Annual Forage Species Production after Spring Triticale Harvested for Hay in the Missouri Coteau Region of North Dakota

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Double cropping in North Dakota is a gamble due to unpredictable rainfall and a short growing season. It may be unfeasible for grain production systems; however, it may be more feasible for annual forage production systems. The first forage crop could be harvested earlier than the corresponding grain crop by either grazing or haying, and the following forage crop could use the rest of the growing season to produce enough forage for late-season grazing. In this study, five each of annual cool-season grasses, warm-season grasses, legumes and brassicas were seeded into spring triticale stubble harvested for hay to evaluate species performance in a double cropping system. The information generated can be used for species selection and cover crop mixtures specifically targeted for double cropping systems in North Dakota.

Summary

Forage barley (varieties Robust and Haybet), hairy vetch and cabbage produced the highest yields among the cool-season grasses, legumes and brassicas, respectively. The annual warm-season grasses seeded after spring triticale hay harvest neither germinated well nor produced harvestable forage.

Dry matter content and maturity stage at the time of the first killing frost varies among the annual forage species. Forage mixtures would be necessary to balance dry matter content, production and quality for late-season grazing.

Introduction

In North Dakota, warm-season crops such as corn and soybean, plus some oil crops such as sunflowers, are harvested after the first killing frost, usually starting in late September. However, small grains, other oil crops such as canola and flax, and some pulse crops such as field peas, lentils and dry beans are harvested around the end of July to the end of August. For these early maturing crops, two to three months of the growing season remains without a crop in the field after the first crop is harvested.

Without green cover, three problems may arise. First, weeds may proliferate, especially glyphosate-resistant weeds such as kochia and waterhemp. Weed invasion can be unappealing visually and, at the same time, raise difficulties for next year's crop.

Second, soil erosion due to shortage of vegetation cover is a problem. Other soil health factors such as soil organic matter accumulation, biological activity and salinity level also will be impacted negatively without good cover.

Third, a loss of income results from idle acreage. Planting annual forages after harvesting an early maturing crop is an option to control weeds, improve soil health and extend late-season grazing.

Limited soil moisture and a short growing season are the challenges to double cropping systems in North Dakota. For row-crop production, the chance of a successful second crop is heavily dependent on timely rainfall and the date of the first killing frost. However, if we grow annual forages for the first crop, the soil moisture could be conserved and the growing season could be lengthened due to early harvest for hay, compared with harvest for grain.

We selected spring triticale as our first forage crop because it is intermediate between early maturing barley and later-maturing oats. Annual forage species that fit the double cropping situation should establish quickly in a warm and dry seedbed, produce enough biomass to cover soils, mature quickly, foster microorganisms to act and maintain high forage quality up to the first killing frost.

Monocultures of these species should be tested. Then mixtures can be evaluated to develop a balance of production, quality and diversity.

The objective of this study is to test different annual forage species that belong to one of four groups: cool-season grasses, warm-season grasses, legumes and brassicas.

Procedures

The study was carried out at the Central Grasslands Research Extension Center in 2014. Spring triticale (Tyndal) was seeded on May 23 as the first forage crop. Prior to seeding (May 21), glyphosate was applied to eliminate existing weeds in the seedbed. After germination and a good stand was established, 100, 50 and 60 pounds per acre of nitrogen, phosphorus and potassium were broadcasted as urea, monoammonium phosphate and potash, respectively. The spring triticale was harvested at the late anthesis stage as hay on July 23.

Five species/varieties each of annual cool-season grasses, warm-season grasses, legumes and brassicas were seeded on July 31 (Table 1). Each of these species/varieties was no-till drilled into the spring triticale stubble. Each plot was 5 by 20 feet. Before seeding, the existing weeds were eliminated with glyphosate, and no further weed control measures were used. No fertilizers were applied for the second crop.

Each plot was evaluated visually for seeded species establishment. The establishment scale was: failed (no seedlings of seeded species and covered by weeds), poor (sparse seedlings of seeded species and covered by weeds at least 50 percent), fair (regularly spaced seedlings of seeded species and covered by weeds at most 50 percent) and excellent (dense seedlings of seeded species and covered by weeds at most 25 percent).

Each plot was harvested on Oct. 23after the first killing frost. Oven-dried subsamples were used to calculate forage production on a dry matter basis. Forage samples were ground for future lab analysis of forage quality.

Table 1. Double cropping of spring triticale for forage followed by annual forage species/varieties screened and evaluated at the CGREC in 2014.

