Foliar-Applied

alphajoule™ Biostimulant

for Alfalfa

Product and Management Guide

Unleash More Alfalfa Yield Potential

Apply alpha*joule*™ Biostimulant to aggressively managed alfalfa acres to minimize above and below ground stressors that hold back:

- Crop-by-crop and seasonal yield
- Root growth and root reserve recharge
- Harvest flexibility and forage quality

This booklet provides an introduction to the emerging field of biostimulants as a crop input for alfalfa and explains how alpha*joule* bacteria work in the plant. It covers how to manage your crop with biostimulant* inputs, in-field illustrations and on-farm results.

**As biostimulants become part of the crop production portfolio, they bring with them new terminology. A short glossary can be found on the back cover of this guide.*

Alfalfa and Bacteria Working Together

The Emergence of Biostimulants

Biostimulants aren't new to agriculture. Seed and silage inoculants, for example, have been around for decades and have lead the way for other even more beneficial products onto the farm. Today's high-performing biostimulants have gained enough grower acceptance to be recognized as a new ag input category in the 2018 U.S. Farm Bill.

This acceptance of a wide range of biostimulants has been driven by consumer preference and conventional crop producers looking for more efficient and environmentally friendly crop production systems. These sustainability trends are certain to further accelerate grower acceptance with alpha*joule* for alfalfa leading the way in the forage sector.

alpha*joule*™ Technical Description

alpha*joule* from Agrovive, Inc. is an in-plant biostimulant for alfalfa comprised of proprietary strains of *Pseudomonas flouresense* and *Bacillus megatarium* bacteria. These non-GMO, patent pending bacteria strains were selected from the natural environment and screened for their ability to recycle nutrients, impact water use efficiency, and reduce the effects of abiotic and biotic stressors on alfalfa growth at the cellular level.

In the alfalfa plant, the alpha*joule* endophytic bacteria live in the inner cellular spaces and the cell walls of the roots, crown, stems and leaves where metabolism and cell division are regulated. Here, the bacteria and the host cells have a symbiotic relationship that promotes plant health, photosynthesis, carbohydrate production, and performance efficiencies.

When stresses begin to adversely affect cell functions in any part of the alfalfa plant, the production of ethylene is triggered within those cells. Ethylene is an anti-growth hormone that slows vital cell functions such as photosynthesis and promotes early maturity and leaf drop if not alleviated. alpha*joule's* multi strains of bacteria mediate ethylene production within the stressed plant at the sub-clinical stage to reduce potential effects on yield, maturity, quality, or persistence.

alpha*joule* *bacteria living in the inner cellular spaces and cells of fast-growing leaves are constantly mediating stresses, recycling cell waste, and driving whole plant growth.*

Living, growing, plant cells produce waste. Alfalfa with alpha*joule* bacteria living in its cells and inner cellular spaces efficiently utilizes this waste as a food source. Through metabolism, the plant and alpha*joule* recycle tied-up micronutrients and essential growth compounds back to the plant cells to renew and maintain plant functions.

Foliar Application for Established Alfalfa

Easy to Apply

alpha*joule* is a liquid product that can be sprayed, fertigated with an irrigation system, or air applied. alpha*joule* can be applied to all alfalfa varieties and technologies at spring green-up and following each harvest during the growing season. alpha*joule* supports improved yield, expands harvest flexibility, and replenishes root reserves for the next crop.

A case of alpha*joule* covers 20 acres of established alfalfa. It can also be applied to alfalfa grass mixtures or spring seeded alfalfa.

Each case contains two 2.5-gallon jugs. One jug is alpha*joule* and the second jug is PRYMER™ for Alfalfa, a bacteria and micronutrient activator. Both products are applied at the rate of one pint per acre in the same tank mix with 10 gallons or more of clean water to deliver 50,000,000 CFUs of beneficial alpha*joule* bacteria. Bacteria are living organisms; producers should apply the tank mix as soon as possible after introducing the alpha*joule* to the mix. Use larger sized nozzles for best crop coverage.

During the growing season, alpha*joule* is recommended for each crop at green-up to mediate above and below ground stresses. Apply alpha*joule* when the majority of crown buds have released and at least three weeks before the next harvest. This recommendation usually provides a 5-7 day application window after the previous crop's cut date.

