Evaluation of Growth Stimulants and Fertilizers on 2012 Early Season Spring Smooth Brome Production, Butler County, NE

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ABSTRACT

Nine treatments were applied to smooth brome on March 23, 2012, to evaluate their effect on increasing forage production. RyzUp SmartGrass® (active ingredient = gibberellins (GA_3)) treatments were the only treatments which resulted in significantly taller plants by 6 days post treatment, and continued to be significantly taller for 6 weeks post treatment. Inclusion of 2,4-D with RyzUp SmartGrass® resulted less growth than other RyzUp SmartGrass® treatments, but greater than untreated smooth brome. SmartGrass RyzUp® resulted in increased forage production even under very low nitrogen and phosphorus levels. Hay yields and associated economic data were unable to be collected due to drought conditions in 2012.

Introduction

Local forage production has high interest due to the convergence of three factors: high corn prices which have resulted in conversion of some pastures to corn fields; high prices for livestock and associated feedstocks; and lower availability of forage, driven in part by drought conditions from Texas northward the past few years as well of conversion of many area pastures to row crops.

These upward pressures on local pasture grass production and resultant forage availability have renewed interest in the economics of increasing forage production, especially those with established smooth brome (*Bromus inermis*). There are products available for usage on grasses, including several fertilizer products, as well as number of recently available growth enhancement products and other technologies, such as lipochitooligo saccharides. Few comparative studies exist for these products, and for some products, no data exist for their effects on brome grass production.

This experiment was initiated to evaluate and compare a number of products that may be economically feasible to use with the current higher prices of grass hay, as well evaluate one product in combination with a herbicide. As there are few data existing for many products in association with brome grass production, a high level of interest exists due to the potential economic benefit as grass prices in October 2011 were already $125-135/ton for small square bales in northeast Nebraska (USDA Ag Market News - Nebraska/Iowa Hay Summary for weed ending Oct. 28, 2011).

Methods and Materials

An established smooth brome hay field was located approximately one mile north of Garrison, NE. This field has a history of fairly high hay yields, partially due to fertilization with 100 lbs./acre of 32-0-0 on an every other year basis. This field was fertilized in April 2011. Soil samples taken during the experiment noted very low levels of soil nitrate (5 lbs./acre in the top 8 inches of soil) as well as phosphorus (7 ppm, Mehlich method) in received analyses (Ward Laboratories, Kearney, NE).

Due to irregular plant residue heights remaining from previous year, plot area was mowed with a riding lawn mower prior to experiment initiation to eliminate residue from intercepting spray. Plot area was twice mowed on Saturday, March 17, 2012 to a height of 1.75 inches, first perpendicularly to plot lengths, and then again at a 30° angle across plots, allowing the strong winds to evenly disperse mowed residues.

Treatments were applied mid-afternoon Friday March 23 after regrowth was evident with a ShurFlo 600 back-pack sprayer equipped with a boom containing four Lurmark 04F80 flat fan nozzles, with spray volume at 28 gallons/acre, with treatment design being a randomized complete block utilizing four replications. All applied treatments utilized the non-ionic organosilicone surfactant ABG-7011 at 0.025% v/v. Weather conditions consisted of temperatures in the 60°s F, a slight breeze, and partially sunny/overcast during application. Plots were 25 foot long x 7 foot wide.

The nine treatments involved products that had plant hormones, fertilizers, growth stimulants and/or combinations thereof, and comparted to an untreated check. Products utilized singly in this experiment were as follows.

BG20+ (BioGreen USA Inc.). This product contains 20% nitrogen (as feed grade urea), 0.5% soluble potash, 1% sulfur, 1% iron, and trace amounts of magnesium, calcium, manganese, zinc and copper in addition to 5% humic acid, 3.5% fulvic acid, and 1% North Atlantic Kelp (*Ascopyhlum nodosum*). The latter product also contains cytokinins (a type of plant hormone). Each gallon weighs 9.5 lbs./gallon and 2.2 lbs. of nitrogen according to the BGAG 20-0-0.5 Complete Hay Nutrition label.

