Applying Biostimulant Products in Pasture and Winter Wheat in Western Colorado 2012

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Summary

Producers are interested in identifying and adopting technologies that are profitable, sustainable, and productive. A number of biostimulant products are commercially available. These products are designed to stimulate beneficial microflora, balance soil pH for a more favorable release of soil nutrients, and provide essential micronutrients, among other things. The objective of this research during the 2012 growing season was to evaluate biostimulant products by Enviro Consultant Service (ECS)[2] for their performance in permanent pasture and winter wheat at Fruita, Colorado. Forage in the permanent pasture includes a mixture of orchardgrass, smooth brome, tall fescue, and a small amount of alfalfa, red clover, and birdsfoot trefoil. The application of ECS biostimulant products had a dramatic positive effect on hay yields in the 2012 pasture study at Fruita and was similar to the results obtained in 2011. This effect was more pronounced at the lower N fertilizer rates and decreased as rates increased from 50 to 90 lbs N/acre, although even at the 90 lb N/acre the effect was notable. The applications of nitrogen and ECS products were effective in all three cuttings and had a positive effect on the total 2012 hay yield and the 2-year total hay yield. The application of ECS products in winter wheat did not show a consistent response across nitrogen fertilizer rates. Considerable lodging occurred in winter wheat in 2012 and there was trend for increased lodging as nitrogen rates increased. The added factor of lodging in winter wheat confounded the results making it difficult to draw conclusions about the ECS and nitrogen treatments.

Introduction

As costs for crop production inputs increase producers are increasingly interested in finding alternative technologies that reduce production input costs without harming yields. A number of products is commercially available as "biostimulants." These products are designed to stimulate beneficial microbes, balance soil pH for a more favorable release of soil nutrients, and provide essential micronutrients, among other things. In 2011, we conducted studies in a permanent pasture at Fruita and winter wheat at Hayden to evaluate the performance of biostimulant products (Pearson, 2011).

The objective of this research during the 2012 growing season was to evaluate biostimulant products by Enviro Consultant Service (ECS) for their performance in permanent pasture and winter wheat at Fruita, Colorado.

Materials and Methods

Expanded Pasture Study

A field study was conducted at the Colorado State University Western Colorado Research Center at Fruita during the 2011 growing season to determine the effects of biostimulant ECS products in permanent pasture. This study was repeated in 2012 using the same plots (Photo 1).

The elevation at Fruita is 4600 feet. The average annual precipitation is 8.4 inches and the average frost-free days are 181 (28ºF base).

The 2012 growing season was favorable for forage production. The last spring frost occurred on April 16, 2012 and the first fall frost occurred

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[2]Mention of a trade name or proprietary product does not imply endorsement by the authors, the Agricultural Experiment Station, or Colorado State University.

on October 7, 2012, thus, the frost-free days for 2012 was 174 (28°F base).

No phosphorus or potassium fertilizers were applied to the experiment area during the 2012 growing season.

Soil was sampled in each plot with two cores per plot on March 22, 2012. Two soil cores in the middle of the two center rows of each plot of the four replicates of each treatment were sampled and bulked. The soil was also sampled on each of the two long sides of the experiment at a distance of 15 feet outside of the plot area.

The soil was a Hanksville silty clay loam. Plot size was 10 feet wide by 15 feet long. The experiment design was a randomized complete block with four replications. Eight treatments were tested. Treatment descriptions, biostimulant ECS application dates, and harvest dates for the three cuttings in the pasture at Fruita during 2012 are shown in Table 1. The application rates of ECS products were Bio-Stimulant™ at 32 oz/acre plus Harvest Energy® at 32 oz/acre plus Fulvic Electrolyte at 8 oz/acre. ECS products were applied with a CO_2–powered backpack sprayer. Teejet 8004VS nozzles were used to apply treatments at 50 gallons H_2O per acre (30 psi). Distilled water was used in the biostimulant treatment solutions. The fertilizer was dry urea.

