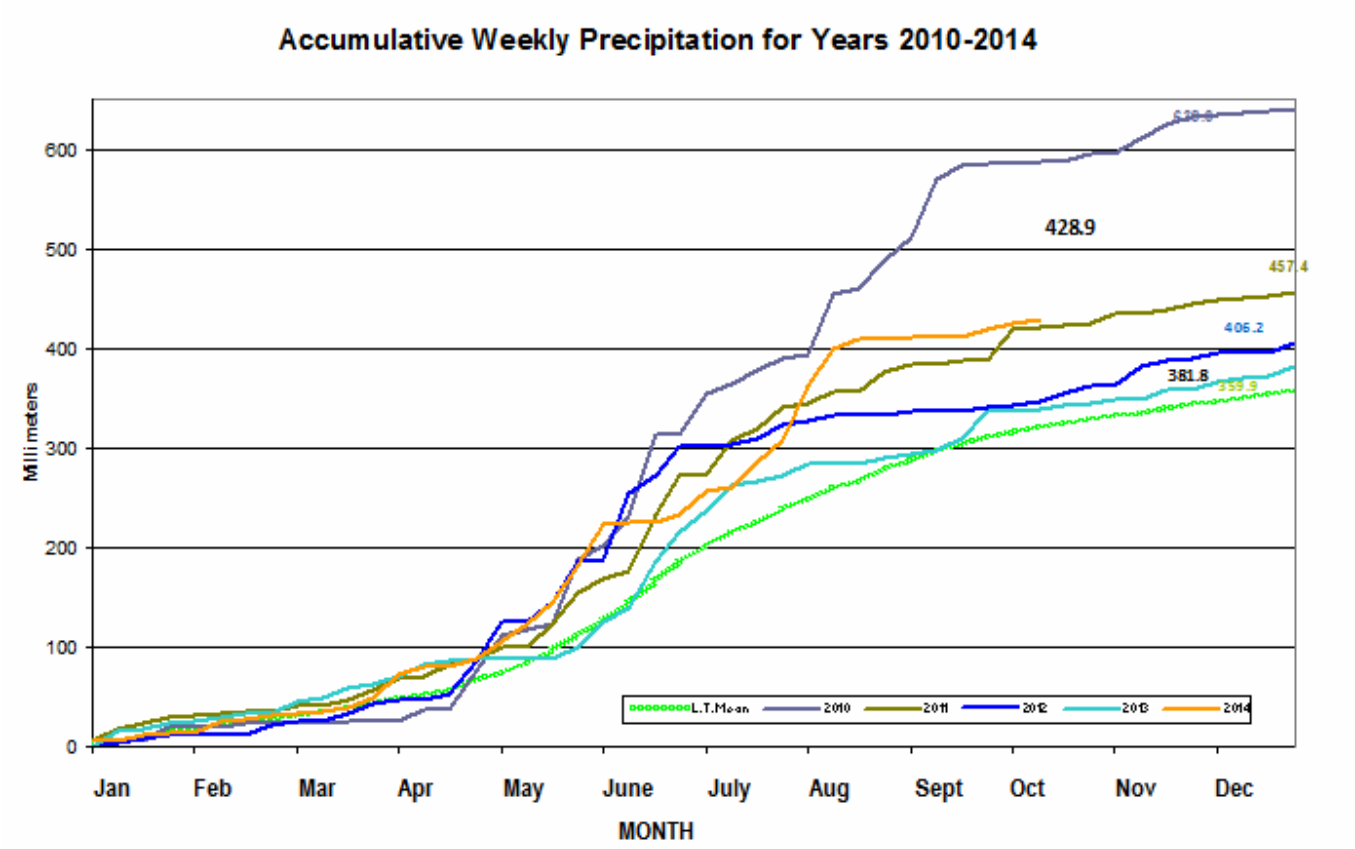
EM 38 Readings: June 11, 2014 Spring EM 38 readings taken and mapped
May 12, 2015 Spring EM 38 readings taken and mapped

Biomass: July 3, 2015 biomass samples taken

General Site Conditions

The salinity site is situated in the Hodgeville area about 75 km southeast of Swift Current. The soil is classified as a Haverhill loam. Overall forage yields in the area were below average with quality being variable. This was generally the case for area producers who experienced similar conditions resulting in similar yields. For the most part in 2015, lower than average precipitation in

the early growing season had a negative impact for shallow seeded crops. Severe drought like conditions continued through May, June, and July having a negative effect on yield potential and made it difficult to show treatment responses in certain trials. Overall yields for oilseed crops were lower than average due to lack of rain fall. Deeper seeded cereal crops had close to average yields. This was generally the case for area producers who experienced similar conditions resulting in similar yields.