*Downloadable product labels and Safety Data Sheets for alpha*joule* Biostimulant and PRYMER for Alfalfa are available at www.alphajoule.com.*

alpha*joule* and PRYMER for Alfalfa are tank mix compatible with other products applied to alfalfa at the green-up stage of growth. This would include micronutrients (except copper), insecticides, herbicides (except glyphosate), and most fungicides. Bacteria are not compatible with chlorine bleach. alpha*joule* bacteria are temperature sensitive and have a performance range in the alfalfa plant of 32°-108° F.

There are no restrictions on re-entry or harvest after application of alpha*joule* and PRYMER. However, other products applied in the same tank mix may have restrictions. Read and follow all label instructions.

In the field, differences between treated and untreated acres may not be easily seen from a distance. Kneeling in the crop will highlight differences in plant height, leaf size, overall leafiness, and auxiliary branching. To confirm these subtle differences, collect representative treated and untreated plants and place side-by-side to evaluate.

alpha*joule* bacteria are removed from the field by harvest and require re-introduction during the next crop's green-up. The number of bacteria left post-harvest in the crown tissue is usually insufficient in concentration to be effective for the next crop.

alpha*joule* bacteria removed from the field in the dry hay or haylage expire during the drying or silage fermentation process.

Southwestern U.S. Management

Growers using semi- and non-dormant alfalfa can apply alpha*joule* with the following adjustments:

- Avoid over dilution by flood irrigation. Apply by ground sprayer, pivot irrigation, or by air.
- For drip irrigation systems, apply alphajoule without PRYMER to reduce native bacteria growth in the lines.
- Apply to spring or fall cuts when day time temperatures are under 108°F.

Apply alpha*joule* *after most crown buds have been released and before 6" of regrowth. This application window usually allows for 3 weeks of active vegetative growth and minimal wheel traffic damage. Irrigators will want to time application of* alpha*joule* *to maximize available water resources.*

Below-Ground Carry-Forward Benefits

alpha*joule* in Action

The above ground effects of alpha*joule* are seen and measured through the season as each crop is harvested, while the below ground effects of alpha*joule* remain hidden and out of sight unless plants are dug and evaluated.

In the field, all carbohydrate energy for root and root hair growth, as well as root reserve replenishment, originates from top growth during the two week or so period before harvest. At this time alpha*joule* bacteria are in full action mode recycling cell waste and mitigating abiotic and biotic stress within the plant to maximize carbohydrate production for above and below ground growth.

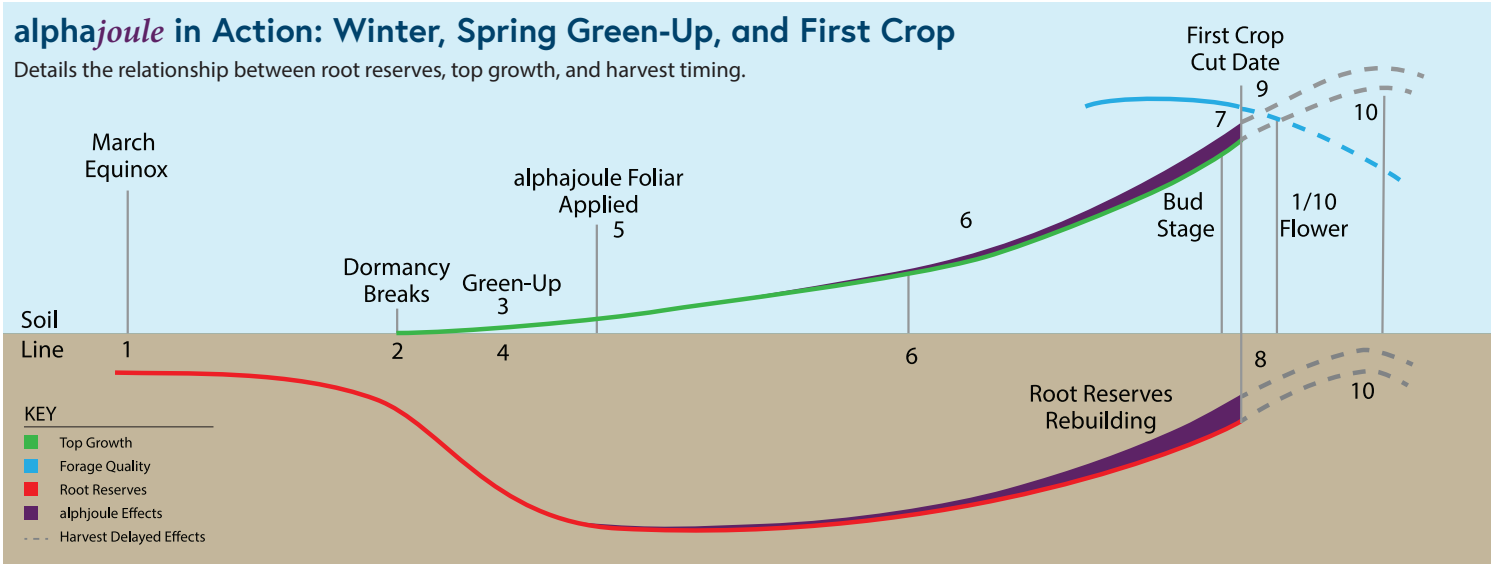
alpha*joule* *bacteria not only benefit the crop applied to, but have a carry-forward benefit to the next. Healthy fast-growing plants produce more dry matter yield, while also restoring plant root reserves. Fully charged roots are better able to fuel a timely and uniform crown bud release and green-up.*

