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Yellow-flowered Alfalfa and Cool-Season Grass Mixtures: A Demonstration Planting in Perkins County, South Dakota

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ABSTRACT

Yellow-flowered alfalfa [*Medicago sativa* subsp. *falcata* (L.) Arcang.] and cool-season grass cultivars were established in a demonstration planting in Perkins County, South Dakota near Bison in 2008-2013. The purpose of the demonstration planting served as a field location to educate and train NRCS field office staff and landowners about grass-legume forage options, and collect general information on production potential of binary mixtures of yellow-flowered alfalfa and cool-season grasses for haying and grazing. Yellow-flowered alfalfa generally produced the highest yield and forage quality when planted alone. Yellow-flowered alfalfa remained persistent over the 6 years, alone, and in all the binary mixtures. The only grasses that were persistent in the mixtures were 'Manska' pubescent wheatgrass [*Thinopyrum intermedium* [Host] Barkworth & D.R. Dewey] and 'NU-ARS AC2' crested wheatgrass [*Agropyron cristatum* (L.) Gaertn.]. Yellow-flowered alfalfa was more competitive in the other mixtures where grass stands declined to less than 20%. Additional plantings, which integrate experimental design and data collection procedures into the evaluation process, are needed to fully understand the compatibility of these binary mixtures and long-term sustainable production for hay and grazing in the Northern Great Plains.

INTRODUCTION

A common practice in the Northern Great Plains is to plant legumes with cool-season grasses to improve quality, production, and digestibility of forage. Adding legumes to the mix can also reduce the need for added nitrogen fertilizer. Alfalfa (*Medicago sativa* L.) is typically the primary legume recommended for cool-season grass-legume mixtures (Sedivec and Printz, 2014). On farmland where the yellow-flowered falcata alfalfa had been inter-seeded for more than 3 years, large increases in soil nitrogen have been measured and plant protein content in these areas has increased by as much as 30 percent. (Schuman, 2003).

To encourage the practice of including legumes in forage grass mixtures, the Bismarck Plant Materials Center installed a demonstration planting of binary mixtures of yellow-flowered alfalfa and various cool-season grasses in Perkins County, South Dakota. This demonstration also served as a visual for educating field office staff and landowners on the benefits of binary mixtures for hay and grazing in the Northern Great Plains.

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MATERIALS AND METHODS

The Bismarck Plant Materials Center (PMC), in cooperation with Jim Lyon, a producer in Perkins County, South Dakota; Perkins County Conservation District; and the USDA-NRCS Perkins County field office, planted six (6), 11-ft x 57-ft plots on 30 April 2007 in Perkins County, South Dakota near Bison on a Reeder Loam soil. Yellow-flowered alfalfa was planted (non-replicated plots) alone and in a binary mixture of 'Manska' pubescent wheatgrass; 'Fleet' meadow bromegrass [*Bromus biebersteinii* Roem. & Schult. [excluded]; NU-ARS AC2 crested wheatgrass; 'Mankota' Russian wildrye [*Psathyrostachys junceus* (Fisch.) Nevski]; 'Rodan' western wheatgrass [*Pascopyrum smithii* (Rydb.) Á. Löve]. Plots were seeded at 1.5 times the recommended pure live seed planting rate on a well-prepared seedbed (Table1). The percentage of grass and yellow-flowered alfalfa in each mixture was 70% and 30%, respectively. Areas between and around the perimeter of the plots were planted to Bad River ecotype blue grama [*Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths]. Bromoxynil was applied approximately one month after planting at a label rate for the control of Russian thistle (*Salsola kali* L) and other broadleaf weeds.

Fig. 1. 2-ft x 10-ft swaths harvested from each plot for dry matter yield.

Visual stand ratings of yellow-flowered alfalfa and cool-season grass cultivars were determined at the beginning of the growing season in 2009-2013 using a scale of 1 to 9 where 1 = best and 9 = poor. Yield was determined in late July-early August in 2009, 2011 and 2012 by harvesting 2-ft x 10-ft swaths, representative of the stand of yellow-flowered alfalfa and perennial grass (fig. 1) within each plot.

Samples were dried and dry matter yield was determined for each respective harvest date. Forage quality estimates of percent crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), and relative feed value (RFV) were determined from representative samples collected from the 18 July 2012 harvest.

Table 1. Pure live seed planting rates of perennial cool-season grasses and yellow-flowered alfalfa.