Graph 1. Accumulated Precipitation.

Results

Soil conductivity readings in 2014 and 2015 were taken in transects to determine a saline gradient down each plot. These readings were plotted on a map *(fig. 1 & fig. 2)* and separated into the following saline categories as follows:

EC Readings
Dark Green < 70 (Non-Saline)
Light Green 70-100 (Low Salinity)
Yellow 100-130 (Low to Moderate)
Dark Yellow 130-160 (Moderate to High)
Red >160 (Relatively High Salinity)

Fig 1: EM 38 soil conductivities taken in 2014 and the following contour map was developed:

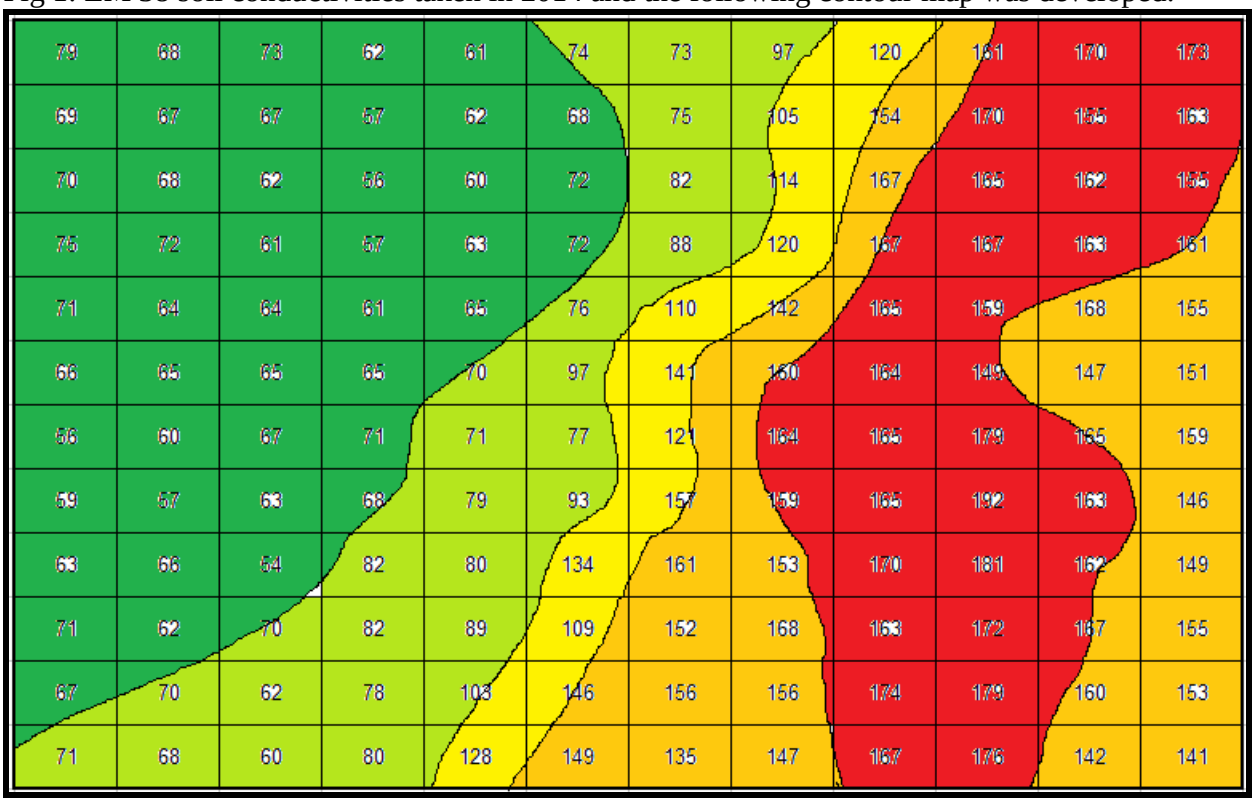
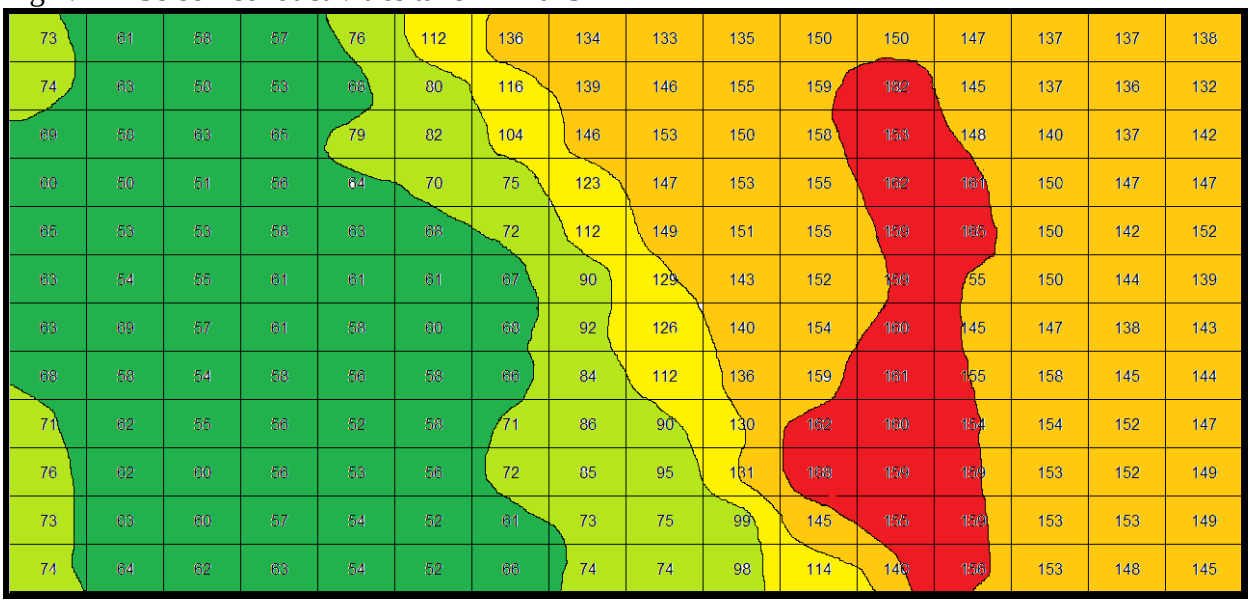
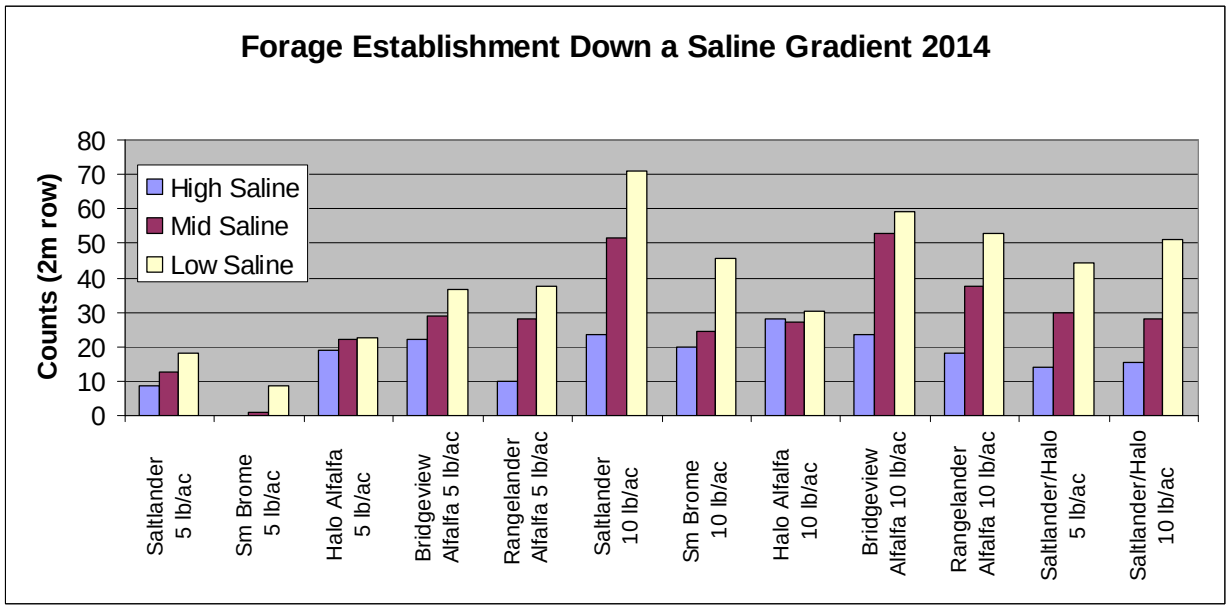