GreenSol™ 48 (FRIT Industries, Ozark, AL) contains the plant hormones kinetin and gibberellic acid in an 8-20-20 water-soluble fertilizer base (from which the number 48 is arrived). This product is designed to promote plant vigor, early maturity, higher yields and improved crop quality. Product usage is also marketed via faster transition from the vegetative to reproductive stage of plant development resulting in heavy bloom and fruit set for some crops. GreenSol™ 48 is typically used early in the plant growth cycle between first true leaf and bloom development, however few data exist for effects on perennial grass crops. The product is also referenced hereafter as GS-48 in this report. GS-48 was evaluated at both 4 and 8 oz./acre in this experiment.

ProSol 20-20-20 (Frit Industries, Ozark, AL) is a water soluble fertilizer that contains 20% nitrogen (3.9% ammoniacal, 5.8% nitrate, and 10.3% urea), 20% P_2O_5, 20% K_2O, 0.02% boron, 0.05% copper, 0.1% iron, 0.05% manganese, 0.0005% molybdenum and 1% chlorine. This product was applied at the rate of 3 lbs./acre.

Ratchet™ (Novozymes BioAg Inc.) contains a unique LCO (lipo-chitooligosaccharide) molecule which enhances nutritional capabilities that improve nutritional capabilities that drive natural growth processes; maximizing plant health and crop performance. While Ratchet™ is currently available for use in annual crops such as corn and soybeans, previous experimentation data for this product on perennial grasses are unknown. Ratchet™ was used at the rate of 4 oz./acre.

RyzUp SmartGrass® (Valent USA) is a naturally occurring plant growth regulator (giberellic acid 3) that promotes growth, and is thought to maintain quality and improve forage yields when cool temperatures limit natural plant growth. This product is also OMRI listed. Valent USA representatives have indicated that no experimental data for this product in association with smooth brome are known to exist. RyzUp SmartGrass® was applied at the rate of 0.3 oz./acre.

Vitazyme® (Vital Earth Resources, Gladewater, TX) is an all natural biostimulant concentrate microbially synthesized from plant materials. Its label states that it works through multiple active agents and multiple modes of action. Vitazyme® stimulates the indigenous soil microbiota to work more efficiently, thus improving the availability of soil nutrients, and is also thought to increase root growth. There are many compounds in Vitazyme®, including brassinosteroids, 1-triacontanol, kinetin, gibberellic acid, indoleacetic acid, biotin, folic acid, niacin, pantothenic acid, and vitamins B1, B2, B6 and B12. Vitazyme® was applied at 13 oz./acre.

Two combination treatments were also included in this experiment. One such combination was ProSol 20-20-20 + RyzUp SmartGrass® with both products using the same rates as previously noted.

The second combination treatment was Lo-Vol 6 2,4-D (Tenkos® Inc., formulation = 2-ethylhexyl ester of 2,4-dichlorophenoxyacetic acid; 5.5 lbs. 2.4-D/gallon) applied at a rate of 5.33 oz./acre plus RyzUp SmartGrass® (0.3 oz./acre). This combination was included as local producers will desire to apply combination treatments to save time and application costs.

The rate of LoVol 2,4-D used in this experiment was below the bottom labeled rate for pastures/and rangeland (10.67 oz./acre), but was equal to the lowest labeled rate (5.33 oz./acre) noted for certain applications of this product on small grains (wheat, barley, rye), oats, corn, and sorghum. There are no known data for the combination of RyzUp SmartGrass + 2, 4-D on any grass species, hence the need for data development.

Sampling

Natural Plant Heights

Plots were evaluated on March 29, April 6, 13, and 21, and May 3, 11, 18 (6, 14, 21 and 29 days after treatment (DAT) respectively). Plant height measurements consisted placing a yardstick in five locations in each plot and noting the natural plant height, measured to the last numeral inch increment which was no longer visible on the ruler.

Very windy conditions were noted on several dates (14, 21, 29 DAT) which may have decreased natural plant heights (bend in top leaf). Rainfall was lacking the first 20 days after application, with approximately 2.5+ inches of rainfall received from April 12-15.

