Effect of BAS125 10W on Late Spring/ Early Summer Alfalfa Growth, 1998

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Abstract

Four rates of BAS125 were evaluated to document rate effects on reduction in stem elongation and associated increase in alfalfa leaves during the peak period of summer growth. Increasing rates of BAS125 resulted in greater inhibition of alfalfa stem elongation, as the highest rate (0.1875 lbs. a.i./acre) had stems 27-37% shorter than the untreated check through 12 days post treatment, and 20% shorter thereafter. Alfalfa weights (both stem and leaf) were also reduced by BAS125 treatments through 12 days after treatment. Higher rates resulted in lighter leaves. Significantly more trifoliate leaves were noted at the higher rates of BAS125 at 19 days after treatment, as was increased leaf and stem weights than untreated check with most noted at the 0.125 rate. Stem diameters were not significantly different, although untreated stems were wider. Numerically more open flowers were documented with usage of BAS125 at 19 days post treatment, but fewer floral racemes/stem were associated with higher rates at 27 days post treatment. No differences existed for alfalfa plant height measurements in regrowth following harvest, indicating that application of BAS125 are only effective on forage harvest to which they were applied and have no subsequent residual effect.

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+° F, soil temperatures at 2-4 inches of depth exceed 100° F, and daytime temperatures are usually even warmer, with high temperatures of 115°+F not uncommon beginning as early as May and during the summer. The heat affects the quality of low desert alfalfa hay. Bloom (alfalfa flowers) is often associated with heat/stress/rapid growth under summer conditions.

Alfalfa yields and quality are also affected by day length. Alfalfa yields usually mirror day length (longer days = more hours of photosynthesis = higher yields). During the summer when day length is long, alfalfa stems and internode lengths are also long, resulting in a larger height:node ratio, and a lowering of alfalfa quality class and associated prices received by local 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). The price difference per ton between good and premium quality categories varies, but often is $10+/ton in the low desert valleys of Arizona and California and is often $25/ton in other areas such as the San Joachin Valley (USDA, 2002).

The active ingredient in BAS125 is prohexadione calcium, which serves to inhibit gibberellic acid. 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 increased leaf production, which

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could potentially increase alfalfa quality. Research with this product conducted during August when alfalfa growth was slower and days shorter than in late spring/early summer indicated a potential increase in alfalfa quality (Rethwisch et al., 2002). This study was initiated to further examine the effects of various rates of BAS125 on late spring/early summer alfalfa yield and quality in the low desert.

Methods and Materials

Four rates of BAS125 10W (0.0625, 0.1044, 0.125, and 0.1875 lbs active ingredient/acre) were applied the morning of June 7, 1998, to a second year stand of alfalfa (variety = CUF 101) grown on beds, that had an average of 5.05 inches 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 30.4 gal/acre at 20 psi with one T-Jet 8003S and one T-Jet 8003VS nozzle.

A randomized complete block design with four replications was utilized for the experiment. All BAS125 treatments had a non-ionic spreader-sticker (First Choice, Western Farms Service) added a rate of 0.75% vol/vol. Temperature was 82°F when last treatment was completed at 10:15 a.m.

A minimum sample of 20 plants per plot was collected at 5, 12, 19, and 27 days post treatment by cutting stems with scissors at the previous cutting height (2-2.5 inches). Numbers of nodes and trifoliate leaves per node, internode distances, and floral structures were recorded for 20 stems per plot. Stem diameters were also measured at approximately 4 cm above the cut, and each 5 cm (9, 14, 19, etc.) thereafter. Leaves were also separated from stems for each set of 20 plants and fresh (wet) weights of the leaves and stems were obtained. Alfalfa stem regrowth height data were also calculated from the internode measurements.

In-field plant height data were collected at 5, 12, 19 and 27 days post treatment (June 22, 29, July 6 and 14) by measuring and recording heights of 10 plant stems from ground level to growing tip. Measurement of subsequent alfalfa regrowth following alfalfa cutting was also obtained via this procedure on July 31 to ascertain if usage of BAS125 would continue to effect regrowth.

