Effect of BAS125 on Low Desert Alfalfa Growth and Quality During the August Production Period

Michael D. Rethwisch, Michael D. Kruse, Robert Kallenbach and Marcus Goad

Abstract

Alfalfa was treated with five rates of BAS125 on August 5, 1997. Data were obtained to determine rate effects on stem regrowth (both height and width), trifoliate leaves, and yield. Variation in plot area affected some results. No statistical differences were noted for quality classification or yields, although increased protein levels were noted from BAS125 treatments. Increasing BAS125 rates resulted in significant decreases in plant height and significant increases in numbers of trifoliate leaves at nodes 1-6. Differences in stem diameters were also noted, with stem width affected by rate of BAS125 at lower portions of stem. Differences in stem diameters of upper parts of stems were primarily associated with plant height reductions as a function of BAS125 rate.

Introduction

Summer alfalfa production (June -September) in the low desert areas of Arizona and California is greatly affected by heat. Low temperatures at night during July-early September often average 80+^{o} F, soil temperatures at 2-4 inches of depth exceed 100^{o} F, and daytime temperatures are usually even warmer, with high temperatures of 115^{o}+F not uncommon. The heated surroundings often cause a yield reduction referred to as summer slump, noted primarily during August and September, as yields rebound slightly in the fall as temperatures cool.

The heat also affects the quality of low desert alfalfa hay. Bloom (alfalfa flowers) is often associated with heat/stress/rapid growth under summer conditions, as is larger stems and smaller leaves, lowering alfalfa quality and prices received by growers. Very seldom does quality of alfalfa hay produced in the low desert under typical summer conditions remain in the premium quality class (acid detergent fiber<29% on 100% dry matter basis, total digestible nutrients (TDN) above 54.5% on a 90% dry matter basis), but is usually at the next highest level (good) and sometime is only fair. The price difference per ton between quality categories varies in the low desert (often is $10-25 per ton), and often is greater in the San Joachin Valley.

BAS125 is a gibberellic acid inhibitor product that may help offset some of the production problems associated with summer desert conditions. Gibberellic acid is the plant hormone responsible for stem elongation. By inhibiting this hormone, alfalfa quality may increase as energy/nutrients associated with stem formation/growth would be utilized for leaf production thereby increasing overall relative feed value of alfalfa hay by increasing crude protein and total digestible nutrients, and reducing acid detergent fiber. This is the initial field study known by the authors to examine the effects of various rates of BAS125 on summer alfalfa yield and quality in the low desert.

This is a part of the 2002 Forage and Grain Report, The University of Arizona College of Agriculture and Life Sciences, index at: http://ag.arizona.edu/pubs/crops/az1301

Methods and Materials

Five rates of BAS125 10W (0.0625, 0.1044, 0.125 0.1875 and 0.25 lbs active ingredient/ acre) were applied the morning of August 5, 1997, to a first year stand of alfalfa (variety = Grasis, planted October 1996) grown on beds, that averaged 7.5 inches tall and had 5-5.5 inches (12.7-14.0 cm) of regrowth. Plots were 25 ft. long by one bed wide (40 inches). Treatments were applied with a backpack CO_2 sprayer calibrated to deliver 20 gal/acre at 11 psi with one T-Jet 8003S and one T-Jet 8003VS nozzle.

A randomized complete block design with four replications was utilized for most of the treatments with the exceptions of the 0.1044 rate which had only 3 replications and was applied at a rate of 33.3 gal/acre, and the untreated check, which had five replications. All BAS125 treatments had a non-ionic spreader-sticker (First Choice, Western Farms Service) added a rate of 0.75% vol/vol. Temperature was 110^{o}F when last treatment was completed.

Plant height data in plots were collected at 6, 13 and 17 days post treatment. Measurements were obtained by taking 10 readings per plot by placing a yardstick in the plot and recording average plant height. Plots were rated for phytotoxicity symptoms at six days post treatment.