Fig 2: EM 38 soil conductivities taken in 2015



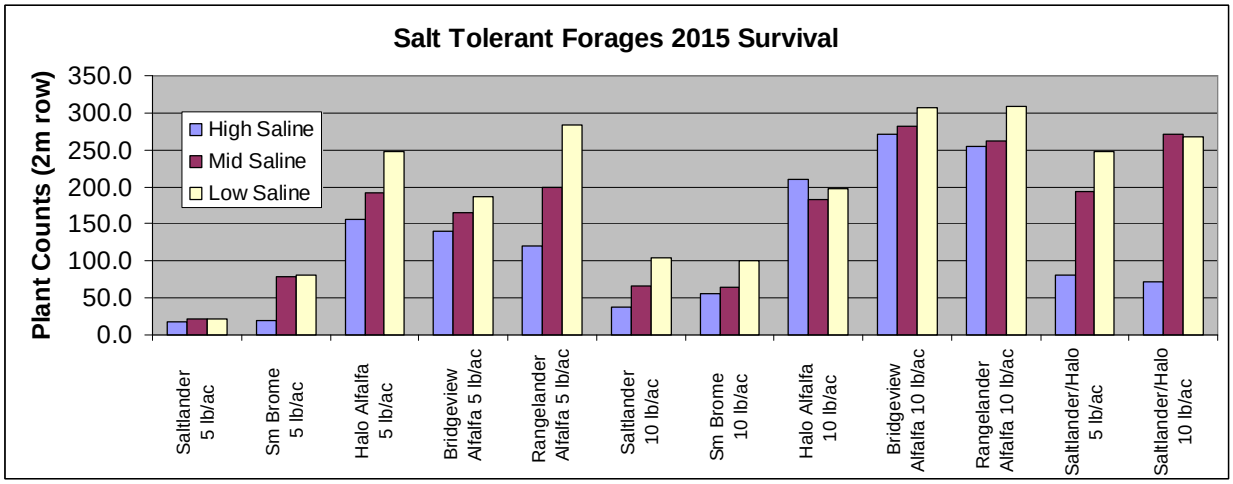
Establishment counts were taken in year one to determine how seeding rates would affect plant establishment under saline conditions with these newer salt tolerant forages. In the high saline areas, we observed increased plant establishment with increased seeding rates with the older, less salt tolerant varieties compared to the newer more salt tolerant varieties, where in most cases seeding rates did not have as much of an impact on establishment *(Graph 2.)*. For example, the Rangelander alfalfa and the Smooth Brome (less tolerant to salinity) both had higher establishment counts with higher seeding rates when salinity was present. On the other hand, the newer more salt tolerant varieties like Halo and Bridgeview alfalfa only saw a slight increase in establishment with increased seeding rates under saline conditions. The exception was with the AC Saltlander seeded on its own, where we did see increased plant counts from the high seeding rate. However, when seeded in a mixture with Halo alfalfa, establishment was the same regardless of seeding rate at all levels of salinity.

Graph 2.