Data means were statistically compared using a Student-Newman-Keuls test or a Fishers least significant difference.

Results

Phytotoxicity

Some leaf spotting was apparent on plants in all plots treated with BAS125 at 5 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 and was similar to that noted in a previous experiment (Rethwisch et al., 2002). Spotting was not as evident at 12 days post treatment as new alfalfa growth had overgrown leaves that received the treatments and showed spotting.

Effects on plant height

All rates of BAS125 caused a significant reduction in plant height by 5 days post treatment (Fig. 1, Tables 1, 2) with increasing doses resulting in significant inhibition of stem elongation until plots were harvested (Figs. 2-4).

Increasing rates of BAS125 resulted in greater inhibition of alfalfa stem regrowth elongation, as the highest rate (0.1875 lbs.ai/acre) had stems 27-37% shorter than the untreated check through 12 days post treatment, and 20% shorter thereafter from laboratory measurements. In-field measurements at 27 days post treatment reflected the effects of differing rates with a least reduction noted in the 0.0625 rate (3.83% reduction) and most in the 0.1875 rate (14.25% height reduction).

Plant heights obtained in the field (Table 1) appear to be approximately 3 inches higher and reflected somewhat different growth patterns between 21 and 29 days post treatment than those noted from laboratory measurements (Table 2) of stems. Differences noted are in part due to the entire alfalfa stem height (ground to tip) being measured in field vs. stem regrowth (from previous cut to tip) in laboratory measurements (difference of about 2-2.5 inches), as well as partially due to sampling methodology. In field measurements (10/plot) tended to reflect tallest alfalfa (although sampling of shorter alfalfa was also included in sampling methodology). Laboratory measurements of cut stems may

be a more accurate reflection of actual stem height means as more samples (20/plot) were utilized and stems were randomly selected and did not have taller plants potentially obscuring shorter stems.

No differences existed for alfalfa plant height measurements in regrowth following harvest (Table 1), indicating that application of BAS125 is only effective on forage harvest to which applied and has no subsequent residual effect on plant height.

Effects on leaves

Application of BAS125 resulted in increased numbers of trifoliate leaves. The responses observed varied by rate of active ingredient as well as the days after application on which samples were obtained. At five days post treatment numbers of trifoliate leaves across treatments resembled a bell curve distribution across rates with highest number noted in the 0.1 lb active ingredient/acre rate (Fig. 5) although numerical differences of trifoliate leaves per stem were not statisically different (Table 3).

At 12 days post treatment (Fig. 6), the greatest number of trifoliate leaves (27.4) was documented in the highest rate (0.1875 lbs. active ingredient/acre) of BAS125 tested, a 12.3% increase compared with the untreated check. Total trifoliate leaf numbers were not signicantly different on this sample date however (Table 4). Fresh weight of trifoliate leaves was almost identical for all BAS125 treatments, but total weight of the untreated check leaves was greater by approximately 6.5%. Data documented that although more leaves were being produced as a result of treatment with BAS125, these leaves weighed less than those in the untreated check. Data also documented that trifoliate leaf weights were inversely related to BAS125 rates (higher rates resulted in more leaves/stem, but mean weight per trifoliate leaf decreased) on this sample date.

At 19 days post treatment (Table 5, Fig. 7), significant increases in numbers of trifoliate leaves per stem were noted from higher rates of BAS125, although numerical differences noted in trifolaite leaf numbers for the lower two rates tested were not significantly different from the untreated check. Highest fresh leaf weight/stem (17.3g) was noted with the 0.125 rate, with this being a 16.1% increase in leaf weight over the untreated check. Treatments varied in the amount of fresh leaf weight/stem with all BAS125 treatments having numerically more fresh leaf weight/stem than the untreated check with the exception of the 0.1 rate.

Number of leaves per stem decreased between 19 and 27 days (Table 6) post treatmemt for some treatments in part due to presence of spider mites (which were webbing plants and defoliating lower nodes) and in response to alfalfa bloom as lower leaves were undergoing senescence. Many of the first three nodes (especially nodes 1 and 2) were completely void of any leaf structures.