Biostimulant treatments and fertilizer were applied on the same dates and were applied on April 9, 2012, June 8, 2012, and August 6, 2012 (Table 1). Environmental conditions during application of biostimulant ECS products were excellent.

Plots were harvested with an automated forage plot harvester that was designed and constructed at the Western Colorado Research Center at Fruita (Pearson, 2007). During harvest a small forage sample was obtained from each plot and placed in a paper bag. That sample was used for moisture determination and forage quality analyses. Pasture samples were oven dried at 60°C and yields were calculated and reported on a dry matter basis.

Winter Wheat

Eight biostimulant ECS treatments were evaluated in winter wheat during the 2012 growing season at the Colorado State University, Agricultural Experiment Station, Western Colorado Research Center at Fruita, Colorado. Treatments applied to winter wheat are shown in Table 2. The application rates of ECS products for the entire growing season were Bio-Stimulant™ at 12 oz/acre plus Harvest Energy® at 12 oz/acre plus Fulvic Electrolyte at 2 oz/acre plus 1 qt/acre of 3% liquid calcium chelated with EDTA. The plot area was soil sampled prior to planting in fall 2011. The results of the soil test analysis for the 2012 plot area are shown in Table 3.

The experiment design was a randomized complete block with four replications. Plot size was 10 feet wide by 40 feet long. The seeding rate was 120 lbs/acre and planting occurred on 10 Oct. 2011. An application of 12 oz/acre of 2,4-D ester (4 lb/gallon formulation) plus 1 qt of Activator 90 in 100 gallons of water with 22 gallons/acre at 25 psi occurred on March 28, 2012 for weed control. Weed pressure was low and this application prevented weeds from having an adverse impact on yield.

An application of Lorsban at 1 pint/acre of Lorsban plus 1 quart of Activator 90 in 100 gallons of water with an application of 22 gallons/acre at 25 psi occurred on March 29, 2012 to control Russian wheat aphid. The incidence of Russian wheat aphid was low and this application prevented an increase in insect population. Russian wheat aphid was controlled with this application and did not adversely impact yield during the growing season.

Prior to planting in fall 2011, a blanket application of 200 lbs/acre of 18-46-0 was applied to the entire field on September 28, 2011. The eight biostimulant ECS treatments were applied to the winter wheat on April 10, 2012. The fertilizer was dry urea and was also applied on April 10, 2012. Environmental conditions during application of biostimulant ECS products were excellent. A CO_2-powered backpack sprayer was used to apply the ECS products. Teejet 8004VS nozzles were used to apply treatments at 50 gallons H_2O per acre at 30 psi. Distilled water was used in the biostimulant treatment solutions.

Photo 1. Biostimulant plots with sample bags following third cutting harvest on October 11, 2012 at the Colorado State University, Agricultural Experiment Station, Western Colorado Research Center at Fruita. Photo by Calvin H. Pearson.

The two middle beds (5 feet) of the 4-bed plot were harvested for yield. Harvest occurred on August 1, 2012 using an IH1440 commercial combine equipped with an electronic weighing system in the grain tank. The two middle beds (5 feet) of the 4-bed plot were harvested for yield.

A grain sample was collected from each plot at harvest and used for determining grain moistures and test weights. Grain moistures and test weights were determined using a DICKEY-john GAC2100b™ Grain Analysis Computer[3]. Grain yields were calculated and reported at 12% moisture content.

Results and Discussion

Expanded Pasture Study

In the first cutting in 2012, the application of ECS products without any fertilizer increased hay yields by 102% when compared to the check which received no fertilizer or ECS products (Table 4; Fig. 1). The application of 50 lbs N/acre with ECS products increased hay yields by 74% compared to the treatment that received 50 lbs N/acre without ECS products. The application of 70 lbs N/acre with ECS products increased hay yields by 36% compared to the treatment that received 70 lbs N/acre without ECS products. The application of 90 lbs N/acre with ECS products increased hay yields by 32% compared to the treatment that received 90 lbs N/acre without ECS products.