These photos were taken after 4th crop in Wisconsin to illustrate the effects of alpha*joule* *foliar-applied to each crop during the season on the roots. Pits were dug side-by-side for the control (untreated check strip) and* alpha*joule* *treated field. The ten best plants from each dig were positioned for the photos. See page 10 for yield, forage quality, and milk per acre results for this field.*

The charts on page 7, 8 and 9 illustrate a dormant alfalfa plant's annual growth cycle. Examine the above and below ground growth on the charts to see alfalfa's crop-by-crop and seasonal response to a typical 28-30 day harvest management system. This is superimposed with anticipated effects of alpha*joule* foliar applications. ■

alpha*joule* in Action: Winter, Spring Green-Up, and First Crop

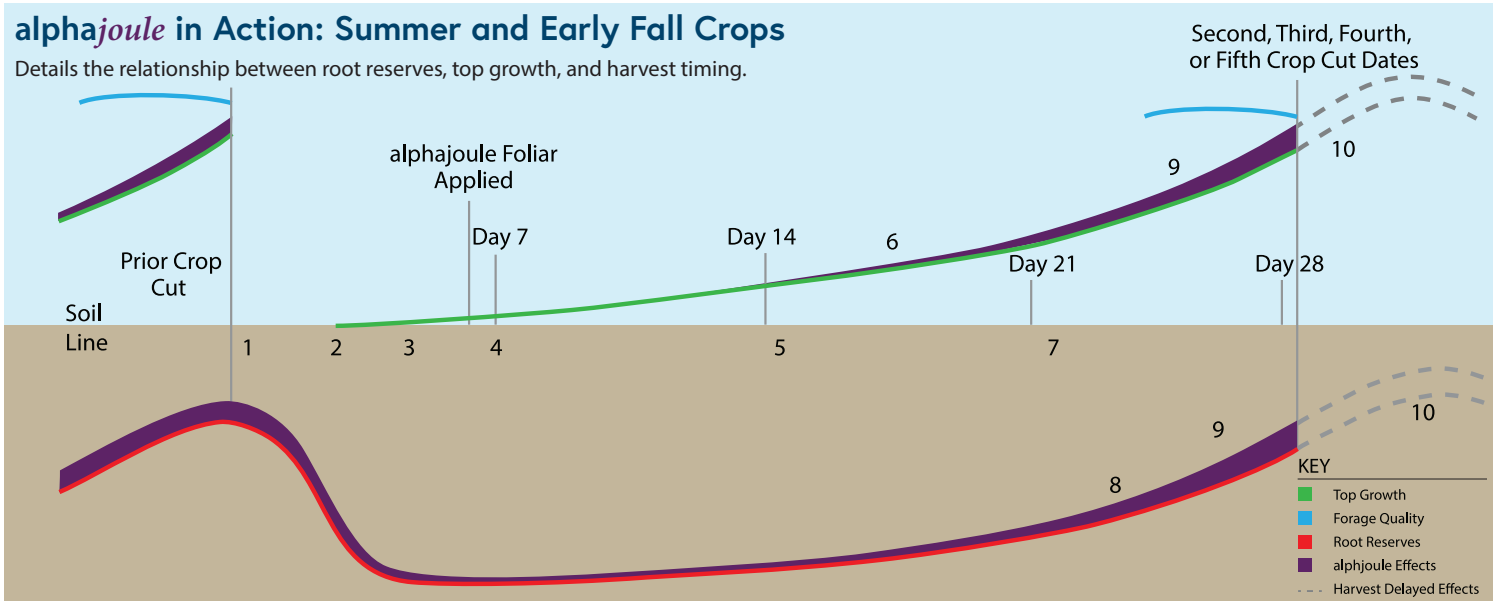
Details the relationship between root reserves, top growth, and harvest timing.