Stem Diameters

No statistical differences were noted for stem diameters at $\leq$15 cm (6 inches) of alfalfa stem regrowth at 5 days post treatment, and $\leq$20 cm (8 inches) at 12 and 19 days after application. Significant differences were noted at stem diameters above these heights on the respective sampling dates but these differences were associated with alfalfa stem height regrowth as a rate response to BAS125 (higher rates = shorter stems = newer, less developed stem growth at similar heights of stems when compared with the untreated check). Widest stems were consistently noted in the untreated check at all points measured for all sample dates.

Lower rates (0.0625, 0.1) had the narrowest stems in the lowest four inches of regrowth (0.0666 and 0.0675 inches for 0.0625 and 0.01 rates respectively vs. 0.071 inches for the untreated check at 13 days post treatment), although average regrowth was 5.5 inches at time of application. The reason for this observation is unclear. These data are also somewhat different than that documented for alfalfa treated in August (Rethwisch et al., 2002) when stem diameters had more of a bell curve response with several rates having larger stem diameters than the untreated check in the lower stem sections.

Floral structures

Floral structures were not well documented early in this study as the emphasis was to document interactions between height reductions and leaf numbers. Numerically more open blooms were noted in BAS125 treatments at 19 days after treatment than in the untreated check, but fewer floral racemes/stem were noted with higher usage rates of BAS125. No trend was noted for open flowers at 27 days post treatment.

Literature Cited

Rethwisch, M. D., M. D. Kruse, R. Kallenbach and M. Goad. 2002. Effect of BAS125 on low desert alfalfa growth and quality during the August production period. Pp. 5-12. In University of Arizona College of Agriculture 2002 Forage and Grain Report, Series P- 132 . M. Ottman, ed. 96 pp.

USDA. 2002. Alfalfa Hay 2001. Agricultural Marketing Service, Livestock and Grain Market News. 24 pp.

Acknowledgements

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Table 1. Alfalfa heights (inches) from field measurements at five, 12, 19 and 27 days after treatment on June 17, 1988, with BAS125 10W, Poston, AZ.

	Days after Treatment (sample date)				
Rate (lbs ai/acre)	5 (June 22)	12 (June 29)	19 (July 6)	27 (July 14)	July 31 Regrowth
0.00	12.74a	21.51a	27.23a	27.68a	12.03a
0.0625	11.08 b	17.66 b	24.20 b	26.62ab	11.45a
0.10	9.91 c	17.06 bc	24.58 b	25.69abc	11.63a
0.125	9.80 c	15.96 c	22.46 c	24.64 bc	11.95a
0.1875	9.95 c	14.18 d	22.10 c	23.46 c	11.50a

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

Table 2. Mean alfalfa stem regrowth (inches) from laboratory measurements at five, 12, 19 and 27 days post treament after June 17, 1988, with BAS125.

	Days after Treatment (Sample date)			
Rate (lbs ai/acre)	5 (June 22)	12 (June 29)	19 (July 6)	27 (July 14)
Untreated	8.86 a	15.51 a	18.70 a	24.17a
0.0625	7.48 b	12.40 b	17.72 ab	22.87ab
0.1	7.32 bc	11.26 b	16.61 bc	21.02 bc
0.125	6.85 bc	10.94 c	16.42 bc	18.70 c
0.1875	6.59 c	8.86 d	15.08 c	19.49 c

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (S-N-K test)

Table 3. Alfalfa Fresh Leaf and Stem Weight Means/20 Stems at 5 days post treatment.

Rate (lbs ai/acre)	Leaves/stem	Leaf wt (g)	Stem wt (g)	Total wt (g)	% Leaf
0.0	15.4 a	9.4a	13.8a	23.2a	40.4 c
0.0625	16.2 a	9.1a	11.1 b	20.2ab	44.9 b
0.1	16.9 a	10.3a	11.4 b	21.7ab	47.6ab
0.125	15.9 a	9.7a	9.9 b	19.5ab	49.4a
0.1875	15.2 a	9.4a	9.6 b	19.0 b	49.5a

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

Table 4. Alfalfa Fresh Leaf and Stem Weight Means/20 Stems at 12 days post treatment, 1998.

