HELPFUL OR NOT? – BIOSTIMULANT USE IN CORN SILAGE PRODUCTION

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ABSTRACT

There has been a recent increase in both the availability and marketing of biostimulant products to local producers, particularly to dairymen, in southern Idaho. These products claim to increase yield and nutrient use efficiency while improving soil health in agricultural fields. The objective of this study was to assess four commercially available products and one locally produced one on their impact when applied to corn grown for silage. Measurements included corn silage yield, quality, and changes to soil health properties. Initial results from this two-year study indicate that none of the products tested increased corn silage yield or moisture, crop uptake, or soil health properties, such as infiltration characteristics, microbial biomass carbon, microbial respiration, active carbon, or penetration resistance. There were statistical differences in dairy feed quality between treatments, but the results are mixed. Individual products may have benefits in certain fields under certain conditions, but overall, these products do not seem to have a robust impact on corn silage or soil health in Southern Idaho.

INTRODUCTION

There has been a recent increase in both the availability and marketing of biostimulant products to local producers, particularly to dairymen, in southern Idaho. These products claim to increase yield and nutrient use efficiency while improving soil health in agricultural fields. If these claims are true, the use of these products would ultimately aid in promoting the overall sustainability of Idaho farms. However, there is a lack of objective data to support these claims, leaving producers uncertain as to if and how these products may benefit their operation. Further, these products contain nutrients, like phosphorus, that may not be accounted for in nutrient recommendations.

On a nearly weekly basis, agricultural extension personnel are asked by agricultural producers and their advisors about whether one of the hundreds of biostimulants on the market is a worthwhile investment. To provide robust, scientifically justifiable recommendations for Southern Idaho, products need to be tested in a controlled, well-designed study. Thus, the objective of this study was to assess four commercially available products and one locally produced one on their effectiveness to increase corn silage yield and quality and soil health properties.

METHODS

A two-year study was launched in 2021 at the University of Idaho Kimberly Research and Extension Center. There were 6 treatments with 4 replicates each for a total of 24 plots arranged in a completely randomized complete block design. Plots measured 20 ft wide to accommodate 8 rows of corn silage by 35 ft long. Blocks were separated by a 35 ft buffer of winter wheat; the same field and study design was used in year 2 to assess the effect of multiple years of product application. The study was sprinkler irrigated. Prior to planting, the field was fertilized using the University of Idaho recommendations based on a spring soil sample. Between years 1 and 2, the

field was lightly tilled with a chisel plow and harrow to break up compaction and incorporate residue without transporting soil between plots.

Treatments included a control with no biostimulant added and five biostimulant products: Amend, PS-Foundation, Bactifeed, Lalrise Max, and compost tea. The biostimulant products were chosen based on feedback from stakeholders to represent locally available and marketed products. In addition, each product represented different types of biostimulants; their rates and description (type) are shown in table 1. Briefly, the compost tea was brewed using dairy compost from a local provider and brewed aerobically for a minimum of 24 hours before being filtered to remove the large particles. Biostimulant treatments were applied according to instructions at suggested manufacturer rates. For the biostimulants applied at planting, products were applied in the seed furrow with the planter. Water was applied in-furrow for the control plots. The products tested are generally applied in-season using an irrigation system. To simulate this, a backpack sprayer was used to spray the center four rows of corn with the appropriate product. Immediately after biostimulant application, irrigation for the entire field containing the study was initiated.

Table 1. Biostimulant product information

Product	Manufacturer	Description	Total Product Applied Annually	Application Timing
Amend	Paradigm Ag Solutions	8-26-0	640 oz per acre	In-furrow at plant 3x in-season
PS- Foundation (BMZ)	BMZ Biological	Nutrient concentrate w/ humates, kelp, trace minerals, organic acids, and enzymes	24 oz per acre	In–furrow at plant Optional 1x in-season
Bactifeed	Bactifeed Soil Treatment	Bacteria-based inoculant	Pre-measured powder activated in water	In-furrow at plant 3x in-season
Lalrise Max	Lallemand	mycorrhizae-based inoculant	1.5 oz (dry powder) per acre of seeds	Seed treatment
Compost Tea		Locally produced	64 oz per acre	In-furrow at plant 3x in-season