In the second cutting in 2012, the application of ECS products without any fertilizer increased hay yields by 71% when compared to the check which received no fertilizer or ECS products (Table 4, Fig. 1). The application of 50 lbs N/acre with ECS products increased hay yields by 45% compared to the treatment that received 50 lbs N/acre without ECS products. The application of 70 lbs N/acre with ECS products increased hay yields by 30% compared to the treatment that received 70 lbs N/acre without ECS products. The application of 90 lbs N/acre with ECS products increased hay yields by 24% compared to the treatment that received 90 lbs N/acre without ECS products.

In the third cutting in 2012, the application of ECS products without any fertilizer increased hay yields by 168% when compared to the check which received no fertilizer or ECS products (Table 4, Fig. 1). The application of 50 lbs N/acre with ECS products increased hay yields by 148% compared to the treatment that received 50 lbs N/acre without ECS products. The application of 70 lbs N/acre with ECS products increased hay yields by 33 % compared to the treatment that received 70 lbs N/acre without ECS products. The application of 90 lbs N/acre with ECS products increased hay yields by 21% compared to the treatment that received 90 lbs N/acre without ECS products.

In the total 2011 yield, the application of ECS products without any fertilizer increased hay yields by 140% when compared to the check which received no fertilizer or ECS products (Fig. 2). The application of 50 lbs N/acre with ECS products increased hay yields by 104% compared to the treatment that received 50 lbs N/acre without ECS products. The application of 70 lbs N/acre with ECS products increased hay yields by 26% compared to the treatment that received 70 lbs N/acre without ECS products. The application of 90 lbs N/acre with ECS products increased hay yields by 15% compared to the treatment that received 90 lbs N/acre without ECS products.

In the 2012 total yield, the application of ECS products without any fertilizer increased hay yields by 112% when compared to the check which received no fertilizer or ECS products (Table 4, Fig. 2). The application of 50 lbs N/acre with ECS products increased hay yields by 86% compared to the treatment that received 50 lbs N/acre without ECS products. The application of 70 lbs N/acre with ECS products increased hay yields by 33% compared to the treatment that received 70 lbs N/acre without ECS products. The application of 90 lbs N/acre with ECS products increased hay yields by 26 % compared to the treatment that received 90 lbs N/acre without ECS products.

In the two-year total yield, the application of ECS products without any fertilizer increased hay yields by 123% when compared to the check which received no fertilizer or ECS products (Table 4, Fig. 3). The application of 50 lbs N/acre with ECS products increased hay yields by 93% compared to the treatment that received 50 lbs N/acre without ECS products. The application of 70 lbs N/acre with ECS products increased hay yields by 30% compared to the treatment that received 70 lbs N/acre without ECS products. The application of 90 lbs N/acre with ECS products increased hay yields by 21 % compared to the treatment that received 90 lbs N/acre without ECS products.

Photo 2. Winter wheat containing biostimulant plots just prior to harvest on August 1, 2012 at the Colorado State University, Agricultural Experiment Station, Western Colorado Research Center at Fruita. Photo by Calvin H. Pearson.

Winter Wheat

The application of ECS products without any fertilizer was not significantly different from the non-treated control that did not receive ECS products (Table 5). The application of 25 lbs N/acre with ECS products increased grain yield by 13% compared to the treatment that received 25 lbs N/acre without ECS products. The application of 35 lbs N/acre with ECS products decreased grain yield by 16% compared to the treatment that received 35 lbs N/acre without ECS products. The application of 45 lbs N/acre with ECS products increased grain yield by 15% compared to the treatment that received 45 lbs N/acre without ECS products.

Grain moisture was affected by nitrogen application and ECS application (Table 5). The highest moisture content was in the non-treated control. The difference in grain moisture contents between the 25 lbs N/acre with and without ECS applications were not significantly different. The grain moisture content of wheat that was fertilized with 35 lbs N/acre without ECS application was similar to the grain moisture content of the non-treated control. Grain moisture contents of the wheat that was fertilized with 25 lbs N/acre with and without ECS application was similar to wheat that received 45 lbs N/acre with and without ECS products. Wheat that was fertilized with 45 lbs N/acre had the lowest grain moisture content.