1. Cell metabolism during dormancy draws down root reserves.
2. Driven by temperature, crown bud release is initiated using root reserves.
3. Temperature and light intensity drive green-up and photosynthesis with 80% of carbohydrates to spring top growth.
4. Root reserves are used to repair winter injury to roots, root hairs and to generate new top growth due to late frosts.
5. alpha*joule* Biostimulant applied to 3-5" of top growth.
6. At 10-14" of top growth surplus carbohydrates rapidly begin translocating to the root, while supporting auxiliary branching.
7. First crop is cut at late bud stage with a yield boost attributed to alpha*joule*.
8. alpha*joule* impacts rebuilding root reserves which carry forward to the next crop; however, carbohydrates transfer to the root ceases at cutting.
9. In-plant alpha*joule* bacteria leave the field with the forage.
10. Dotted lines indicate growth, quality, and root reserve curves if harvest had been delayed to mid-flower.

alpha*joule* in Action: Summer and Early Fall Crops

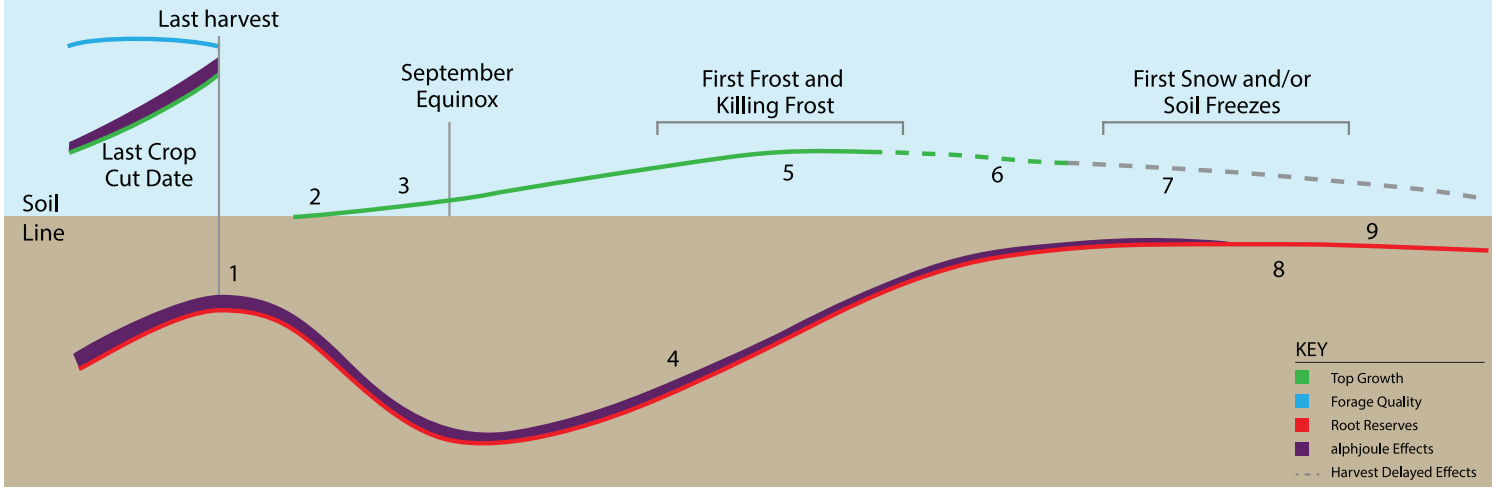
Details the relationship between root reserves, top growth, and harvest timing.