Numbers of leaves and nodes, and internode lengths were also obtained at 6 and 13 days post treatment. Twenty plants per plot were collected by cutting them off at the previous cutting height (2-2.5 inches above ground). Numbers of nodes and trifoliate leaves per node, distances between nodes, and plant height were recorded for each plant. Stem diameters were also measured at 3-5, 8-10, 13-15, and 18-20 cm of regrowth above previous cutting level. Leaves were also separated from stems for each set of 20 plants and fresh (wet) weights of the leaves and stems were obtained.

Plots were harvested at 17 days post treatment. Plots were cut with a TroyBilt Trail Blazer sickle bar mower, and cut foliage from each plot was raked and placed into plastic garbage containers. Containers were then weighed to obtain alfalfa fresh (wet) weights. A subsample (approximately 300 grams) of alfalfa was removed from each container, placed in a paper bag, weighed, and then oven dried for seven days at 50^{o} C, and then reweighed. Dry weight:wet weight ratios were then recorded to calculate alfalfa hay yields per plot. Dried alfalfa samples were then ground for hay quality analysis, obtained by wet chemistry (Division of Agriculture and Natural Resources laboratory, University of California Cooperative Extension, Davis, CA).

Data were analyzed using StatGraphics Plus for Windows. Means were compared statistically using Fishers LSD.

Results

One end of the plot area (across all the end plots of all four replicates) had very low yields, and caused much variation in yields and probably affected associated quality. This affected comparative results as not all of the six treatments were had plots in the affected area. Most affected were the results of the 0.1044 rate.

Phytotoxicity

Some leaf spotting was apparent on plants in all plots treated with BAS125 at 6 days post treatment. Spotting appeared as small white areas on leaves near terminal growth, and resembled potassium deficiency symptoms. Phytotoxicity increased as rate of BAS125 increased (Table 1). Spotting was not as evident at 13 days post treatment as new alfalfa growth had overgrown leaves that received the treatments and showed spotting.

Effects on plant height

A rate response in plant height was noted with in-field plot measurements as mean plant heights decreased as higher active ingredient rates of BAS125 were used (Figures 1, 2), with this rate response best noted at 13 days post treatment (Figure 2). Alfalfa plant height treated with the highest rate (0.25 lbs active ingredient BAS125/acre) was the shortest on all sample dates and averaged about 75% that of the untreated check on the first two sample dates (6 and 13 days post treatment), and 85% at 17 days post treatment, and were about 3 inches different throughout the study. Mean heights of the other four treatments were within 1 inch of each other at 6 days post treatment, 1.5 inches at 13 days after treatment and 1 inch at 17 days after treatments were applied.

Alfalfa that was cut in the plots (laboratory data) at approximately 2.5 inches (6.4 cm) above ground also reflected this pattern, with the height of the 0.25 rate being about 82% of the check (4.5 cm taller) at 6 days after application. Mean heights of the other treatments were within 1 cm of each other at 6 days post treatment.

Effects on leaves and stems

Treatments of BAS125 increased numbers of trifoliate leaves/stem at both 6 days after treatment (Figure 3) compared with the untreated check, with this effect most evident at 13 days after treatment (Figure 4). Highest number of trifoliate leaves was noted in the 0.1875 rate at 6 days post treatment, an increase of 25% when compared with the check, while at 13 days post treatment the most trifoliate leaves were noted in the 0.1044 rate which had 32% more leaves than the check. Numbers of leaves increased from all treatments, but increases were smaller in the lowest (0.0625) and highest (0.25) rates tested, with increased numbers of leaves averaging less than 10% more than the check. Significant increases in trifoliate leaves was noted at nodes 1-6 from the usage of BAS125, as well as node 9. The reason for the significant increase at node 9 (when nodes 7 and 8 were not significantly different) is not fully understood but may be due to growth patterns of the alfalfa plant as affected by rate of BAS125. It was interesting to note that numbers of leaves per node at the lower sections of the alfalfa stem continued to increase between 6 and 13 days post treatment.