Extended leaf heights

While plant height was used for most measurements, it was felt that a more definitive measurement may be that of extended leaf heights. This was partially due to winds during many of the sample dates as well as noting that the natural plant height (roughly the top of the stem plus some leave arch) may be providing a different result in growth measurement than visually noted for certain treatment effects resulting in much longer leaves in addition to stem growth increases.

Extended leaf heights data were collected on April 21 and May 11. Five plants/plot were sampled by taking a plant, lifting leaves and recording distance from soil line to tip of uppermost extended leaf (nearest 1/4 inch of growth).

Chlorophyll

Chlorophyll data were obtained only once during this experiment at 6 days after treatment (March 29) utilizing a Minolta 502 SPAD meter. Eight leaves/plot were sampled.

Data Analyses

Data were analyzed and treatment means statistically separated using the Tukey-Kramer Honestly Significant Difference (HSD) test (JMP 8.0.2, SAS Institute Incorporated, Cary, NC).

Results and Discussion

The 2012 growing season was very unusual in that March temperatures were very high, which allowed field and growing conditions to be about 5 weeks earlier than normal. This was evidenced by this experiment's applications to growing smooth brome in late March. Warm conditions existed for much of the year, with 2012 noted as a drought year during the summer due to high temperatures and much below normal rainfall. This followed a very dry fall in 2011, thus increasing moisture stress upon the experimental area.

Some frost damage was noted to the uppermost surfaces of smooth brome leaves in April, however, this did not appear to affect plant growth. Plant growth in this experiment was noted to increase until early May, with reduction of plant growth noted in association with some treatments by May 11. Smooth brome plant height reduction was noted from May 11 to May 18, due to lack of moisture combined with low fertility levels as noted from soil samples. Smooth brome with the greatest growth were noted to have the earliest symptoms of nitrogen deficiency in this experiment. These observations were not quantified in this experiment however.

The lack of rain, high temperatures and low soil fertility resulted in a great lack of forage production after May. Forage yields similar to those for a normal harvest were unable to obtained in this experiment, thus preventing economic analyses based on typical forage production.

Chlorophyll levels/SPAD readings

No statistical differences were noted on March 29 for SPAD readings of chlorophyll activity. Highest level (47.3) was noted in smooth brome treated with BG20+ (Table 1), which also had the highest level of nitrogen applied/acre (4.4 lbs.) of any treatment in this experiment.

While most treatments resulted in mean SPAD meter reading were very similar to slightly higher than untreated smooth brome (44.2), treatments which had RyzUp SmartGrass® in them resulted in similar to slightly numerically less mean SPAD meter readings than untreated smooth brome (Table 2). This is not necessarily surprising as faster plant growth often results in less concentrated chlorophyll and accompanying lower SPAD meter readings.

Chlorophyll levels/SPAD meter data were not collected on subsequent sample dates, therefore determining the duration of relationships for chlorophyll levels associated with the differing treatments relative to untreated smooth brome was not achieved.

Natural plant height

Treatments containing RyzUp SmartGrass® were the only treatments that resulted in significant smooth brome growth increases as a measurement of natural plant height at any time in this experiment (Table 2). Smooth brome growth increases due to RyzUp SmartGrass® treatments were evident by the first sample date (March 29, 6 days post treatment) and were easily discernable through May 3 (Fig. 1). Natural height of the RyzUp SmartGrass® + ProSol 20-20-20 treatment was more than 3 inches taller than untreated smooth brome by April 6 (Fig. 2, 14 days post treatment) with this amount of difference or more noted throughout April and into early May (Table 2). Mean growth of smooth brome in this experiment is shown in Figure 1.

The combination treatment of RyzUp SmartGrass® + ProSol 20-20-20 also resulted in slightly numerically taller smooth brome than RyzUp SmartGrass® treatment alone. While the increased height differences ranged from 2.3-11.7% from April 6-May 11 and averaged slightly over 8% for this time period, the differences were not statistically different when all treatment means were included.

