Dunn County Forage Production Systems Demonstration

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Summary

Forage production is an important component that supports the livestock industry in North Dakota and surround states. An alfalfa-grass termination demonstration was initiated on a Dunn County Ranch using a preharvest glyphosate application. 1.62 tons per acre of alfalfa/grass was harvested. Sixteen days later sorghum-sudan grass was no-till seeded into the killed sod. Sorghum-sudan grass produced 2.74 tons per acre of hay bringing the total hay produced in this demonstration in 2005 to 4.36 tons per acre. In May 2006 alfalfa was reseeded with no-till seeding methods and produced 1.98 tons per acre of hay. This demonstration showed that normally where one hay crop is harvested during a two year period in North Dakota using traditional methods of terminating and seeding the next forage crop, producers could produce three forage crops using no-till methods and equipment designed for seeding directly into sod. A system which produces three forage crops where only one was produced before is more likely to be sustainable with today's economics and environmental concerns.

Introduction

In 2005 alfalfa and alfalfa-grass mixed hay was produced on 1,650,000 acres in North Dakota (North Dakota Agricultural Statistics, 2006). This forage base is important to the livestock industry and the economic well being of North Dakota. Annually, producers seed approximately 107,000 acres or 6.5 percent of the total acres of alfalfa and alfalfa grass hay. At this rate of replacement the average life span of an alfalfa stand is approximately 15 years. Stand productivity declines significantly by the third year (Undersander et al, 2004). Much of the decline in dryland conditions has been attributed to depletion of subsoil moisture as well as plant density, accumulation of winter injury and weeds taking advantage of thin alfalfa stands (Meyer and Helm, 1994).

Producers traditionally have terminated stands of alfalfa and alfalfa grass through tillage in western North Dakota after the first cutting has been removed. Tillage requires at least three, four and sometimes more operations to eliminate or reduce the competition of these perennials so that crops can be successfully seeded and established (Eriksmoen, 2007).

With the introduction of herbicides producers have reduced the number of tillage operations. Herbicide timing is critical. Application is usually made to regrowth after the first cutting. Regrowth after the herbicide operation is then controlled with tillage and the following spring a new crop is seeded.

Tillage used exclusively or used in combination with herbicides, exposes soil to erosion, reduces carbon sequestration, increases N_2O emissions, and changes soil structure (Grandy, Robertson, and Thelen, 2006). Tillage has also been associated with a reduction in arbuscular mycorrhizal fungi, and glomalin, a proteinatious substance that holds soil peds together, and a reduction in yield of responsive crops (Ryan and Graham, 2002). Conventional tillage and minimum tillage have also been associated with increases in the survivability and germination of weed seeds when compared to no-till and natural prairie systems (Anderson, 2005a, Anderson 2005b, Derksen et. al., 2002a). Increased weed density and lower crop plant density has been associated with openers that cause a greater degree of soil disturbance (Derksen et. al., 2002b).

Recently Roundup (glyphosate) received a label for termination of alfalfa and associated grassy and broadleaf weeds as a preharvest application treatment. This change provides producers an opportunity to terminate alfalfa during the time when alfalfa is least likely to be under water stress during a month that historically receives the greatest amount of precipitation for the year. This method has the lowest erosion and water loss compared to methods that use tillage.

No-till seeding forage crops in killed sod requires equipment suitable for precisely metering and placing a wide variety of crop seeds at a uniform and intended depth and maintain the soil environment for successful seed germination and seedling emergence (Saxton, 2004). Further, seeding must be done on a soil

surface which has crop residues from previous crops without destroying residue while leaving it in an optimum configuration for soil, water and crop protection. Also the simultaneous placement of fertilizer in a parallel band with the seed row to provide the most efficient use of the fertilizer by the seedling and growing plants while minimizing utilization by weeds is desired.

The Pribyl Ranch, located southeast of Manning, North Dakota lies along Crooked Creek in a 16 inch annual precipitation zone. Forage produced on this ranch is primarily used to feed cows and calves though occasionally extra hay is sold when available. When hay or other crops are planted on the ranch, tillage is the primary means for preparing the soil for planting.