Yellow-flowered alfalfa and grass mixtures[1/]	Seeding rate/acre	
	Grass	Legume
	--------PLS lb/acre--------	
YA	----	8.25
YA + PW	8.9	2.06
YA + CW	6.3	2.06
YA + MB	14.2	2.06
YA + RW	6.3	2.06
YA + WW	8.4	2.06

1/ YA = yellow-flowered alfalfa; YA + PW = yellow-flowered alfalfa + 'Manska' pubescent wheatgrass; YA + CW = yellow-flowered alfalfa + 'NU-ARS AC2' crested wheatgrass; YA + MB = yellow-flowered alfalfa + 'Fleet' meadow bromegrass; YA + RW = yellow-flowered alfalfa + 'Mankota' Russian wildrye; YA + WW = yellow-flowered alfalfa + 'Rodan' western wheatgrass

RESULTS AND DISUSSION

Rainfall received during the primary growing season for cool-season grasses (April-June; Sedivec et al., 2007) near Bison, South Dakota, in 2009 and 2011 was near or above the long-term average. Rainfall during the same period in 2012 was significantly below average. During the late growing season (late August-October; Sedivec et al., 2007), rainfall amounts were average in 2009 and well below average in 2011 and 2012 (fig. 2).

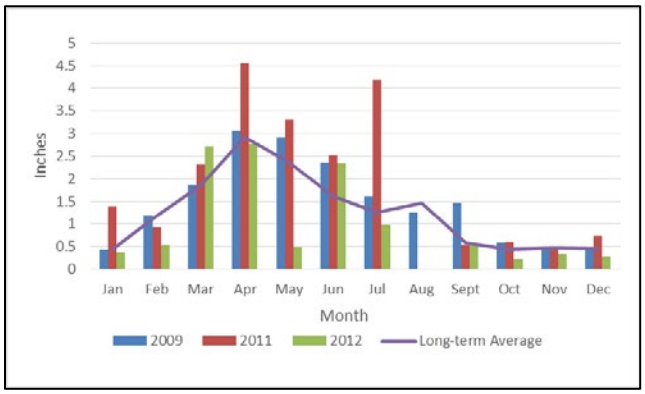

Fig 2. Annual rainfall for 2009, 2011, 2012 and long-term average, Bison, SD.

Stands of yellow-flowered alfalfa and yellow-flowered alfalfa and grass mixtures in 2008-2009 were near average, except for 'Rodan' western wheatgrass, which rated below average (data not shown). From 2010-2011, the yellow-flowered alfalfa and yellow-flowered alfalfa and grass mixtures of 'Fleet' meadow bromegrass, 'Manska' pubescent wheatgrass and 'NU-ARS AC2' crested wheatgrass, rated highest in stand. A 1:1 yellow-flowered alfalfa to grass ratio was observed in these plots (data not shown). By 2012-2013 (six years after planting) 'Manska' pubescent wheatgrass and 'NU-ARS AC2' crested wheatgrass were the only grasses with acceptable stands. Yellow-flowered alfalfa maintained good to excellent stands in these plots, and was the dominant species in the other grass plots, presumably due to less competition from the grass (data not shown). Moreover, yellow-flowered alfalfa had good stands and displayed outstanding persistence 6 years after planting.

Productivity of yellow-flowered alfalfa, and yellow-flowered alfalfa and grass mixtures varied depending on year and yield contribution of each component in the mixture (fig. 3). In 2011, the wettest year of the demonstration planting (fig. 2), the yellow-flowered alfalfa mixtures of 'Fleet' meadow bromegrass, 'Manska' pubescent wheatgrass and 'NU-ARS AC2' crested wheatgrass produced the greatest forage yields at this site. The mixture with 'Manska' pubescent wheatgrass produced 36% more forage than the other grass mixtures. The yield obtained for yellow-flowered alfalfa and 'Manska' pubescent wheatgrass in 2011 was similar to yellow-flowered alfalfa planted alone. This is likely due to above average rainfall during the 2011 growing season (April-June for cool season species) (fig. 2). Yields reported for 'Fleet' meadow bromegrass, 'Mankota' Russian wildrye and 'Rodan' western wheatgrass

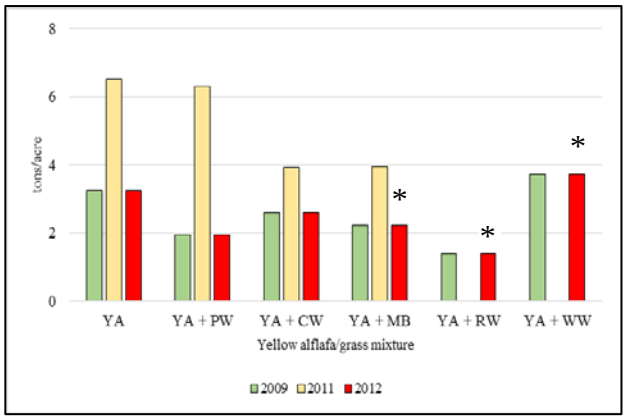

Fig 3. Dry matter yield of yellow-flowered alfalfa grown alone and in combination with perennial cool season grass harvested in late July-early August 2009, 2011, and 2012, Bison, SD.