Test weights (Table 5) and plant heights (Table 6) were not affected by nitrogen fertilizer application or ECS application.

Lodging was affected by nitrogen application (Table 6). A severe thunderstorm occurred on July 21, 2012 that caused considerable lodging in the winter wheat (Photo 2). The least amount of lodging occurred in the non-treated control and lodging was highest in wheat that received 45 lbs N/acre without an ECS application. At 25 lbs N/acre the difference in lodging scores was not significantly different between treatments with and without ECS application. This was also the case at both the 35 and 45 lbs N/acre rates.

Combine harvest of wheat plots with considerable lodging is difficult and these data indicate that lodging was not enhanced when ECS products were applied. Yet, the application

of ECS products with no nitrogen application resulted in wheat that had a low amount of lodging, but did not increase wheat yields. Wheat yields without applying any nitrogen and with ECS products did not increase grain yield over the non-treated control. The added factor of lodging confounded the results making it difficult to draw conclusions about the treatments in the winter wheat study.

Conclusions

The application of ECS biostimulant products had a dramatic positive effect on hay yields in the 2012 pasture study at Fruita and the response was similar to the results obtained in 2011. This effect was more pronounced at the lower N fertilizer rates and decreased as rates increased from 50 to 90 lbs N/acre, although even at the 90 lb N/acre the effect was notable. The application of nitrogen and ECS products were effective in all three cuttings and had a positive effect on the total 2012 hay yield and the 2-year total hay yield.

The application of ECS products in winter wheat did not show a consistent response across nitrogen fertilizer rates. Considerable lodging occurred in winter wheat in 2012 and there was trend for increased lodging as nitrogen rate increased. The added factor of lodging in winter wheat confounded the results making it difficult to draw conclusions about the ECS and nitrogen treatments.

Acknowledgments

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Table 1. Biostimulant ECS treatments, application dates, and cutting harvest dates for an expanded biostimulant ECS study conducted in permanent pasture at the Western Colorado Research Center at Fruita during 2011.

Treatment	Application date
First cutting – May 29, 2012	
1. Non-treated control, no fertilizer, no ECS products.	April 9, 2012
2. ECS products application only (no fertilizer)	April 9, 2012
3. 50 lbs N/acre (dry urea)	April 9, 2012
4. 50 lbs N/acre + ECS products	April 9, 2012
5. 70 lbs N/acre	April 9, 2012
6. 70 lbs N/acre + ECS products	April 9, 2012
7. 90 lbs N/acre	April 9, 2012
8. 90 lbs N/acre + ECS products	April 9, 2012
Second cutting – July 25, 2012	
1. Non-treated control, no fertilizer, no ECS products.	June 8, 2012
2. ECS products application only (no fertilizer)	June 8, 2012
3. 50 lbs N/acre (dry urea)	June 8, 2012
4. 50 lbs N/acre + ECS products	June 8, 2012
5. 70 lbs N/acre	June 8, 2012
6. 70 lbs N/acre + ECS products	June 8, 2012
7. 90 lbs N/acre	June 8, 2012
8. 90 lbs N/acre + ECS products	June 8, 2012
Third cutting – October 11, 2012	
1. Untreated control, no fertilizer, no ECS products.	August 6, 2012
2. ECS products application only (no fertilizer)	August 6, 2012
3. 50 lbs N/acre (dry urea)	August 6, 2012
4. 50 lbs N/acre + ECS products	August 6, 2012
5. 70 lbs N/acre	August 6, 2012
6. 70 lbs N/acre + ECS products	August 6, 2012
7. 90 lbs N/acre	August 6, 2012
8. 90 lbs N/acre + ECS products	August 6, 2012

Table 2. Biostimulant ECS treatments for an ECS study conducted in winter wheat at the Western Colorado Research Center, Fruita, Colorado in 2012.