Plants receiving the combination treatment of RyzUp SmartGrass® + the herbicide LoVol 6 2,4-D in this experiment were significantly taller than untreated smooth brome for all sample dates though April, but also significantly shorter than smooth brome treated with RyzUp SmartGrass® or RyzUp SmartGrass® + ProSol 20-20-20 (Table 2).

The usage of 2,4-D by itself has previously been noted to reduce smooth brome growth in Nebraska (McCarty and Scifres, 1968) and was further affected by rate and inclusion of nitrogen fertilizer. Additional research is necessary to document herbicide interactions with RyzUp SmartGrass® for future potential combination applications, as the rate of 2,4-D in this experiment (5.33 oz./acre of LoVol 6) was very low. The petroleum distillates contained in this formulation may also be a factor in the noted yield reduction noted for the RyzUp SmartGrass® + the LoVol 6 2,4-D combination treatment relative to RyzUp SmartGrass®alone.

All other treatments resulted in very similar smooth brome height to that of untreated smooth brome early through April 21 (Table 1), when slight numerical increases were noted for treatments. Of the non-RyzUp SmartGrass® treatments, smooth brome natural height was noted tallest in plots treated with BG 20+ on April 13 and 21, with a 0.8 inch height difference noted when compared with untreated smooth brome the latter sample date (Table 2). It is not surprising that some effect was noted from the BG 20+ treatment as this contained the highest amount of nitrogen/acre (4.4 lbs.) of all the treatments, and soil nitrogen levels were very low in this experiment.

Extended leaf Height

As strong winds often buffeted plot areas during sampling for natural height measurements and may have affected such relative to treatment differences, extended leaf height measurements would not have been so affected.

Extended leaf heights trends on April 21 mirrored those of natural plant heights (Table 3). Greater differences existed between RyzUp SmartGrass® treated vs. untreated smooth brome for extended leaf height than when examining natural forage height (Table 3), as numeric increases in extended leaf heights were greatest for RyzUp SmartGrass® treated smooth brome (minimum of 2.9 inches of increase in comparison). All non-RyzUp SmartGrass® treatments resulted slightly less (approximately 2.2-2.5" taller) smooth brome height differences when comparing extended leaf height with forage height on this sample date (Table 3). Trends for statistical differences were similar for extended leaf heights and forage/natural height, but with greater clarity as less overlap between treatment mean separations were noted for extended leaf heights.

Although differences in extended leaf height ranged from 2.2-3.0 inches when compared with forage/natural leaf height, the percentage difference was much greater and somewhat reversed (Table 3), ranging from only 40.6% for the tallest smooth brome (RyzUp SmartGrass® + 20-20-20) to 80.7% in the shortest (untreated).

Conclusions

Application of RyzUp SmartGrass® resulted in increased smooth brome growth in this experiment. This was especially noteworthy as it was the first time that this product had been evaluated on smooth brome. Increases were noted under low fertility and moisture production conditions, indicating increased early forage production and applicability for Nebraska under such conditions It is unknown if growth responses will be similar or greater under normal conditions. While application of other products included in this experiment did not result in significant growth increases, the low fertility and lack of sufficient moisture may have limited their effects on smooth brome growth.

Inclusion of a formulation of 2,4-D with RyzUp SmartGrass® resulted in less smooth brome growth than RyzUp SmartGrass® by itself, thought due to 2,4-D interactions with smooth brome, however, the possibility of antogonism exists. Additional research is necessary to document herbicide interactions with RyzUp SmartGrass® for future potential combination applications, as the rate of 2,4-D in this experiment (5.33 oz./acre of LoVol 6) was very low.

While final economics for this study were unable to be obtained due to lack of yields, the cost associated with RyzUp SmartGrass® ($7/acre + surfactant and application) appear to make this product very promising from an economical aspect based upon early increased forage production. More research and actual yields will be necessary for data development to adequately address economic aspects.

Literature Cited

McCarty, M.K., and C.J. Scifres. 1968. Smooth bromegrass response to herbicides as affected by time of application in relation to nitrogen fertilization. Weed Science. 16(4): 443-446.