Changes in leaf numbers also changed weight relationships between stems and leaves (Table 2). As treatment rate increased percent leaf weight per stem also increased, with the greatest increase noted from the highest treatment (12.6% at 13 days after treatment). Leaf weight percentages per stem were significantly greater from the highest three rates tested (0.1044, 0.125 and 0.1875) than the check, although the highest stem and leaf weights were noted with rates from 0.1044-0.1875 lbs. active ingredient/acre. The two treatment extremes had less fresh leaf weight than the check at both 6 and 13 days post treatment.

Stem diameters

Stem diameters were affected by the treatments (Table 3), with effects noted both on new growth as well as on stems that were probably already formed when treatments were made (tallest regrowth average at time of spraying was 12.7-14.0 cm). Stem diameter means from the highest rate of BAS125 (0.25 lbs active ingredient/acre) at a height of 18-20 cm of regrowth at both 6 and 13 days post treatment were significantly smaller than all other treatments and the untreated check, thought due in part to plant height being reduced by this rate of BAS125. The untreated check had the largest stem diameters at 18-20 cm on both sample dates, but differences between untreated and treatment means were greater at 6 days than at 13 days post treatment (Table 3).

Mean stem diameter of the untreated check at 13-15 cm of regrowth height was also significantly larger than the means from treated alfalfa at 6 days post treatment, but was not larger at 13 days. Mean stem diameters were usually smallest although very similar to other means at the lower two heights on both sample dates from the 0.25 lbs. active ingredient/acre rate, with differences in means increasing as plant height increased with this rate compared with other treatment means. Means of treated alfalfa stem diameters had a somewhat bell shaped distribution, with smaller diameters noted for the lowest and highest rates of BAS125 tested (0.0625 and 0.25 lbs. active ingredient/acre) and larger diameters noted from the middle three rates.

Effects on yields

Yields in this experiment were highly variable, with yields ranging from 1,046-2,426 lbs. of hay/acre. One end of the plot area (across all the end plots of all four replicates) had very low yields, and caused much variation in yields and probably affected associated quality. In this experiment the untreated check (Table 4) had higher yields than all BAS125 treatments except the 0.125 rate (which was very similar), and the 0.1044 rate. Highest hay yields (1,996 lbs/acre) were noted in the 0.1044 rate. This treatment yielded about 200 lbs./acre more than the check and the 0.0625 and 0.125 rates. Yield increase noted for this rate is thought due to absence of this rate in the low yielding end of plot area. Yields were not significantly different.

Both the check and the 0.1044 rate had greater than 23% of dry/wet weight, with hay yields (dry) from all other treatments yielding less than 23.3% of the wet weights. One reason these two treatments had highest dry matter percentages may be that at 13 days post treatment the untreated check and 0.1044 rate had the tallest stems based on regrowth height (Figure 2), and that stems are heavier than leaves. In addition, stem diameter was largest at the 18-20 cm of regrowth, averaging greater than 0.04 inches for both treatments. The combination of stem and leaves may have increased yields of the 0.1044 rate over other treatments as this rate had the most trifoliate leaves/plant.

It should be noted that the yields are based on green-chop harvest. Yield results should expected to be lower when plots are larger and experiments use field harvest equipment due to leaf loss, etc. Effects of treatments on petiole size or strength were not measured, which could affect yield, quality and resulting economics. BAS125 treatments may affect leaf retention during curing and harvesting processes but this factor was not investigated when plants were harvested green in field, and then dried in the laboratory.

Effects on quality

Because of the wide variation in yields and plot conditions, quality was also affected. Although no statistical differences existed for any quality parameters, highest numerical quality from both wet and dry lab analyses was noted in the 0.1875 rate which provided extra premium alfalfa, based on acid detergent fiber (Table 4). Premium hay was noted from all other treatments using wet lab analysis with the exception of the highest yielding treatment, the 0.1044 rate, which had hay in the good quality class. All BAS125 treatments resulted in higher protein levels (minimum of 0.95% increase) than the untreated check, with those of the 0.1875 lbs. active ingredient/acre rate having the highest protein levels (23.95%)

Yields, quality and economics

Value of alfalfa hay on August 25, 1998 in the Parker Valley area for best production ranged from a high of $105-110/ton, to $95-96/ton for the lower valued hay. Off grade hay was receiving $90-85/ton. Quality class extra premium was assigned a value of $107.50/ton for value (average of 105-110), premium was $95.50/ton and good hay was assigned an average price of $87.50/ton (average of $85-90). Values for quality classes were then used to calculate value of hay per acre (Table 4).