Biostimulant treatments
1. Non-treated control, no fertilizer, no ECS products.
2. ECS products application only (no fertilizer)
3. 25 lbs N/acre (dry urea)
4. 25 lbs N/acre + ECS products
5. 35 lbs N/acre
6. 35 lbs N/acre + ECS products
7. 45 lbs N/acre
8. 45 lbs N/acre + ECS products

Table 3. Soil test result from soil sampling in the winter wheat field prior to planting in fall 2011at the Colorado State University, Western Colorado Research Center at Fruita, CO.

Treatment	O.M.	pH	Salts	N	P	K
	%		mmhos/cm	ppm	ppm	ppm
Soil test results at planting	1.3	7.7	0.5	22	29.7	60

Table 3 (continued). Baseline soil test result from soil sampling prior to establishing the expanded pasture study of ECS biostimulant treatments during spring 2012 at the Colorado State University, Western Colorado Research Center at Fruita, CO.

Treatment	S	Zn	Mn	Fe	Cu	B
	ppm	ppm	ppm	ppm	ppm	Ppm
Soil test results at planting	11.7	2.3	3.2	81.7	1.6	0.5

Table 4. Hay yields in a biostimulant ECS study conducted in permanent pasture at the Western Colorado Research Center at Fruita during 2012 and the two-year total hay yield.

Treatment	First cutting May 29, 2012	Second cutting July 25, 2012	Third cutting October 11, 2012	2012 Total yield	Two-year total
	Tons dry matter/acre				
Non-treated control, no fertilizer, no ECS products	0.54f	0.52c	0.44e	1.49g	2.52f
ECS products application only (no fertilizer)	1.09d	0.89b	1.18d	3.16e	5.63e
50 lbs N/acre (dry urea)	0.78e	0.60c	0.54e	1.92f	3.11f
50 lbs N/acre + ECS products	1.36c	0.87b	1.34b	3.57d	6.00de
70 lbs N/acre	1.14d	0.91b	1.46b	3.50de	6.47d
70 lbs N/acre + ECS products	1.55b	1.18a	1.94a	4.67b	8.39b
90 lbs N/acre	1.49bc	0.95b	1.62b	4.07c	7.57c
90 lbs N/acre + ECS products	1.97a	1.18a	1.96a	5.11a	9.14a
Average	1.24	0.89	1.31	3.44	6.10
LSD (0.10)	0.18	0.16	0.14	0.37	0.60
C.V.(%)	12.0	14.8	8.6	8.8	8.1

[1]Numbers within a column followed by a different letter are significantly different at P < 0.10 level of probability.

Table 5. Grain yield, grain moisture, and test weight of winter wheat applied with biostimulant ECS products at the Colorado State University Western Colorado Research Center at Fruita, Colorado in 2012.

Treatment	Grain yield		Grain moisture	Test weight
	bu/acre	lbs/acre	(%)	lb/bu
Non-treated control, no fertilizer, no ECS products	106 B	6385 B	10.1 A	61.0
ECS products application only (no fertilizer)	101 BC	6081 BC	9.7 BC	60.7
25 lbs N/acre (dry urea)	94 CD	5639 CD	9.5 CDE	60.7
25 lbs N/acre + ECS products	106 B	6383 B	9.5 CDE	60.7
35 lbs N/acre	120 A	7211 A	10.0 AB	60.9
35 lbs N/acre + ECS products	101 BCD	6262 BCD	9.4 DE	60.7
45 lbs N/acre	92 D	5531 D	9.3 E	60.5
45 lbs N/acre + ECS products	106 B	6376 B	9.6 CD	61.0
Average	103	6208	9.6	60.8
LSD (0.10)	7.1	7.1	0.3	NS
C.V.(%)	8.9	535	2.5	0.5

[1]Numbers within a column followed by a different letter are significantly different at P < 0.10 level of probability.

Table 6. Plant height and lodging of winter wheat applied with biostimulant ECS products at the Colorado State University Western Colorado Research Center at Fruita, Colorado in 2012.