Acknowledgements

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Table 1. Smooth brome leaf chlorophyll levels and height on March 29 as measured by a SPAD 502 meter following treatments applied on March 23, 2012, Garrison, NE.

Treatment	Rate/acre	Height	Chlorophyll reading
BioGerminator 20-0-0.5+	2 gal.	3.6 b	47.3a
GreenSol™ 48	4 oz.	3.6 b	46.7a
ProSol 20-20-20	3 lbs.	3.95 b	45.8a
GreenSol™ 48	8 oz.	3.8 b	45.8a
Ratchet™	4 oz.	3.5 b	45.5a
Vitazyme®	13 oz.	3.7 b	45.2a
Untreated	-----	3.6 b	44.2a
RyzUp SmartGrass®	0.3 oz	5.5a	44.2a
RyzUp SmartGrass® + LoVol 6 2,4-D	0.3 oz 5.33 oz.	4.5ab	43.9a
RyzUp SmartGrass® + ProSol 20-20-20	0.3 oz 3 lbs.	5.3a	41.9a

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ *level (Tukey-Kramer HSD test,* JMP 8.0.2).

Table 2. Smooth brome (*Bromus inermis*) forage height (inches) following treatments applied on March 23, 2012, Garrison, NE.

		Sample Date						
Treatment	Rate/acre	March 29	April 6	April 13	April 21	May 3	May 11	May 18
RyzUp SmartGrass® + ProSol 20-20-20	0.3 oz 3 lbs.	5.3a	6.7a	6.7 a	7.1a	8.6a	7.6a	6.9a
RyzUp SmartGrass®	0.3 oz	5.5a	6.1ab	6.55a	6.6a	7.8ab	6.8ab	6.7ab
RyzUp SmartGrass® + LoVol 6 2,4-D	0.3 oz 5.33 oz.	4.5ab	5.3 b	4.85 b	5.2 b	6.8abc	5.9 bc	5.8ab
Vitazyme®	13 oz.	3.7 b	3.6 c	3.55 c	4.1 bc	6.0 bc	5.8 bc	5.4ab
ProSol 20-20-20	3 lbs.	3.95 b	3.5 c	3.65 c	4.2 bc	5.9 c	5.7 bc	5.5ab
BioGerminator 20-0-0.5+	2 gal.	3.6 b	3.6 c	3.95 bc	4.3 bc	5.6 c	6.0 bc	5.5ab
Ratchet™	4 oz.	3.5 b	3.5 c	3.45 c	3.9 c	5.3 c	5.7 bc	5.1ab
GreenSol™ 48	4 oz.	3.6 b	3.5 c	3.45 c	4.0 bc	5.2 c	5.3 c	5.0 b
GreenSol™ 48	8 oz.	3.8 b	3.3 c	3.60 c	3.7 c	5.1 c	5.6 bc	5.2ab
Untreated	-----	3.6 b	3.6 c	3.45 c	3.5 c	5.4 c	5.8 bc	5.5ab

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Tukey-Kramer HSD test, JMP 8.0.2).

Table 3. Smooth brome (*Bromus inermis*) extended leaf height and forage height comparisons (inches) on April 21 and May 11 following treatments applied on March 23, 2012, Garrison, NE.

		April 21				May 11		
		Height (inches)		Height (in.)	Percent	Height (inches)		Height (in.)
Treatment	Rate/acre	Forage	Extended	Difference	increase	Forage	Extended	Difference
RyzUp SmartGrass® + ProSol 20-20-20	0.3 oz. 3 lbs.	7.1a	10.0 a	2.9a	40.6a	7.6a	8.3a	0.7
RyzUp SmartGrass®	0.3 oz.	6.6a	9.6ab	3.0a	45.6a	6.8ab	7.2ab	0.4
RyzUp SmartGrass® + LoVol 6 2,4-D	0.3 oz. 5.33 oz.	5.2 b	8.2 b	3.0a	57.4a	5.9 bc	6.2 bc	0.3
BioGerminator 20-0-0.5+	2 gal.	4.3 bc	6.6 c	2.3a	53.1a	6.0 bc	6.1 bc	0.1
ProSol 20-20-20	3 lbs.	4.2 bc	6.5 c	2.4a	56.8a	5.7 bc	6.2 bc	0.5
Vitazyme®	13 oz.	4.1 bc	6.3 c	2.2a	57.1a	5.8 bc	5.5 c	- 0.3
Ratchet™	4 oz.	3.9 c	6.2 c	2.4a	62.3a	5.7 bc	5.8 bc	0.1
GreenSol™ 48	4 oz.	4.0 bc	6.2 c	2.2a	54.8a	5.3 c	5.9 bc	0.6
GreenSol™ 48	8 oz.	3.7 c	6.2 c	2.5a	74.1a	5.6 bc	5.6 c	0.0
Untreated	-----	3.5 c	6.2 c	2.7a	80.7a	5.8 bc	5.7 c	- 0.1