Highest calculated value per acre was from the 0.1875 rate, valued at $89.71/acre, followed by the 0.1044 rate at $87.33/acre. The untreated check was valued at $82.94/acre, with the 0.125 rate at $84.37/acre (Table 4). Hay from the highest and the lowest rates tested were less valuable per acre than the untreated check. None of the values have included cost of application or material in the calculations at this time.

It appears that these treatments would provide more value and perhaps be economical earlier in the year when hay yields are higher. Baling and other field operations may also change the results. More testing is necessary to confirm these findings under uniform field conditions and as well as testing this product using other alfalfa varieties as varieties differ in yield and quality considerations under desert summer conditions.

Acknowledgements

The cooperation of CRIT Farms and Farm Manager Greg Sprawls is greatly appreciated. Product and financial support was provided by BASF.

Table 1. Mean alfalfa plant heights (inches) obtained in field at 6, 13 and 17 days post treatment with BAS125 10W, and phytotoxicity ratings at 6 days post treatment.

Rate (lbs active ingredient per acre)	Days after treatment 6	13	17	Phytotoxicity rating* at 6 days
0.00	12.7a	16.4a	18.7a	0.0
0.0625	10.6 bc	14.4 b	17.7ab	0.2
0.1044	11.4 b	14.0 bc	18.0ab	0.4
0.125	11.1 b	13.9 bc	17.0ab	0.5
0.1875	10.9 bc	13.05 cd	17.4ab	0.7
0.25	9.9 c	12.2 d	15.9 b	0.9

* Ratings are on scale of 0-10 with 0 being no damage, 5 equivalent to 50% of plant area expressing symptoms, and 10 equivalent to yellowing/blanching/death of entire plant.
Means in columns followed by the same letter are not statistically different at the p<0.05 level (Fishers LSD test)

Table 2. Mean fresh weight per alfalfa stem (including leaves) and percent of weight from leaves at 6 and 13 days post treatment with BAS125 10W.

Rate (lbs active ingredient per acre)	Mean Weight (g) Days post treatment 6	13	% leaf weight of total wt. Days post treatment 6	13	Fresh leaf weight (g) Days post treatment 6	13
0.00	0.75a	1.25 bc	59.92a	50.76a	0.43a	0.63 bc
0.0625	0.70a	1.13 bc	60.56ab	53.91ab	0.42a	0.61bc
0.1044	0.84a	1.51a	61.02ab	53.56ab	0.52ab	0.81a
0.125	0.79a	1.37ab	61.27 b	56.03 b	0.49ab	0.77ab
0.1875	0.88a	1.29abc	63.23 b	56.78 b	0.56 b	0.73abc
0.25	0.68a	1.04 c	63.98 b	57.18 b	0.43ab	0.59 c

Table 3. Mean alfalfa stem diameters at various heights (cm) of regrowth at six and thirteen days post treatment with BAS125 10W.

Treatment (lbs ai/acre)	3-5 cm		8-10 cm		13-15 cm		18-20 cm	
	6 days	13 days	6 days	13 days	6 days	13 days	6 days	13 days
0.00	0.0526a	0.0586ab	0.0504a	0.0574a	0.0426a	0.0516a	0.0192a	0.0434a
0.0625	0.0505a	0.0593ab	0.0458a	0.0578a	0.0285 b	0.0485a	0.0103ab	0.0310a
0.1044	0.0560a	0.0640 b	0.0510a	0.0620a	0.0347ab	0.0553a	0.0140ab	0.0413a
0.125	0.0535a	0.0648 b	0.0470a	0.0613a	0.0295 b	0.0515ab	0.0108ab	0.0298a
0.1825	0.0530a	0.0613ab	0.0528a	0.0590a	0.0343ab	0.0503ab	0.0128ab	0.0320a
0.25	0.0495a	0.0570a	0.0458a	0.0533a	0.0223 b	0.0393 b	0.0060 b	0.0155a