Rate (lbs ai/acre)	Leaves/stem	Leaf wt (g)	Stem wt (g)	Total wt (g)	% Leaf
0.00	24.4a	13.5a	20.5a	34.0a	39.7 c
0.0625	23.4a	12.6a	17.1ab	29.7a	42.3 bc
0.1	26.2a	12.7a	15.1 b	27.8a	46.0ab
0.125	26.2a	12.6a	16.5ab	29.0a	43.5ab
0.1875	27.4a	12.6a	14.3 b	26.9a	46.9a

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

Table 5. Alfalfa Fresh Leaf and Stem Weight Means/20 stems at 19 days post treatment, 1998.

Rate (lbs ai/acre)	Leaves/stem	Leaf wt (g)	Stem wt (g)	Total wt[1] (g)	% Leaf
0.00	29.2 b 14.9ab	23.7a	38.6ab	38.5a	
0.0625	33.3ab	15.4ab	24.2a	39.6ab	39.2a
0.1	35.8ab	12.5 b	23.8a	36.3 b	34.7a
0.125	41.5a	17.3a	31.4a	48.7a	35.9a
0.1875	41.9a	15.3ab	26.4a	41.7ab	36.4a

[1] Weights of stems and leaves only, flowers excluded
Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fishers LSD test).

Table 6. Alfalfa Fresh Weights of Leaves, Stems and Flowers/20 Stems at 27 days post treatment (July 14, 1998).

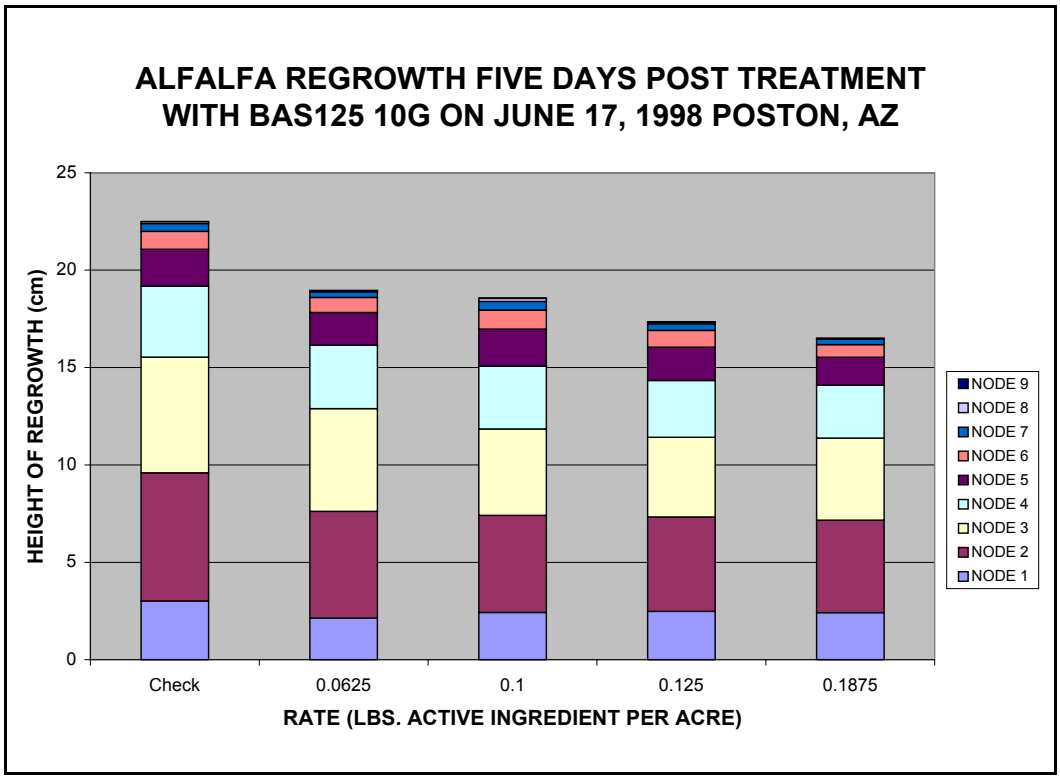
Rate (lbs ai/acre)	Leaves/stem	Leaves(g)	Stems (g)	Flowers (g)	Total wt (g)	% Leaf
0.00	37.7a	10.7a	32.7a	8.2a	51.7a	20.8ab
0.0625	42.7a	8.7a	30.6ab	9.1a	48.4a	18.3 b
0.1	38.5a	8.9a	24.9ab	7.5a	41.3a	21.3ab
0.125	38.5a	9.5a	23.7 b	6.7a	39.9a	24.0a
0.1875	39.3a	9.0a	25.3ab	7.3a	41.6a	21.7ab