Treatment	Plant height	Lodging[†]
	inches	0.2-9.0[‡]
Non-treated control, no fertilizer, no ECS products.	48.4	0.3 E
ECS products application only (no fertilizer)	48.0	0.4 DE
25 lbs N/acre (dry urea)	48.9	2.1 BCD
25 lbs N/acre + ECS products	47.9	3.2 ABC
35 lbs N/acre	48.0	1.4 CDE
35 lbs N/acre + ECS products	47.6	2.6 ABC
45 lbs N/acre	49.1	3.9 A
45 lbs N/acre + ECS products	47.7	3.2 AB
Average	48.2	2.1
LSD (0.10)	NS	1.8
C.V. (%)	1.9	68

[†]Numbers within a column followed by a different letter are significantly different at P < 0.10 level of probability.

[‡]0.2 = no lodging, 9.0 total lodged.

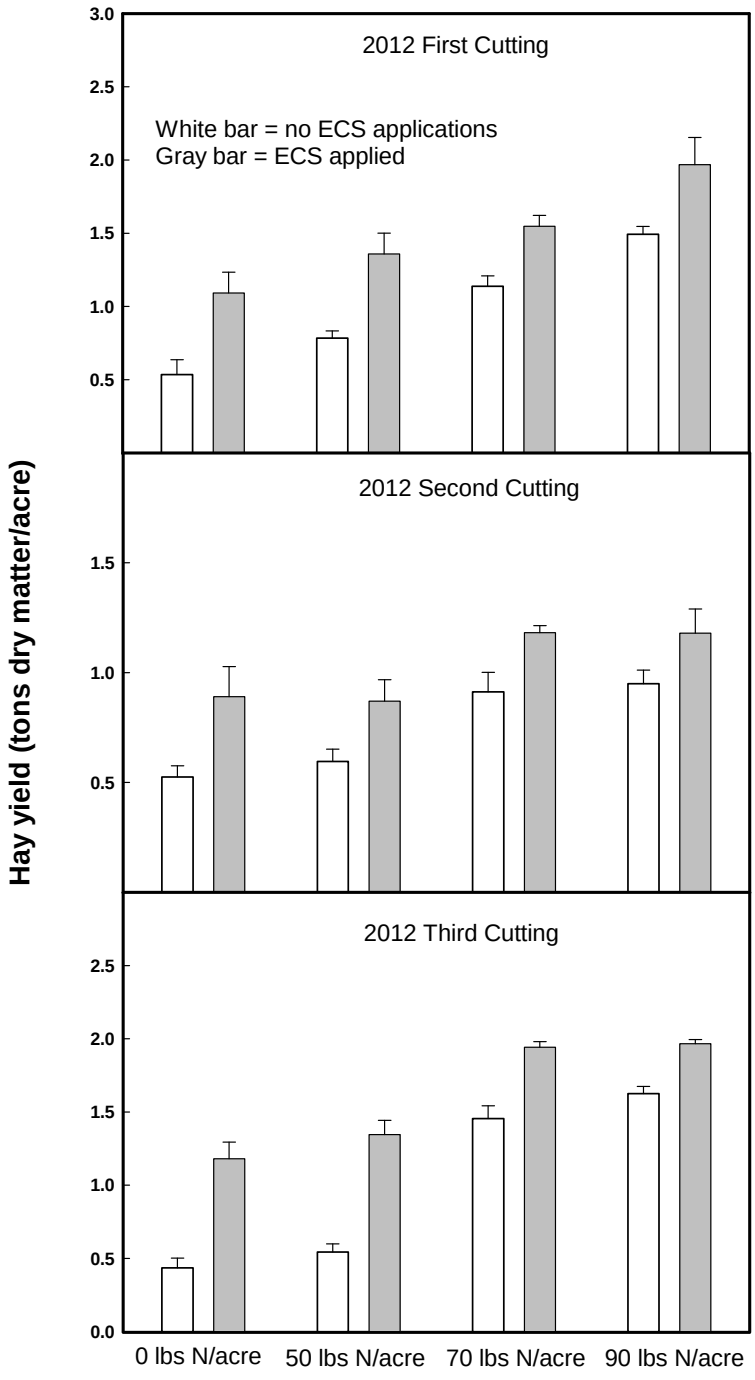

Fig.1. Pasture hay yields as affected by nitrogen fertilizer and application of ECS biostimulant products for each of three cuttings during the 2012 growing season at the Western Colorado Research Center at Fruita.