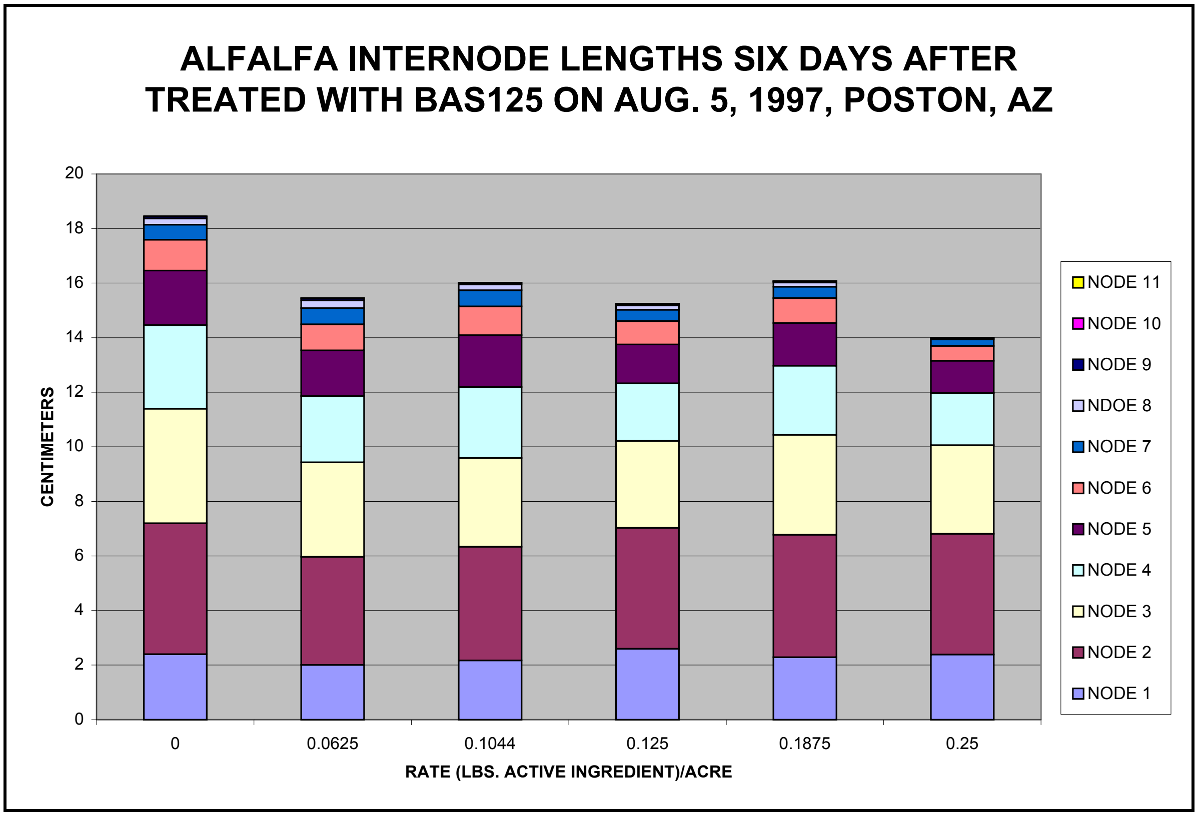
Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fishers LSD test)