The purpose of this demonstration was to show 1) an effective method to terminate established alfalfa-grass stands with a herbicide, 2) no-till seed an annual forage crop , and 3) reestablish alfalfa in the field without using tillage.

Materials and Methods

A five acre field located in the NE ¼, Section 33, Township 143 North, Range 95 West on the Butch Pribyl Ranch southeast of Manning, North Dakota was selected. The soil is predominately a Straw Loam and is described in the Dunn County Soil Survey (USDA SCS, 1982). Soils at the demonstration site are level except where dikes are used to prevent floodwater from inundating the field. A soil sample was taken on 13 May 2005 and submitted to the NDSU Soil Testing Lab for analysis (Table 1). The demonstration field's history was oats in 1985 and then seeded to alfalfa in 1986. The stand was in decline since 2000 as a result of flooding and extensive winter grazing. Prior to 2000, the alfalfa was managed under a two-cut system. In 2004, an attempt was made to terminate the alfalfa-grass with tillage but the alfalfa-grass reestablished itself.

Roundup UltraMax (glyphosate) at the rate of 44 fluid oz per acre (glyphosate 1.71 lbs/acre a.i.) and 40 fluid oz per acre of Actamater (ammonium sulfate 1.1 lbs/acre) was applied as a preharvest application to an alfalfa-grass field on June 18 except where a check strip was left for comparison. The alfalfa was in full bloom, smooth brome grass had flowered and the quackgrass was headed at the time of the application. The field was swathed 48 hours after the herbicide application (Figure 1), allowed to dry and then baled on 23 June and removed from the field. A random sample of bales were selected, weighed and subsampled. The subsample was sent to a lab in a plastic bag to prevent loss of moisture where moisture and nutrient content was determined.

The week following the alfalfa-grass hay harvest, 2.5 inches of precipitation fell delaying seeding of an annual forage crop. On 4 July the soil was sufficiently dry enough to support the weight of a tractor and the Dickinson Research Extension Center Cross-slot™ opener equipped no-till drill. Buffalo sorghum-sudan grass was seeded at the rate of 25 pounds per acre at the depth of ¾ inch deep. During seeding, 75 pounds per acre of 11-52-0 was placed in a separate band through the drill. An additional 100 pounds per acre of 34-0-0 was broadcast after seeding to provide adequate nitrogen for an expected yield of 2 tons per acre. On 8 July the sorghum-sudan grass had germinated and fully emerged (Figure 2). Thirty additional pounds per acre of nitrogen in the form of ammonium nitrate was broadcast applied to the field. Few weeds emerged during early development of the crop and it was decided a post-emergent herbicide was not necessary. Sudan-sorghum plant height in portions of the field were short compared to plants grown in other parts of the field.

On 8 September when the Sudan-sorghum was at boot to heading, the crop was swathed (Figure 3) and allowed to air dry until it was ready to bale on 12 September. Random samples were taken and submitted to a lab to determine feed quality and nitrate levels.

To determine the possible cause of variable plant growth in the sorghum-sudan crop, soils were sampled in six inch increments to a depth of three feet at ten locations in the field, locations georeferenced and submitted to the NDSU soils lab in Fargo, ND for analysis of EC and specific soil salts. In addition to soil sampling a Veris 3100 machine (Figure 4) was used to detect variations in soil electrical conductivity on 11 November. Variability in Veris EC values, soil sample EC values and soil salts were mapped with Spatial Management Systems (SMS), a GIS program.

Costs for terminating the alfalfa-grass hay field, establishing sorghum-sudan grass hay and harvesting were tracked and used to compare to

the method the producer normally uses to establish forages.