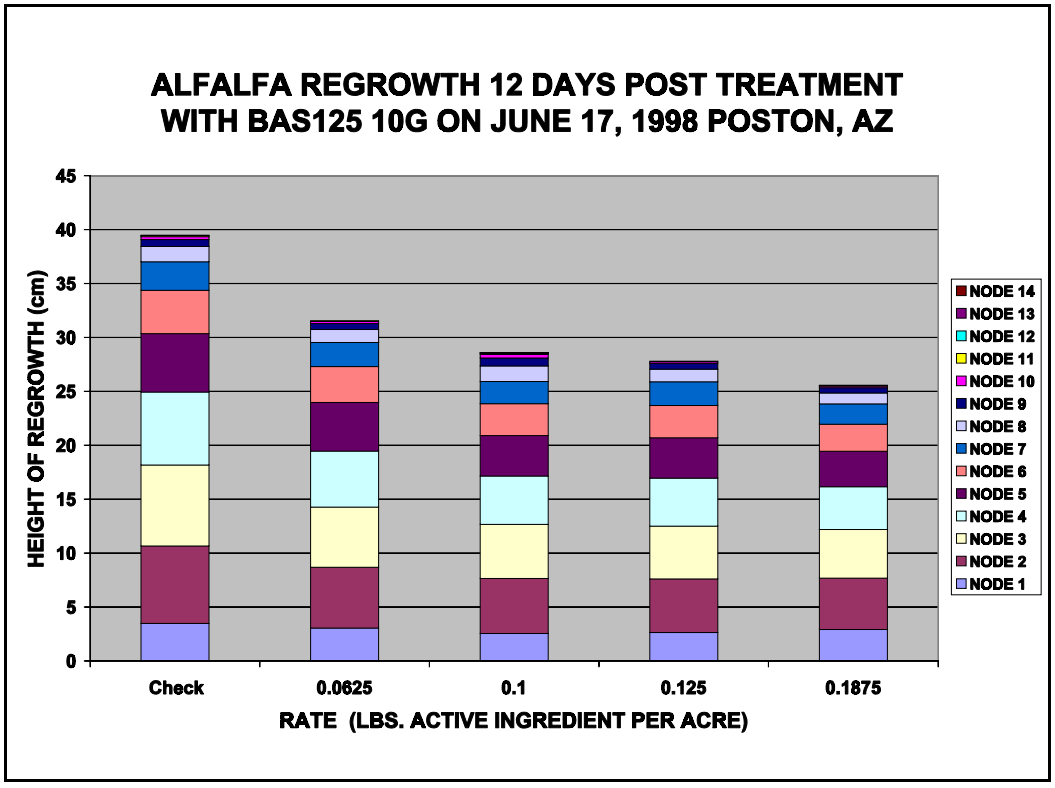
Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fishers LSD test).

Table 7. Mean Open Blooms at 19 and 27 DAT , and Flower Clusters/Racemes on alfalfa 27 days post treatment (July 14, 1998).