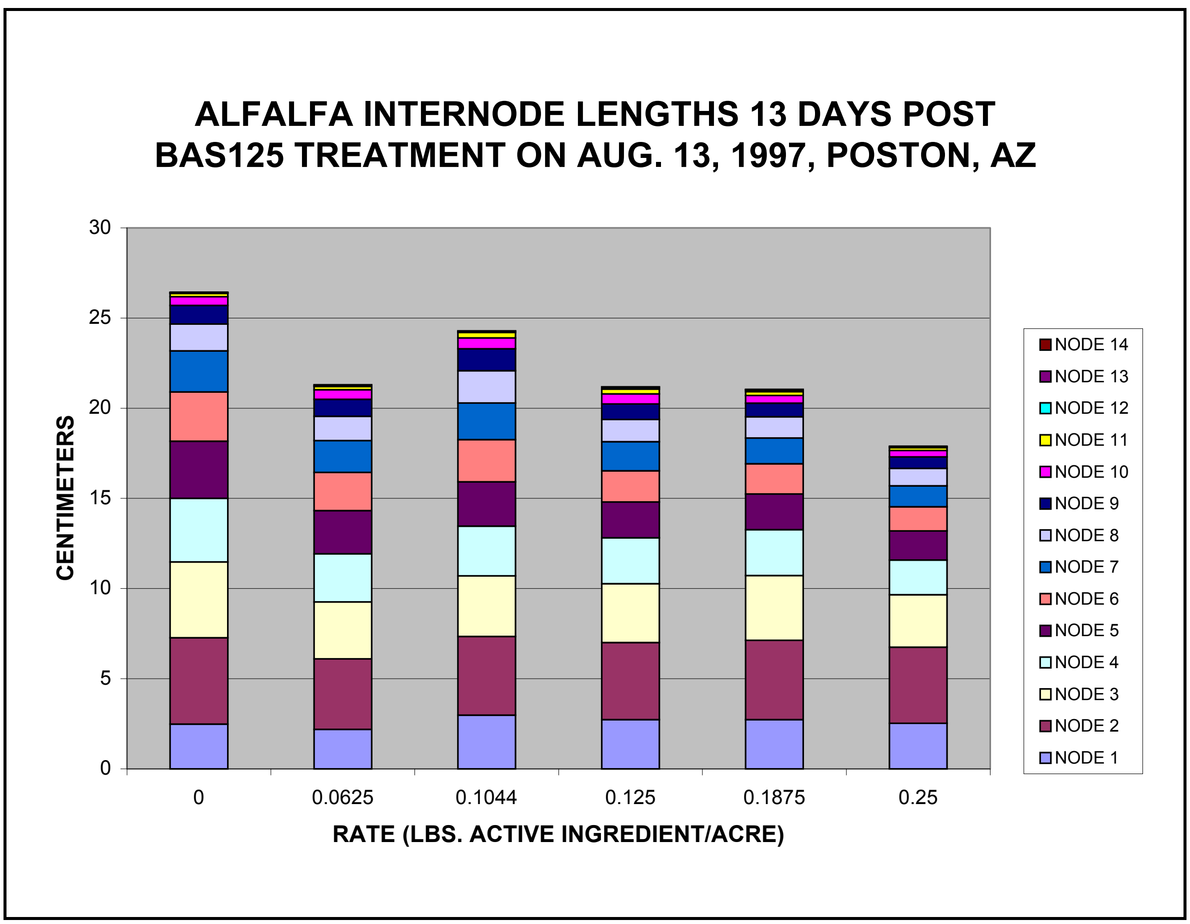
Table 4. Quality, yields and calculated mean ecomomic values/acre of alfalfa green forage harvested at 17 days post treatment.