Establishing alfalfa

In 2006 alfalfa was established on the demonstration area that was used in the previous demonstration outline above. Prior to seeding the alfalfa, glyphosate was applied to the demonstration area by the producer on 15 May. The alfalfa seed was inoculated with the proper strain of *Rhizobium* and then seeded in the demonstration area with a Cross-slot drill at the rate of six pounds per acre on 29 May. Six different varieties were seeded to determine if specific varieties were more resistant to salts found in soils at this location. In addition to seeding, 10-34-0 liquid fertilizer was applied through the drill at the rate of 32.5 gallons per acre (37.7 lbs N and 128.3 lbs P_2O_5). Post emergent weed control was required after alfalfa emergence. Poast at the rate of 1 pt/acre + Raptor at 5 fl oz/acre + methylated seed oil at the rate of 1.5 pt/acre + Actamaster at 3 quarts per 100 gallons of spray solution was applied. The alfalfa was harvested on 25 August and bales weighed and moisture determined with a probe.

Results and Discussion

Termination of alfalfa-grass

The alfalfa-grass hay crop yield was 1.62 tons of dry matter per acre. Since the crop was over mature, nutrient composition was low (data not shown). The herbicide preharvest termination of alfalfa-grass would have been initiated sooner but above normal precipitation during May and much of June prevented the timely termination application of herbicide and harvest of the hay.

Sorghum-sudan grass

The sorghum-sudan hay yield for the five acre field was 2.74 tons of dry matter per acre. Nutrient composition (data not shown) was within the range expected for this type of forage at the particular stage of crop development at the time of harvest.

Cost comparison of termination systems

Alfalfa-grass termination systems was compared using data collected from this demonstration and information provided by the cooperating producer. Costs were greater for the herbicide preharvest termination method used in this demonstration compared to the tillage termination method used by the producer (Table 2). However, net return per acre from the herbicide preharvest termination method was greater than the net return produced by the tillage termination method. The primary reason for the increased net return was the additional value of the forage produced from the herbicide termination method. The time required to terminate alfalfa-grass with tillage is longer than required by the herbicide preharvest termination method and water loss through tillage is avoided with the use of low disturbance no-till seeding methods.

EC value comparison

Veris and soil sample EC values are presented in Figure 5. The correlation between EC values was calculated to be R2 = 0.787008. In this field where EC values are high, plant height was reduced and yield was low (data not shown).

Establishing alfalfa yield

Alfalfa dry matter yield was 1.98 tons per acre in 2006. Data from specific varieties has not been analyzed at this time but will be disclosed in future reports.

Implications of Demonstration

Combining improved alfalfa-grass termination methods and utilizing low-disturbance no-till production methods in a forage production system will help increase flexibility in forage production systems, increase annual hay yields while improving net returns.

Cooperating Producer

Butch Pribyl provided the use of his land, haying equipment, seed, and fertilizer in developing this demonstration. Also the Conservation Districts in southwest North Dakota provided busses during the 2005 Field Day afternoon agronomy tour. The Dunn County Agriculture Improvement Associaiton provided financial assistance for analysis of soils.

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Table 1. Soil test results for 13 May 2005 sample.

Depth	N	P	K	EC	pH	OM	S	Cl
inches	lb/a	ppm	ppm	mmho/cm		%	lb/a	lb/a
0-6	-	9.5	240	1.38	7.8	4.1	-	-
0-12	14			1.67			582	33.9
12-24	8			3.24			708	27.7
24-36	6			2.86				

Table 2. Cost comparison of alfalfa-grass termination methods at the Butch Pribyl Ranch, Manning, ND, 2005.

Alfalfa/Grass Termination – Preharvest herbicide followed by no-till seeding sorghum-sudan

Value of Production				
Item	**Quantity per acre**	**Unit of Measurement**	**Price/Cost per Unit**	**Value per Acre**
Value of Production				
Alfalfa/Grass Hay	1.62	ton	$55.00	$89.10
Sudan-sorghum Hay	2.74	ton	45.00	123.30
Gross Returns				**$212.40**
Costs				
Herbicide (Roundup UltraMax	44	fl oz	$0.51	$22.44
AMS	40	fl oz	0.08	3.20
Herbicide Application	1	acre	4.00	4.00
Planting – No-till drill	1	acre	10.00	10.00
Seed	25	lbs	0.66	16.50
Fertilizer (34-0-0)	100	lbs	0.12	12.00
Fertilizer (11-52-0)	75	Lbs	0.17	12.75
Broadcast Application of 34-0-0	1	acre	4.00	4.00
Swath Alfalfa/Grass	1	acre	8.00	8.00
Bale Alfalfa/Grass	4.05	bales	5.00	20.25
Swath Sudan-sorghum	1	acre	8.00	8.00
Bale Sudan-sorghum	6.85	bales	5.00	34.25
Costs				**$155.39**
Net Return/Acre				**$57.01**