Means in columns followed by the same letter are not statistically different at the p≤0.05 level (Tukey-Kramer HSD test, JMP 8.0.2).

Figure 1. Natural Plant Height of Smooth Brome Following Application on March 23, 2012, Garrison, NE.

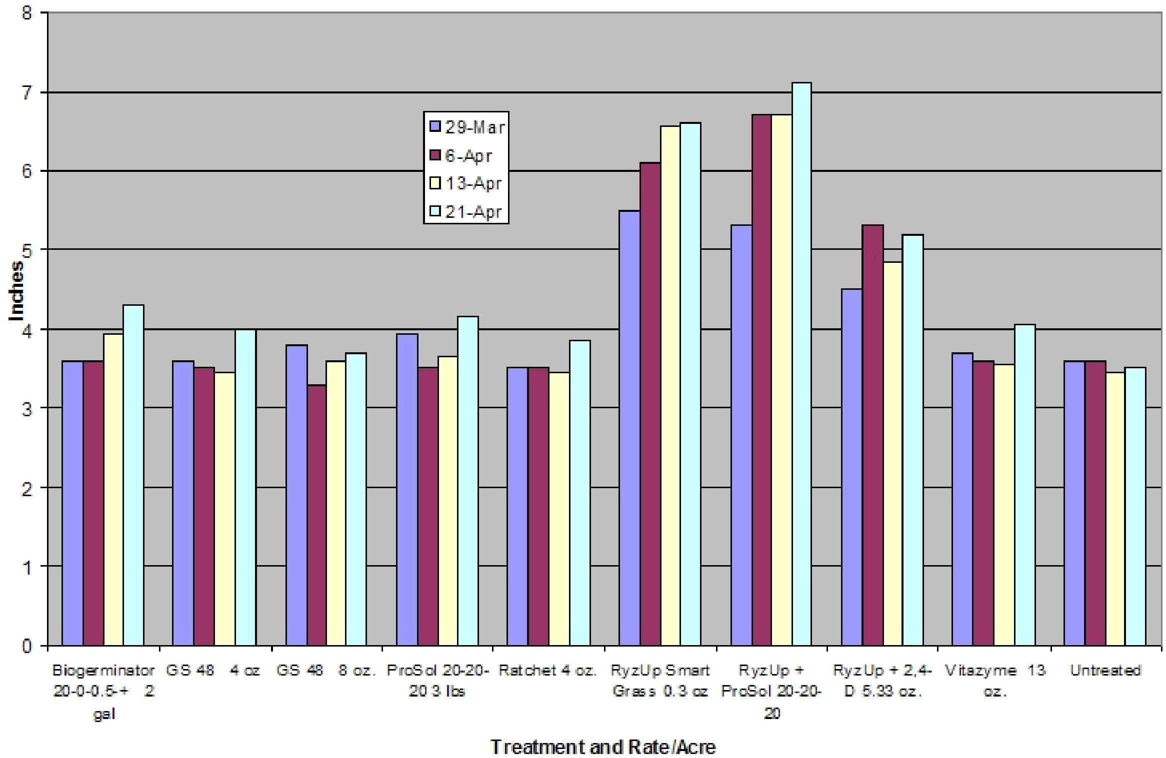

Fig. 2. Smooth brome plots with growth differences, April 9, 2012,