1. Day 1 of a 28-day aggressive cut system.
2. Crown buds emerge using root reserve energy.
3. Photosynthesis begins to support top growth.
4. Root reserves continue to be drawn down to support crown health and root and root hair growth; repair harvest injury and pathogen damage; and provide energy for rhizobia.
5. Surplus carbohydrates available to translocate to the roots.
6. Auxiliary branching initiates.
7. Dry matter yield increases rapidly during the week prior to cutting. On-farm side-by-side trials have shown up to a 30% yield increase from the application of alpha*joule*, with an average increase of 12-13% over multiple cuts and locations.
8. Root reserves translocation accelerates.
9. alpha*joule's* mediation of abiotic and biotic stresses, waste recycling, and efficient water use are expressed as carried-forward benefit, additional dry matter yield, and root reserves.
10. The dotted line illustrates potential yield and root reserve curves if harvest had been delayed to mid-flower.

alpha*joule* in Action: Post Harvest and Early Winter

Details the relationship between root reserves, top growth, and harvest timing.



1. The carry-forward benefit of alpha*joule* in the management system.
2. Crown buds emerge.
3. Fall top growth is determined by variety dormancy ratings, the reaction to decreasing day light length and intensity, and declining temperature.
4. During late summer and fall, plants translocate a higher percentage of carbohydrates produced to the root than they do during spring and early summer to support the dormancy reaction.
5. Dry matter accumulation is slow and decreases as photosynthesis slows and leaves are lost to frost.
6. The growing season has ended.
7. Top growth deteriorates, with stubble left to catch snow.
8. Plant cells begin to draw down root reserves to support metabolism.
9. All alpha*joule* bacteria have left the field as forage or succumbed to frost and frozen soil.

alpha*joule* On-Farm Results–Fed On-Farm to Dairy

Location: Klondike, WI
Oconto County

Soil Type: Sandy loam

Established: Spring 2018 with oats as nurse crop

Harvest Dates: June 4, 2020; June 29, 2020; July 28, 2020; and September 2, 2020

Comments: alpha*joule* applied to each crop starting at spring green-up. Orchardgrass was included in the drill box at planting.

Applying alpha*joule* *to alfalfa/legume mixtures has a positive effect on both species. Follow best management practices to maintain desired balance of alfalfa/grass.*

	Crop	Crude Protein	TTNDFD	Milk per Ton	Yield at 15% Moisture	Milk per Acre at 15% Moisture
Without Treatment	First	24.6%	49.31%	2,956 lbs	2.25 T/A	6,636 lbs/A
With alpha*joule*	First	23.9%	45.28%	3,090 lbs	2.34 T/A	7,237 lbs/A
alpha*joule* **% Advantage**		-2.8%	-8.2%	+4.5%	+4.0%	+9.1%
Without Treatment	Second	24.4%	44.20%	2,997 lbs	1.30 T/A	3,566 lbs/A
With alpha*joule*	Second	22.9%	42.00%	2,881 lbs	1.43 T/A	4,120 lbs/A
alpha*joule* **% Advantage**		-6.2%%	-5.0%	-3.9%%	+10.0%	+15.5%
Without Treatment	Third	24.2%	37.06%	2,804 lbs	1.19 T/A	3,337 lbs/A
With alpha*joule*	Third	25.7%	38.87%	2,846 lbs	1.32 T/A	3,757 lbs/A
alpha*joule* **% Advantage**		-6.2%	+4.9%	-3.9%%	+10.9%	+12.6%
Without Treatment	Fourth	24.6%	40.30%	2,885 lbs	1.13 T/A	3,341 lbs/A
With alpha*joule*	Fourth	24.5%	39.21%	2,951 lbs	1.49 T/A	4,397 lbs/A
alpha*joule* **% Advantage**		=	-2.7%	+2.3%	+31.9%	+31.6.6%
Without Treatment	Total	24.5%	42.72%	2,911 lbs	5.87 T/A	16,880 lbs/A
With alpha*joule*	Total	24.3%	41.34%	2,942 lbs	6.58 T/A	19,511 lbs/A
alpha*joule* **% Advantage**		=	**-3.2%**	**+1.1%**	**+12.1%**	**+15.6%**

BOTTOM LINE:

Note the increasing effect of alpha*joule* through the season: +4% on first, +10% on second, +11% on third, and +32% on fourth crop. On a milk per acre basis, an acre of alpha*joule* treated alfalfa produced over $420 more at $16/cwt milk during the season.