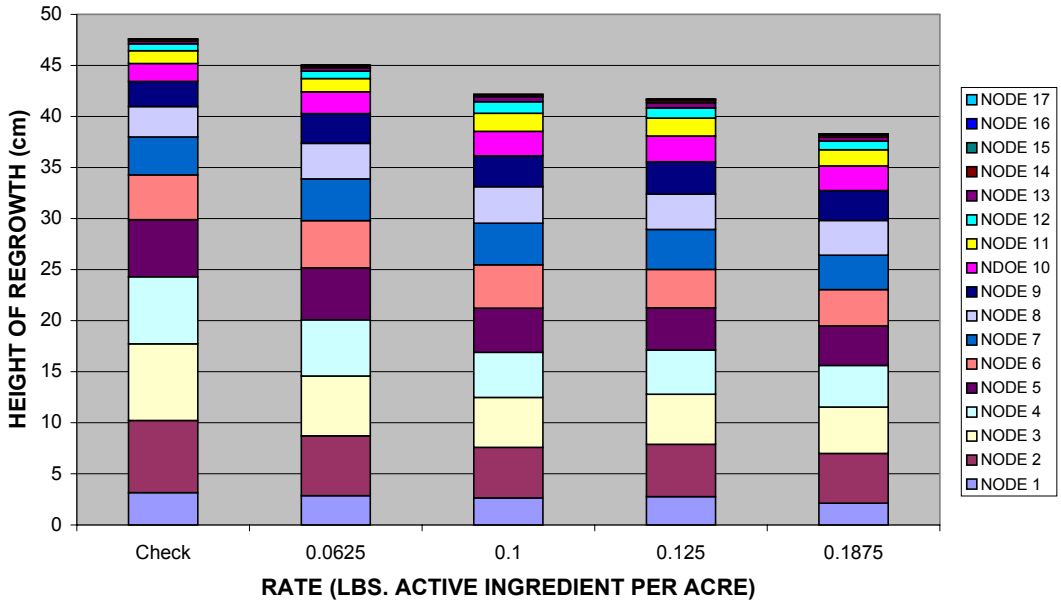
Rate (lbs ai/acre)	Flower Clusters/stem	Open Flowers	
		19 DAT	27 DAT
0.00	11.0a	14.8a	30.1 a
0.0625	11.3a	20.5a	35.0 a
0.10	9.3a	23.8a	30.6 a
0.125	8.2a	20.8a	25.4 a
0.1875	9.1a	17.8a	26.1 a

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (S-N-K test).