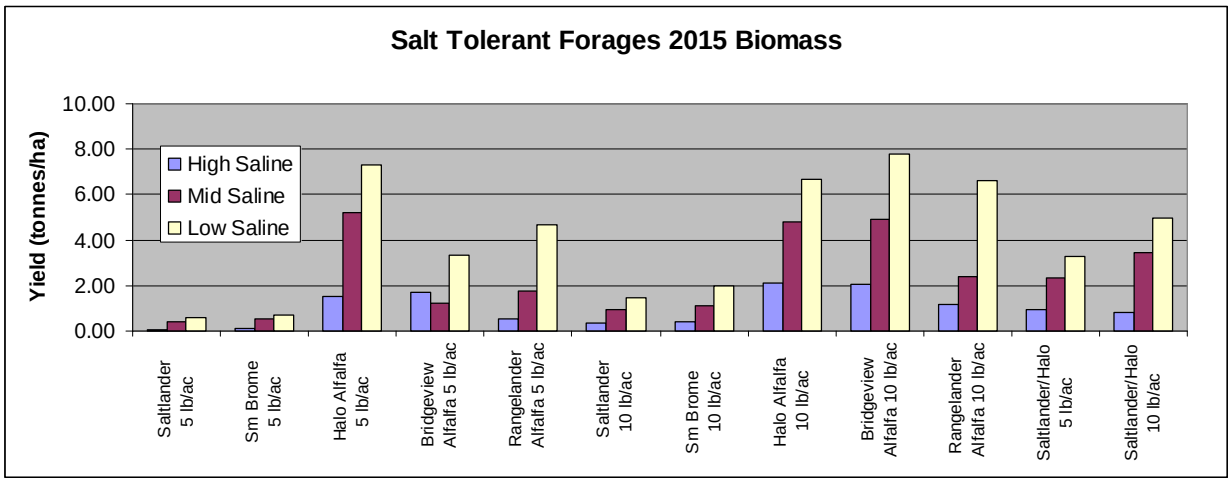
In 2015 we looked at survival rates from the 2014 establishment *(Graph 3)*. The project showed a slightly different patterns when it came to year 2 survival rates. Similar to the 2014 establishment rates, we saw plant survival increasing in the less salt tolerant varieties with increasing seeding rates. However, in addition to this, we observed improved survival rates with increased seeding rates in the more severe salt affected areas of the field with both the tolerant and susepable varieties. To insure improved establishment and plant survival, it is recommended to increase seeding rates as salinity levels increase and as variety tolerance decreases.

Graph 3.



Above ground biomass yields were taken in the second year 2015 *(Graph 4)*. As expected, biomass yields followed the same trends as plant survival. Increasing the seeding rate from 5 lbs/ac to 10 lbs/ac rarely had a negative effect on yield. Only the Halo alfalfa at the low and moderate levels of salinity had a very slight yield reduction at the 10 lb/ac seeding rate. In all other cases we saw some degree of yield benefit from a higher seeding rate. Having said that, the increase seeding rate had less impact in the areas of the field where salinity levels were low. The greatest impact from higher seeding rates was seen in the areas affected by severe salinity. Also, the increase seeding rate had a greater yield benefit in the varieties that are considered to be less salt tolerant. There was only a slight yield benefit by increasing the seeding rates of the more tolerant varieties. Therefore, it is recommended to increase seeding rates as salinity levels increase and as variety tolerance decreases.

Graph 4.



When looking at biomass from high saline areas, plant establishment from the less salt tolerant varieties translated into higher yield when increasing the seeding rate. The 10 lb seeding rate for Rangelander Alfalfa yielded 1.13 tonnes/ha compared to 0.32 tonnes/ha yielded from the 5 lb seeding rate. Smooth Brome seeded at 10 lbs yielded 0.221 tonnes/ha while the 5 lb seeding rate produced a yield of only 0.102 tonnes/ha. Both salt tolerant alfalfas Halo and Bridgeview had the highest over all yields, however, the data shows there was little impact from using higher seed rates in high saline areas.

The treatments will remain intact on this site in 2016 and observation will be made to determine if certain forage stands continue to develop or decline.

This project was promoted during Crop Production Week in Saskatoon in January and will be locally at Cropportunities 2016 on March 3rd in Swift Current (200+ expected participants). This project was promoted on a CKSW radio program called "Walk the Plots" which we broadcast in the summer on a weekly basis. As well this topic was brought to the attention of the group on the Annual Field Day on July 17th (100 participants) as well as a number of smaller individual tours. This topic will also be posted on our website.