* < 20% grass in these plots.

YA = yellow-flowered alfalfa; YA + PW = yellow-flowered alfalfa + 'Manska' pubescent wheatgrass; YA + CW = NU-ARS-AC2 crested wheatgrass; YA + MB = yellow-flowered alfalfa + 'Fleet' meadow bromegrass; YA + RW = yellow-flowered alfalfa + 'Mankota' Russian wildrye; YA + WW = yellow-flowered alfalfa + 'Rodan' western wheatgrass

mixtures in 2012 are primarily the contribution of the yellow-flowered alfalfa rather than the grass, which comprised no more than 20% of the mixture in these plots. Drought following 2011 growing season likely affected the stand and persistence of 'Fleet' meadow bromegrass and 'Mankota' Russian wildrye, while the yellow-flowered alfalfa became dominant in these plots in 2012.

Generally, yellow-flowered alfalfa planted alone or in plots where it was the dominant species ('Rodan' western wheatgrass and 'Mankota' Russian wildrye plots), had the highest forage quality as measured by CP, TDN and the RFV (Table 2). The binary mixtures of yellow-flowered alfalfa with 'Manska' pubescent wheatgrass, 'Fleet' meadow bromegrass, and 'NU-ARS AC2' crested wheatgrass produced respectable CP, TDN and RFV.

Table 2. Forage quality estimates of yellow-flowered alfalfa grown alone and in mixtures with cool season grasses, Bison, SD. Samples collected for quality estimates 18 July 2012.

Yellow-flowered alfalfa and grass mixture [1/]	Forage Quality Estimates				
	CP[2/]	ADF[3/]	NDF[4/]	TDN[5/]	RFV[6/]
	----------%----------				
YA	10	41	52	55	102
YA + PW	9	40	66	57	83
YA + CW	7	42	64	54	81
YA + MB	9	46	64	50	77
YA + RW	11	40	49	57	109
YA + WW	8	43	56	46	81

1/ YA = yellow-flowered alfalfa; YA + PW = yellow-flowered alfalfa + 'Manska' pubescent wheatgrass; YA + CW = 'NU-ARS AC2' crested wheatgrass; YA + MB = yellow-flowered alfalfa + 'Fleet' meadow bromegrass; YA + RW = yellow-flowered alfalfa + 'Mankota' Russian wildrye; YA + WW = yellow-flowered alfalfa + 'Rodan' western wheatgrass; 2/ = crude protein; 3/ = acid detergent fiber; 4/= neutral detergent fiber; 5/ = total digestible nutrients; 6/= relative feed value

CONCLUSIONS

The purpose of the demonstration planting was to serve as a training platform for NRCS field office staff and landowners on the benefit of a grass-legume forage system, and collect general information on production potential of binary mixtures of yellow-flowered alfalfa and cool-season grass cultivar mixtures. Yellow-flowered alfalfa remained persistent over the 6 years of the planting as well as the mixture of yellow-flowered alfalfa and 'Manska' pubescent wheatgrass and 'NU-ARS AC2' crested wheatgrass. Yellow-flowered alfalfa was more competitive than the grasses in plots where grass stands were less than 20%. With abundant moisture, respectable yields and acceptable forage quality were obtained from plots containing only yellow-flowered alfalfa or yellow-flowered alfalfa and 'Manska' pubescent wheatgrass and 'NU-ARS AC2' crested wheatgrass mixture. However, before NRCS or NDSU can validate the compatibility of yellow-flowered alfalfa and cool season grass mixtures of native and introduced grasses, additional data is required from replicated plantings using appropriate experimental methods and procedures.

The yellow-flowered alfalfa in this demonstration planting was released as 'Sholty' yellow-flowered alfalfa in 2015 by the South Dakota Agricultural Experiment Station, South Dakota State University, Michigan Agricultural Experiment Station, Michigan State University, USDA-

NRCS Bismarck Plant Materials Center, Bismarck, North Dakota and USDA-NRCS Rose Lake Plant Materials Center, Lansing, Michigan. It was tested as SD201 prior to naming it as the cultivar ‘Sholty’.

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