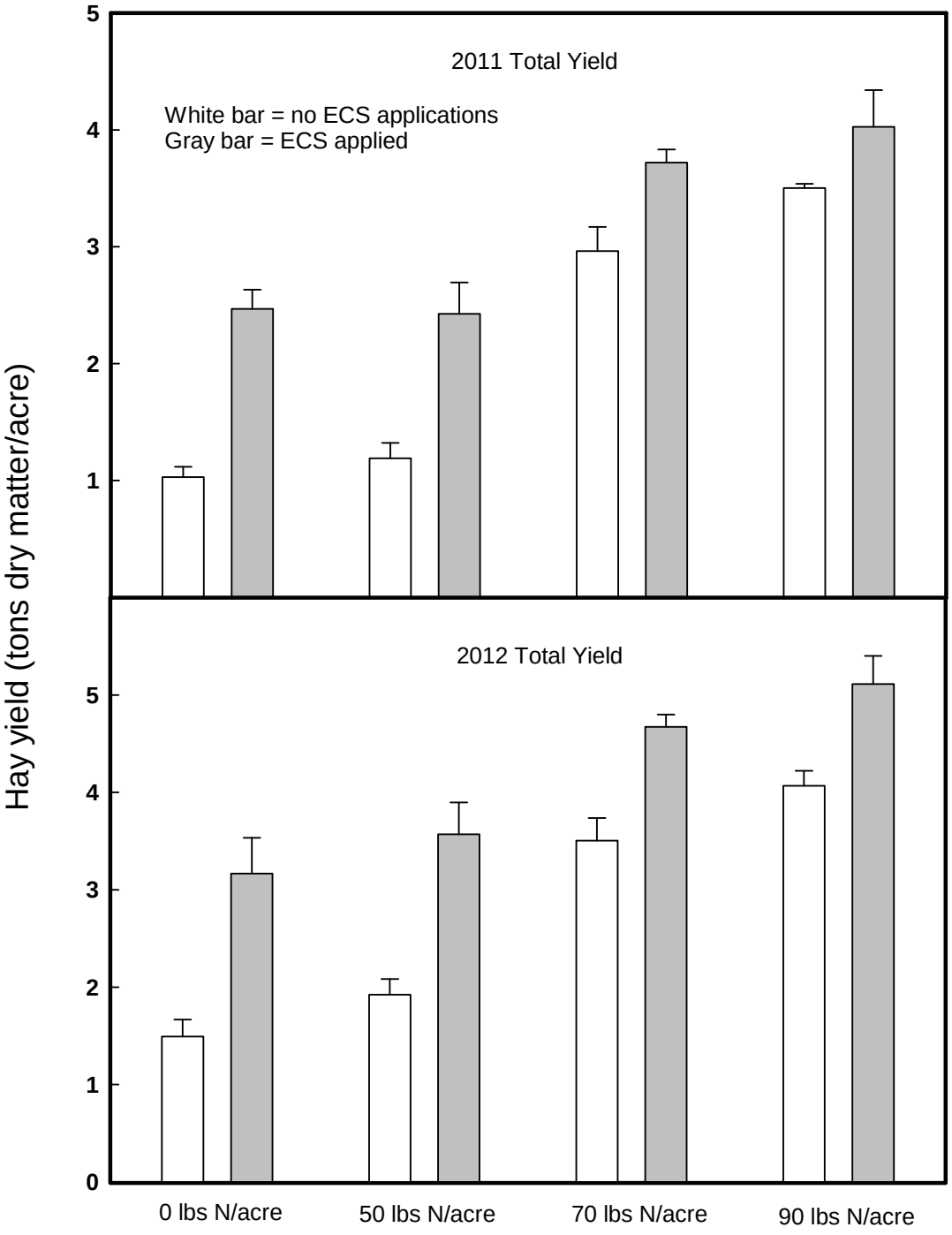

Fig. 2. Pasture hay yields as affected by nitrogen fertilizer and application of ECS biostimulant products during the 2011 and 2012 growing seasons at the Western Colorado Research Center at Fruita.