Conclusions

As suggested by Dr. Harold Steppuhn, we observed little differences in establishment with increased seeding rates of many of the newer salt tolerant forage varieties. This is likely due to their inherent tolerance to salinity and their ability to establish in saline conditions. Forage yield data was collected in year two to determine if establishment will translate into increased forage yield. The biomass yield of less salt tolerant varieties collected from high saline areas showed yield benefits when increasing the seeding rate. The salt tolerant alfalfas (Halo and Bridgeview) had the highest over all yields, however, the data shows there was little impact from using higher seed rates in high saline areas. It is recommended to increase seeding rates as salinity levels increase and as variety tolerance decreases.

Acknowledgements

The Ministry of Agriculture was acknowledged for all our ADOPT projects including plot signage and verbal acknowledgement at field days and on PowerPoint slides during presentations. This will continue at each venue where an extension activity occurs.

Summary

Saline areas are areas of the field that contain salts in the soil at concentrations that affect the growth and production of agricultural crops in Saskatchewan. One practice that has been recommended in the past, is to seed perennial forages at increased seeding rates into the affected area. This has occurred with mixed results because of the lack of salt tolerant perennial forages and the high cost of forage seed. The objective of this project is to demonstrate new varieties of salt tolerant forages like AC Saltlander, Halo Alfalfa, and Bridgeview alfalfa, and second, to determine if it is necessary to increase the seeding rates of these newer salt tolerant varieties in saline areas, similar to the increased seeding recommendations of the traditional forages seeded in saline areas to insure an adequate forage stand.

An area was identified with a good salinity gradient ranging from none saline to severe. An EM38 was used to map the area and each treatment was seeded in strips down the saline gradient. We seeded three salt tolerant varieties, AC Saltlander, Halo alfalfa, and Bridgeview and two less tolerant varieties, Smooth brome, and Rangelander alfalfa at two rates, 5 and 10 lbs per acre. We also included a mix with AC Saltlander and Halo alfalfa at 5 and 10 lbs per acre.

Establishment counts were taken in year one to determine how seeding rates would affect plant establishment under saline conditions with these newer salt tolerant forages. In the high saline areas, we observed increased plant establishment with increased seeding rates with the older, less salt tolerant varieties compared to the newer more salt tolerant varieties, where increased seeding rates had less of an imact on establishment. For example, the Rangelander alfalfa and the Smooth Brome (less tolerant to salinity) both had higher establishment counts with higher seeding rates when salinity was present. On the other hand, the newer more salt tolerant varieties like Halo and Bridgeview alfalfa only saw a slight increase in establishment with increased seeding rates under saline conditions.

Above ground biomass yields were taken in the second year 2015. As expected, biomass yields followed the same trends as plant survival. Increasing the seeding rate from 5 lbs/ac to 10 lbs/ac rarely had a negative effect on yield. Only the Halo alfalfa at the low and moderate levels of salinity had a very slight yield reduction at the 10 lb/ac seeding rate. In all other cases we saw some degree of yield benefit from a higher seeding rate. Having said that, the increase seeding rate had less impact in the areas of the field where salinity levels were low. The greatest impact from higher seeding rates was seen in the areas affected by severe salinity. Also, the increase seeding rate had a greater yield benefit in the varieties that are considered to be less salt tolerant. There was only a slight yield benefit by increasing the seeding rates of the more tolerant varieties. The salt tolerant alfalfas (Halo and Bridgeview) had the highest over all yields, however, the data shows there was little impact from using higher seed rates in high saline areas. It is recommended to increase seeding rates as salinity levels increase and as variety tolerance decreases.

This project will be promoted during Crop Production Week in Saskatoon in January and locally at Cropportunities 2016 on March 3rd in Swift Current (200+ expected participants). This project was promoted on a CKSW radio program called "Walk the Plots" which we broadcast in the summer on a weekly basis. As well this topic was brought to the attention of the group on the Annual Field Day on July 17th (100 participants) as well as a number of smaller individual tours. This topic will also be posted on our website.