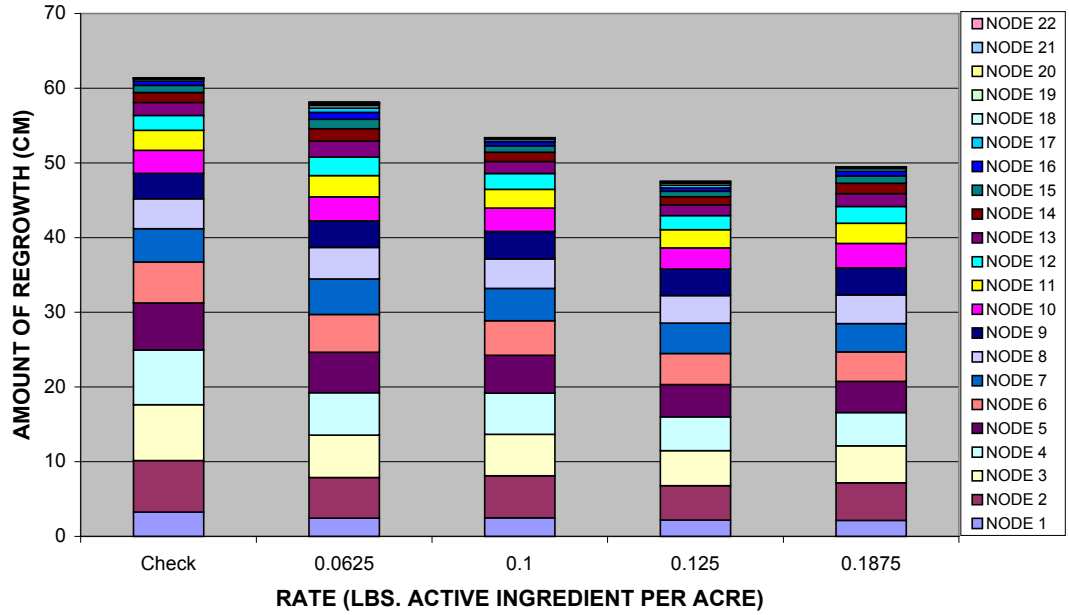

ALFALFA REGROWTH FIVE DAYS POST TREATMENT
WITH BAS125 10G ON JUNE 17, 1998 POSTON, AZ
HEIGHT OF REGROWTH (cm)
25
20
15
10
5
0
Check
0.0625
0.1
0.125
0.1875
RATE (LBS. ACTIVE INGREDIENT PER ACRE)
NODE 9
NODE 8
NODE 7
NODE 6
NODE 5
NODE 4
NODE 3
NODE 2
NODE 1