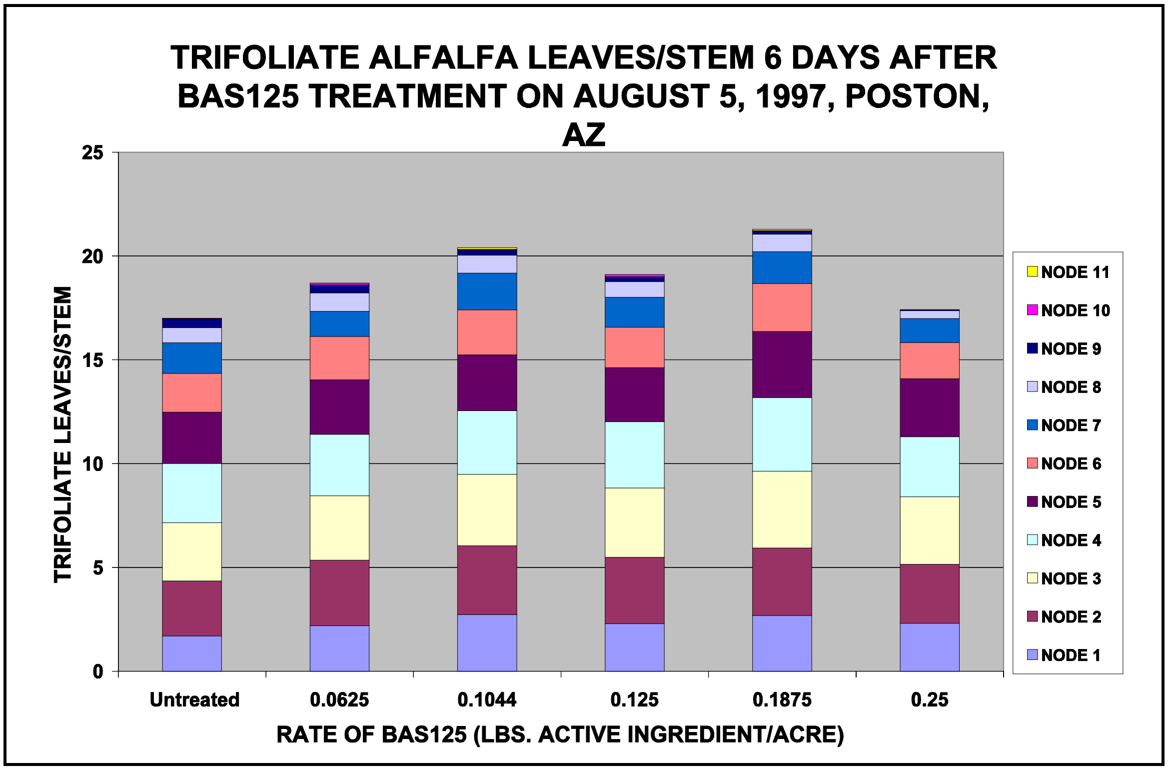
Rate (lbs a.i./acre	Percentage Protein	ADF	TDN	Quality class [A]	Yield lbs/acre	$ Value per ton	per acre
0.00	21.66a	28.54a	54.92	Premium	1,737a	$ 95.50	$ 82.94
0.0625	22.60a	27.73a	55.38	Premium	1,727a	$ 95.50	$ 82.46
0.1044	23.57a	29.36a	54.13	Good	1,996a	$ 87.50	$ 87.33
0.125	23.75a	27.45a	55.55	Premium	1,767a	$ 95.50	$ 84.37
0.1875	23.95a	26.85a	55.98	Ex. prem.	1,669a	$107.50	$ 89.71
0.25	23.10a	28.3a	55.05	Premium	1,657a	$ 95.50	$ 79.12

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fishers LSD test)