On-Farm Results–Commercial Hay Sold Off-Farm to Dairy Customers

Location: Alamosa, CO
Alamosa County

Soil Type: Sandy loam

Established: Fall 2016 in a 110 acre field

Harvest Dates: June 25, 2019; August 3, 2019; September 12, 2019

This 110-acre side-by-side field is at 7,400 feet of elevation. alpha*joule* *was pivot-applied to 55 acres of 8-10" tall alfalfa on May 15, 2019, and reapplied to the same half at green-up of the second and third crops.*

	Crop	Crude Protein	TTNDFD	Milk per Ton	Yield at 15% Moisture	Milk per Acre at 15% Moisture
Without Treatment	First	20.6%	45.67	2,974 lbs	2.10 T/A	6,245 lbs/A
With alpha*joule*	First	21.6%	48.01	2,899 lbs	2.20 T/A	6,378 lbs/A
alpha*joule* **% Advantage**		+5%	+5%	-2%	+5%	+2%
Without Treatment	Second	17.5%	38.59	2,418 lbs	2.00 T/A	4,836 lbs/A
With alpha*joule*	Second	18.5%	39.82	2,522 lbs	2.20 T/A	5,548 lbs/A
alpha*joule* **% Advantage**		+6%	+3%	+4%	+7%	+15%
Without Treatment	Third	23.2%	50.50	3,168 lbs	1.47 T/A	4,646 lbs/A
With alpha*joule*	Third	24.5%	50.08	3,196 lbs	1.70 T/A	5,440 lbs/A
alpha*joule* **% Advantage**		+6%	-1%	=	+16%	+17%
Without Treatment	Total	20.4%	44.92	2,853 lbs	5.57 T/A	15,727 lbs/A
With alpha*joule*	Total	21.5%	45.97	2,872lbs	6.10 T/A	17,366 lbs/A
alpha*joule* **% Advantage**		**+5%**	**+2%**	**=**	**+10%**	**+10%**

BOTTOM LINE:

For commercial hay growers, small increases in yield per acre are magnified by their large acreages. The 55 alpha*joule*-treated acres of this 110-acre circle produced 29 more tons of dairy quality hay during the season than the untreated half. Using $200 per ton, that's nearly $6,000 greater return from the treated side of the field. If this were 1,000 acres, the difference could be well over $100,000.00.

Biostimulant Glossary

As biostimulants become part of the crop production portfolio, they bring with them new terminology and definitions. A short glossary of key words includes:

Abiotic stress – Naturally occurring stresses, often intangible factors such as sunlight, temperature, water, salinity, elevation, etc.

Bacteria – Microscopic, single-cell plants, which have cell walls, lack defined organs and nucleus, but have DNA and reproduce by cell division. Large in numbers and range from beneficial to parasitic.

Biostimulant – A substance or microorganism that stimulates a natural process when applied to seeds, plants, or the rhizosphere (soil), in order to enhance or benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, crop quality or yield. (The legal definition from the December 2018 U.S. Farm Bill.)

Biotic stress – Stress caused by other living organisms such as insects, disease, weeds, fungi, bacteria, molds, etc.

Colony-forming unit (CFU) – A unit used in microbiology to estimate the number of viable bacteria in a container. Viability is defined as the ability to multiply via binary fission (split into two equal bodies) under controlled conditions.

Ethylene – A plant growth regulator that is produced in all parts of the plant when triggered by abiotic or biotic stress. A hormone that promotes early maturity, leaf senescence, yield loss, and declining forage quality.

Metabolism – Includes all biochemical processes in the plant that are necessary for life.

Microbiology – The study of the structure, function, and classification of simple life forms such as algae, bacteria, fungi, yeast, molds, etc.

Sub-clinical stress – Early stage, mild or temporary abiotic or biotic stresses that aren't detectable or producing effects that are not detectable in the plant by usual diagnostic analysis.

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AVAILABLE FROM:

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