Alfalfa/Grass Termination – Tillage

Value of Production				
Item	**Quantity per acre**	**Unit of Measurement**	**Price/Cost per Unit**	**Value per Acre**
Value of Production				
Alfalfa/Grass Hay	1.62	ton	$55.00	$89.10
Gross Returns				**$89.10**
Costs				
Swath Alfalfa/Grass	1	acre	8.00	$8.00
Bale Alfalfa/Grass	1	acre	5.00	20.25
Break Sod	1	acre	10.00	10.00
Tandem Disking	1	acre	6.00	6.00
Field Cultivation	1	acre	5.00	5.00
2nd Field Cultivation	1	acre	5.00	5.00
Costs				**$54.25**
Net Return/Acre				**$34.85**

Figure 1. A preharvest glyphosate application was made to this field 48 hours prior to the time when this photo was taken.

Figure 2. Sorghum-sudan grass emerged four days after seeding on July 4, 2005. In crop herbicide applications were not required for this crop.

Figure 3. Sorghum-sudan grass was swathed on 8 September and then baled on 12 September.

Figure 4. Veris 3100 machine used to map electrical conductivity of the soil.

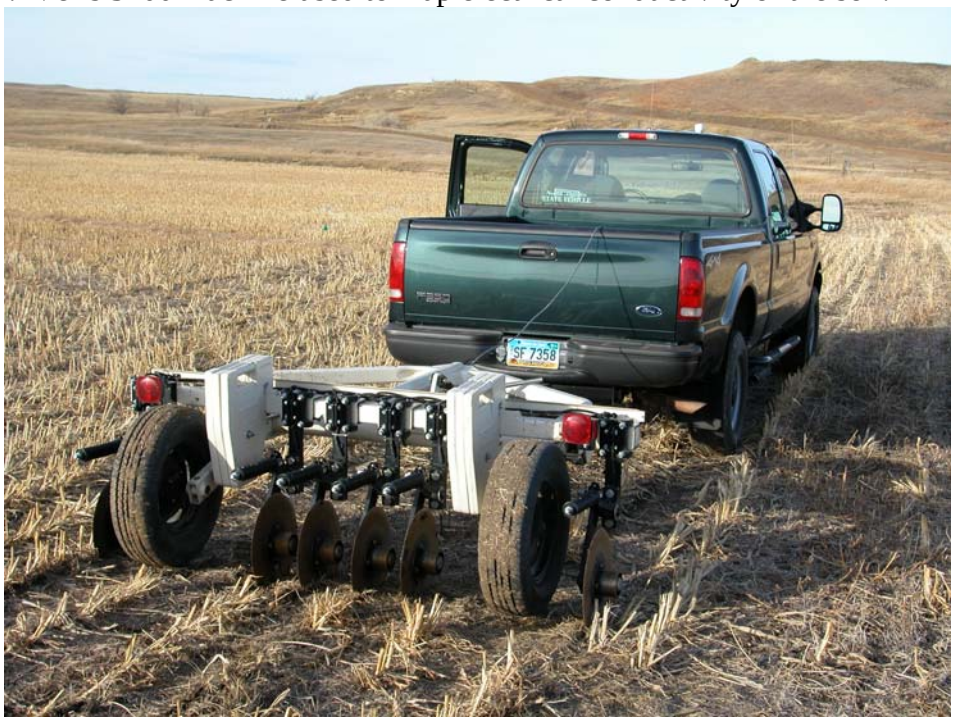

Figure 5. Electrical conductivity (EC) map of field created by Veris machine. Circles with numbers represent the soil sample locations. Areas with the same color represent similar EC values.