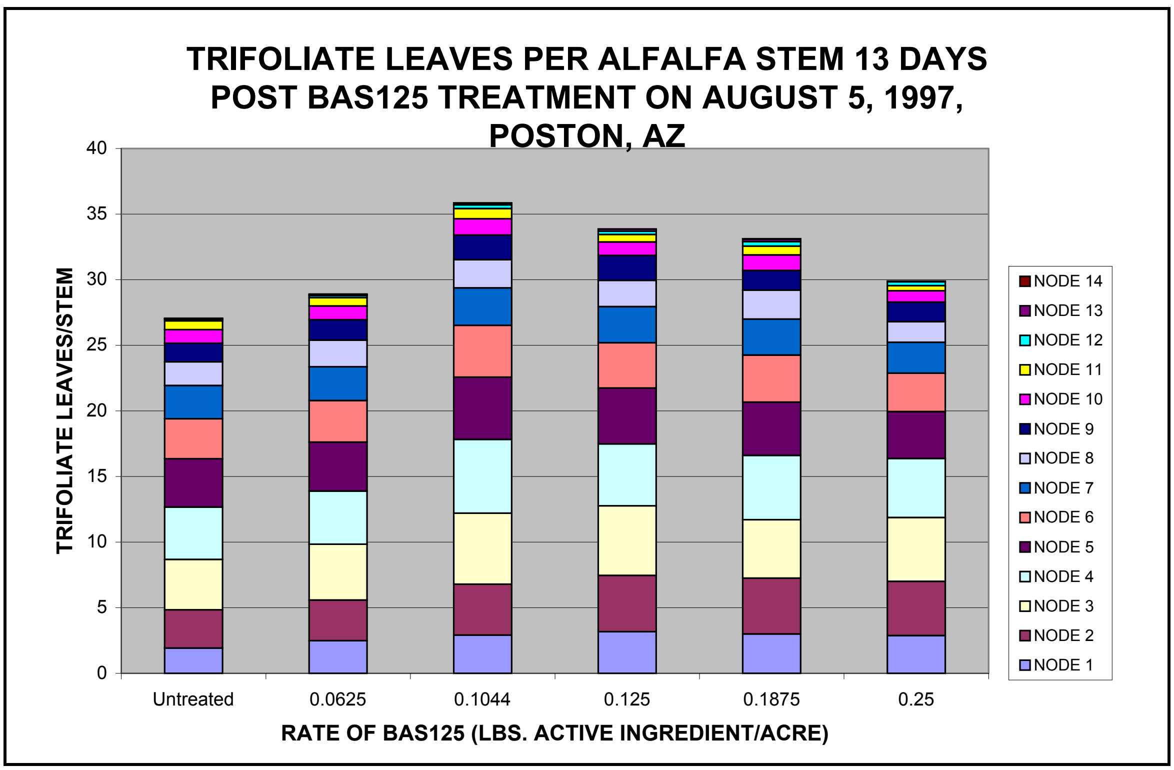
[A] Quality class designation based on Acid Detergent Fiber (ADF) percentage only


ALFALFA INTERNODE LENGTHS SIX DAYS AFTER TREATED WITH BAS125 ON AUG. 5, 1997, POSTON, AZ
CENTIMETERS
0
2
4
6
8
10
12
14
16
18
20
0
0.0625
0.1044
0.125
0.1875
0.25
RATE (LBS. ACTIVE INGREDIENT)/ACRE
NODE 11
NODE 10
NODE 9
NODE 8
NODE 7
NODE 6
NODE 5
NODE 4
NODE 3
NODE 2
NODE 1


ALFALFA INTERNODE LENGTHS 13 DAYS POST BAS125 TREATMENT ON AUG. 13, 1997, POSTON, AZ
CENTIMETERS
0
5
10
15
20
25
30
0
0.0625
0.1044
0.125
0.1875
0.25
RATE (LBS. ACTIVE INGREDIENT/ACRE)
NODE 14
NODE 13
NODE 12
NODE 11
NODE 10
NODE 9
NODE 8
NODE 7
NODE 6
NODE 5
NODE 4
NODE 3
NODE 2
NODE 1



TRIFOLIATE ALFALFA LEAVES/STEM 6 DAYS AFTER BAS125 TREATMENT ON AUGUST 5, 1997, POSTON, AZ
TRIFOLIATE LEAVES/STEM
0
5
10
15
20
25
Untreated
0.0625
0.1044
0.125
0.1875
0.25
RATE OF BAS125 (LBS. ACTIVE INGREDIENT/ACRE)
NODE 11
NODE 10
NODE 9
NODE 8
NODE 7
NODE 6
NODE 5
NODE 4
NODE 3
NODE 2
NODE 1



TRIFOLIATE LEAVES PER ALFALFA STEM 13 DAYS POST BAS125 TREATMENT ON AUGUST 5, 1997, POSTON, AZ
TRIFOLIATE LEAVES/STEM
0
5
10
15
20
25
30
35
40
Untreated
0.0625
0.1044
0.125
0.1875
0.25
RATE OF BAS125 (LBS. ACTIVE INGREDIENT/ACRE)
NODE 14
NODE 13
NODE 12
NODE 11
NODE 10
NODE 9
NODE 8
NODE 7
NODE 6
NODE 5
NODE 4
NODE 3
NODE 2
NODE 1