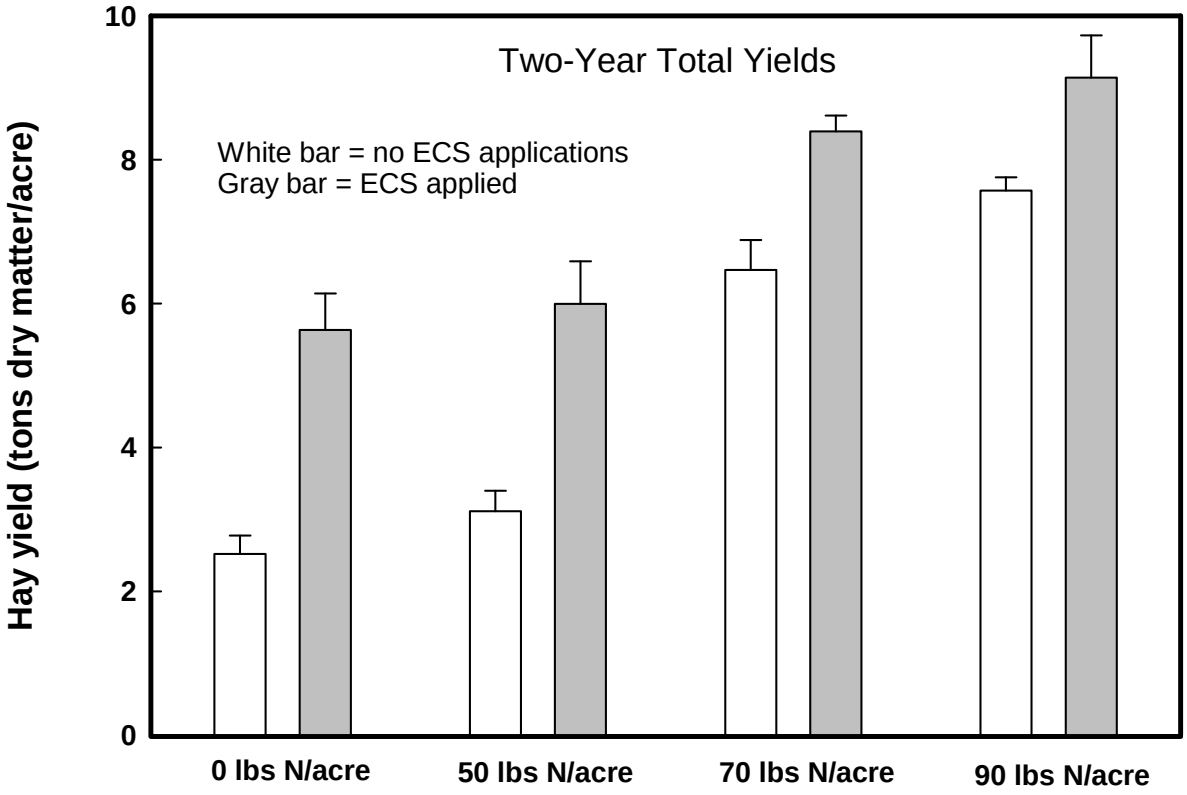

Fig.3. Two-year total pasture hay yields as affected by nitrogen fertilizer and application of ECS biostimulant products during the 2011 and 2012 growing seasons at the Western Colorado Research Center at Fruita.