The soil was sampled for soil health properties late in the vegetative stage every year. Briefly, three samples 0-6 inches were collected and composited per plot from the center four rows and sent to the Soil Health Testing Laboratory at Oregon State University. Analyses completed included microbial biomass carbon, microbial respiration (24 and 96 hours), β-glucosidase activity, and active carbon. Soil compaction with a penetrometer and infiltration characteristics with a single ring were assessed at the same time. In year 2, infiltration was inhibitively slow despite multiple attempts due to crusting. The center four rows of each plot were harvested with a plot harvester and weight was recorded. Subsamples of silage were sent to Stukenholtz for nutrient analyses of crop uptake (N, P, and K) and Dairyland Laboratories for NIR analyses of feed quality and moisture. The soil was sampled soon after harvest in each plot at 0-12 inches for ending soil fertility and sent to Stukenholtz.

RESULTS

The biostimulants tested tout a wide variety of effects on cropping systems. Amend is marketed to prevent crusting and increase water infiltration, water retention, crop health and growth, and increased nutrient density in crops while mitigating high K and sodium salts in the

soil. PS-Foundation (BMZ) is marketed to improve crop vigor by promoting root growth and improving soil nutrient utilization. Both Bactifeed and Lalrise Max are inoculants, applying either bacteria or fungi, respectively, to the soil. Both claim to increase yield as well as improve water infiltration and soil structure. Compost tea contains humic acids and plant-soluble nutrients. It is often used to improve crop yield, promote soil microbial activity, and improve soil structure.

Corn silage yield, when corrected to 68% moisture, was not significantly different between treatments in either year (Figure 1). Yield averaged 34.6 ton ac^{-1} in 2021 and 31.9 ton ac^{-1} in 2022. Silage moisture at harvest was also not statistically different. Average moisture was 67.0% and 63.7% in 2021 and 2022, respectively.

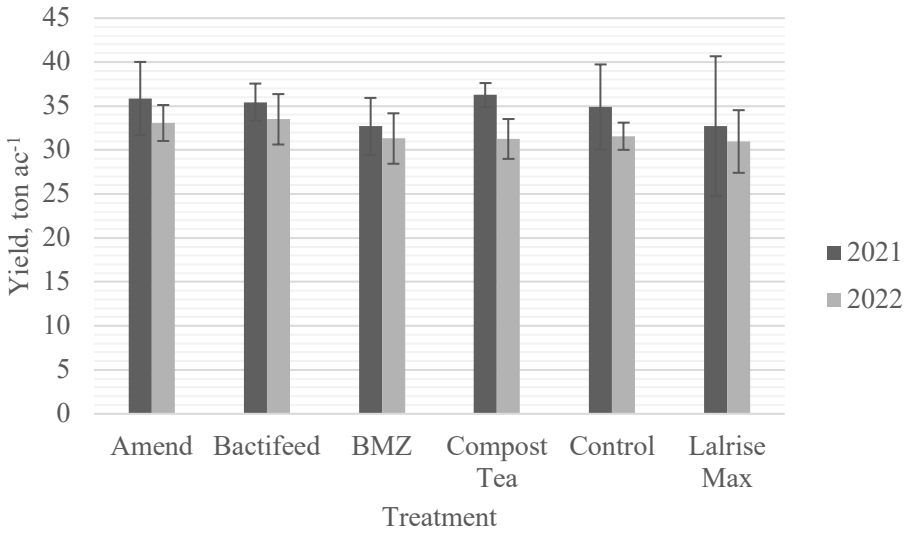

Figure 1. Corn silage yield in 2021 and 2021. Bars represent standard errors.