Species/Variety	Height (inch)	Dry Matter Content (%)	Production (tons/acre dry matter)	Color	Maturity Stage
Spring Triticale/Tyndal	45	26	4.81	Green	Late-anthesis
Cool-season Grasses					
Barley/Haybet	24	18	2.75	Green	Vegetative
Barley/Robust	25	19	3.04	Green	Booting
Oats/Everleaf126	17	15	2.27	Green	Vegetative
Oats/Streaker	19	18	2.12	Green	Vegetative
Triticale/Trical141	14	22	1.56	Green	Vegetative
Warm-season Grasses					
Foxtail millet/German	NA	NA	NA	Yellow	Germinate
Pearl millet/MS2500	NA	NA	NA	Yellow	Germinate
Sorghum/Sweetie	NA	NA	NA	NA	No seedlings
Sudangrass/Piper	NA	NA	NA	Yellow	Germinate
Sorghum-sudan/Cow Conditioner BMR	NA	NA	NA	NA	No seedlings
Legumes					
Berseem Clover/VNS	8	29	1.01	Green	Vegetative
Peas/4010	14	19	1.17	Green	Vegetative
Peas/Granger	14	19	1.07	Green	Vegetative
Soybeans/Big Buck8L	NA	NA	NA	Brown	Germinate
Hairy Vetch/VNS	12	15	1.51	Green	Vegetative
Brassicas					
Brassica/Pasja	14	10	2.66	Green	Vegetative
Cabbage/Ethiopian	20	10	3.08	Green	Vegetative
Radish/Bio Till	16	12	2.42	Green	Vegetative
Rape/Barnapoli	21	10	2.59	Green	Vegetative
Turnip/Purple Top	15	12	2.33	Green	Vegetative

Results

The first forage crop, spring triticale, grew well, with a yield of 4.81 tons/acre dry matter (Table 1). For the second crop, all cool-season grasses were still green after the first killing frost with low dry matter content.

The early maturing cool-season grass barley produced more dry matter on a land area basis than the late-maturing cool-season grasses (Table 1). The only species in the boot stage when harvested was Robust barley, and it produced the highest biomass.

The warm-season grasses failed to germinate (sorghum and sorghum-sudan hybrids) or failed to produce a harvestable crop (foxtail millet, pearl millet and sudangrass) at the time

of the first killing frost.

In the annual legumes group, soybeans did not produce harvestable forage. The biennial legume hairy vetch produced the most biomass in the group. Cabbage grew tall and had the highest production in the brassica group. Legumes as a group produced less biomass, compared with cool season-grasses and brassicas.

Discussion

Weather in the seeding year plays the most important role in growth of the double cropping annual forages. Soil moisture availability determines the success of these annual forage species. In 2014, the timely rainfall gave them a great start, and that may explain the high production levels for the annual cool-season grasses and brassica species we evaluated.

The growing season length determines the species selection based on their maturity stage. The short growing season left after the spring triticale harvest favored the early maturing cool-season grasses such as barley (Robust). At the same time, annual warm-season grasses did not have time to produce harvestable forage.

Seeding annual warm-season grasses to produce harvestable forages later than the end of July is not feasible in North Dakota, so we can omit annual warm-season grasses in our cover crop mixture for double cropping systems. Soybeans, a warm-season legume, produced poorly, compared with cool-season legumes, for the same reason. Brassicas are cold-tolerant, short-season crops and that do well with late-season planting.

The first crop species and the corresponding harvesting schedule play big roles in the second crop's performance. Spring triticale is intermediate to early maturing barley and later-maturing oats. The maturity stage will determine the harvesting schedule.

In turn, the timing of the harvest affects the soil moisture availability and growing season length. For the double cropping system evaluated here, we have to consider the first crop species in a site-specific context. We may plant an early maturing species if we want higher production in the second crop. Otherwise we could select a later-maturing species to produce more for early season forage.

Another factor we can consider is harvesting the spring triticale in an earlier maturity stage. We harvested it in the late anthesis stage. We can harvest spring triticale in the boot stage and save about 10 days for the second crop. By doing so, spring triticale production will be lower, but quality would be higher. Future projects will study species selection for the first forage crop and harvest timing corresponding with this selection.

Dry matter content is an issue for late-season grazing that affects livestock performance. Annual brassicas have high yields; however, animal gain may suffer due to the low dry matter content. We propose that we can use the first crop of spring triticale hay for late-season grazing along with the second crop. We will test this management scenario in the future.

Late-planted annual forages should have higher forage quality due to the low temperatures in the fall and harvest at earlier maturity stages. However, we need lab analysis to justify this hypothesis. We will analyze the quality of the samples and report quality data in 2015.

One year of data cannot promise comprehensive results, so we will continue this study in 2015. Fencing and water presentation may be issues for cropland grazing. However, putting animals back on the landscape will return nutrients to the soil and increase profitability.


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