In terms of feed quality, there were some treatment differences by year (Table 2). For crude protein, the Bactifeed treatment had 0.7% less in 2021 while the Amend treatment had 0.5% higher crude protein in 2022 when compared to the control. For both ADF and NDF, lower values indicate better forage. BMZ (PS-Foundation) and Bactifeed had 2.8% and 3.2% higher NDF when compared to the control in 2021 while the compost tea treatment had 3.1% higher NDF in 2022. For ADF, BMZ and Bactifeed were greater in 2021 compared to the control while all treatments except Bactifeed were greater in 2022. In general, the results of this study are mixed in terms of forage quality. There were statistical differences, but they were inconsistent between years. The Bactifeed treatment resulted in lower NDF and ADF values but also lower protein while Amend had the opposite effect. There were no statistical differences between treatments in plant uptake in terms of total N, nitrate, P or K.

Table 2. Average crude protein, neutral detergent fiber (NDF), and acid detergent fiber (ADF) via NIR by treatment for 2021 and 2022. Treatments not connected by the same letter within column are statistically different (p<0.05).

Treatment	Crude Protein, %DW		NDF, %DW		ADF, %DW	
	2021	2022	2021	2022	2021	2022
Amend	6.6bc	7.8a	36.6bc	37.0ab	21.5b	21.3a
Bactifeed	6.0d	7.6ab	39.3a	33.8c	23.5a	18.5b
BMZ	6.3bcd	7.5ab	38.9ab	36.abc	23.3a	20.4a
Compost Tea	6.3bc	7.6ab	38.3abc	37.8a	22.9ab	21.8a
Control	6.7ab	7.3b	36.1c	34.7bc	21.3b	19.4b
Lalrise Max	7.1a	7.7ab	36.4c	36.7ab	21.4b	21.0a

There were also no significant treatment differences in any of the microbial soil health properties in either year or over both years. Microbial biomass C, β-glucosidase activity, and active C were all greater in 2022 when compared to 2021 while microbial respiration rates were higher (Table 3). There were also no differences between treatments infiltration in 2021 and penetration resistance at depths of 3, 6, or 12 inches in 2021 or 2022. Penetration resistance was significantly greater in 2022 than in 2021. This is what likely inhibited the ability to do infiltration testing in 2022.

Table 3. Average soil health properties for 2021 and 2022 for 0-6 inches of soil depth.

	Microbial Biomass C	β-glucosidase activity	CO_2 24 hr burst	CO_2 96 hr burst	Active C
	µg biomass per g dry soil	nmol B-gluc per g soil per hour	µg CO_2-C per g soil per day		ppm
2021	1733.9	94.3	27.4	15.1	116.7
2022	3041.4	290.3	21.1	11.5	193.5

While there were no differences between treatments in fall soil total N or Olsen P, there were significant differences in soil K (Table 4). The control had significantly higher soil K concentrations after harvest than Lalrise Max, compost tea, and PS-Foundational (BMZ). Interestingly, the Amend treatment was not significantly different even though higher K utilization is one of its key marketing claims.

Table 4. Average soil nutrient concentrations after harvest by treatment for 0-12 inches of soil depth.

	Total N	Olsen P	K
	----------ppm----------		
Amend	8.2	15.6	166.0ab
Bactifeed	8.1	15.8	161.6ab
BMZ	8.2	14.0	148.6c
Compost Tea	8.7	15.1	154.4bc
Control	7.9	16.5	170.5a
Lalrise Max	9.8	14.6	157.3bc

In summary, initial results from this two-year study indicate that none of the products tested increased corn silage yield or moisture, crop uptake, or soil health properties, such as infiltration characteristics, microbial biomass carbon, microbial respiration, active carbon, or penetration resistance. There were statistical differences in dairy feed quality between treatments, but the results are mixed. Individual products may have benefits in certain fields under certain conditions, but it would be impossible to test every scenario. Overall, these products do not seem to have a robust impact on corn silage or soil in Southern Idaho. Producers and advisors interested in trying these products should have clear goals in mind and a well-designed plan to test them for their scenario. Large, replicated strip trials are the best way to do this. These products can be pricey and even if they are effective for one year, they should be re-evaluated often to ensure they are positively impacting profitability and meeting expectations.