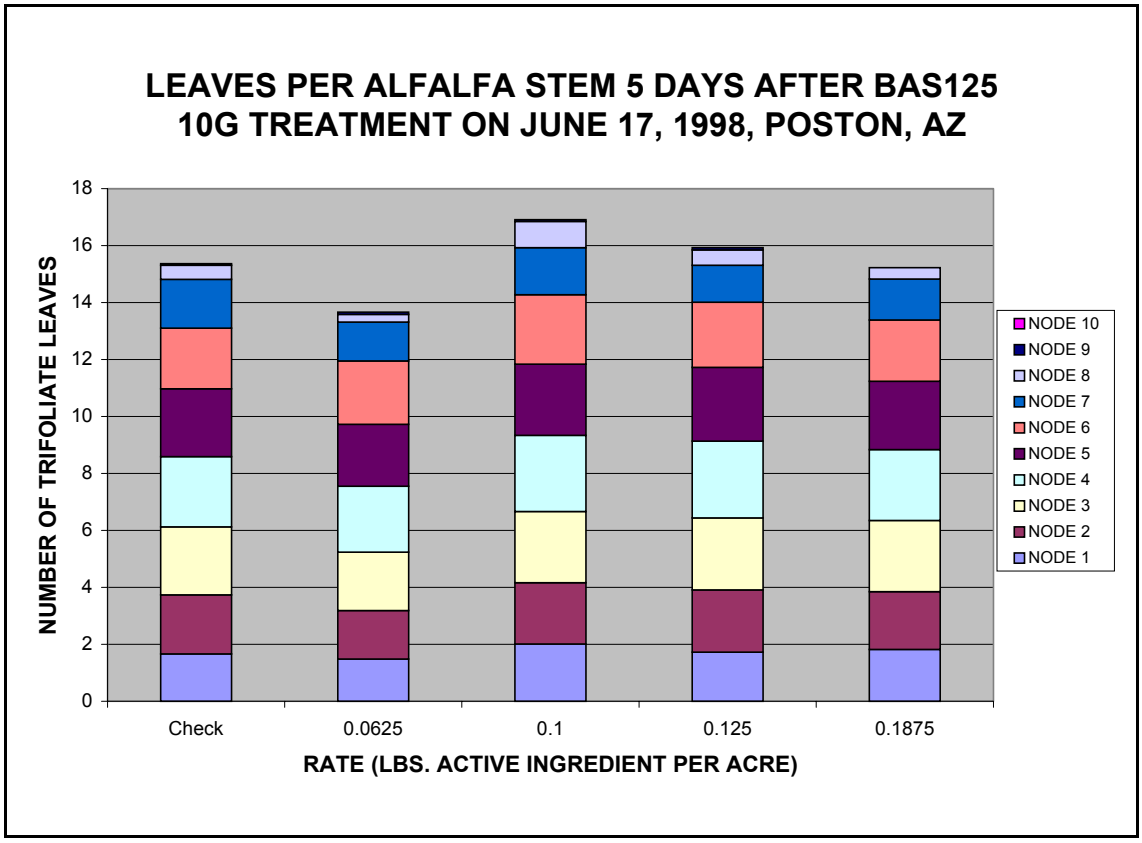

ALFALFA REGROWTH 12 DAYS POST TREATMENT
WITH BAS125 10G ON JUNE 17, 1998 POSTON, AZ
HEIGHT OF REGROWTH (cm)
45
40
35
30
25
20
15
10
5
0
Check
0.0625
0.1
0.125
0.1875
RATE (LBS. ACTIVE INGREDIENT PER ACRE)
NODE 14
NODE 13
NODE 12
NODE 11
NODE 10
NODE 9
NODE 8
NODE 7
NODE 6
NODE 5
NODE 4
NODE 3
NODE 2
NODE 1

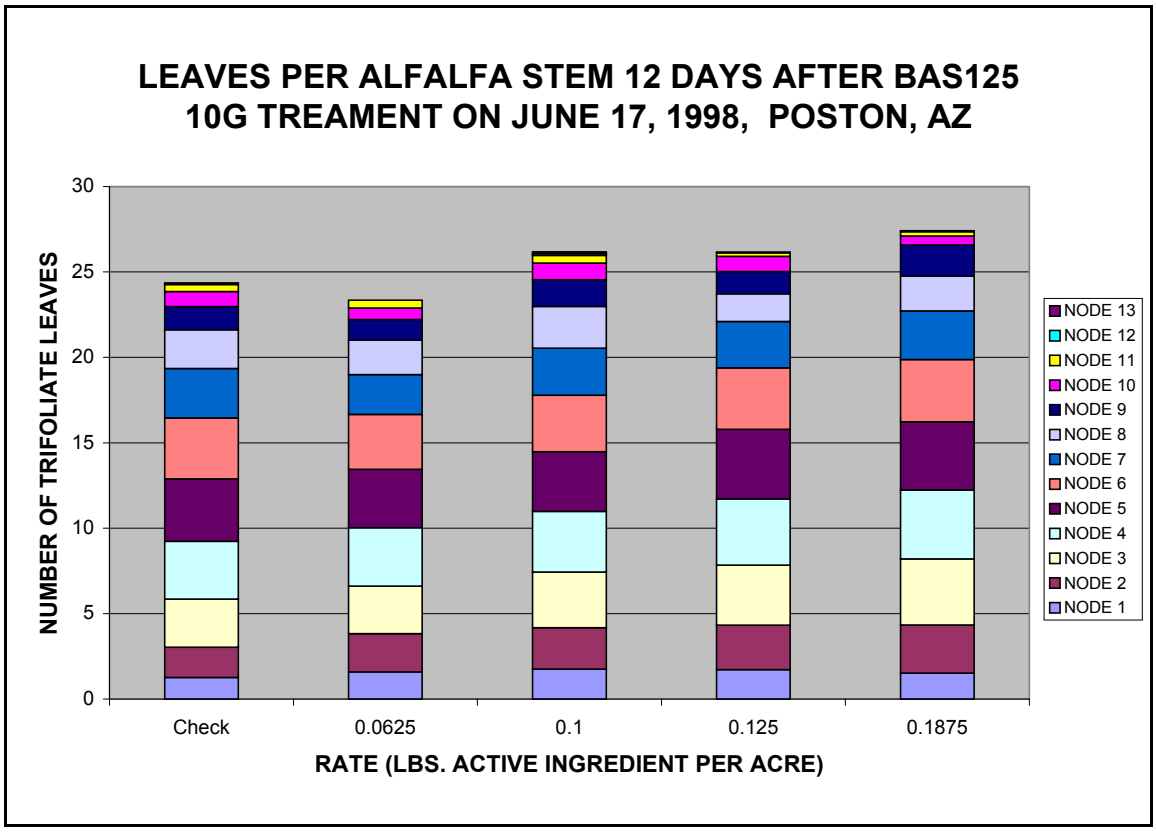
ALFALFA REGROWTH 19 DAYS POST TREATMENT WITH BAS125 10G ON JUNE 17, 1998 POSTON, AZ

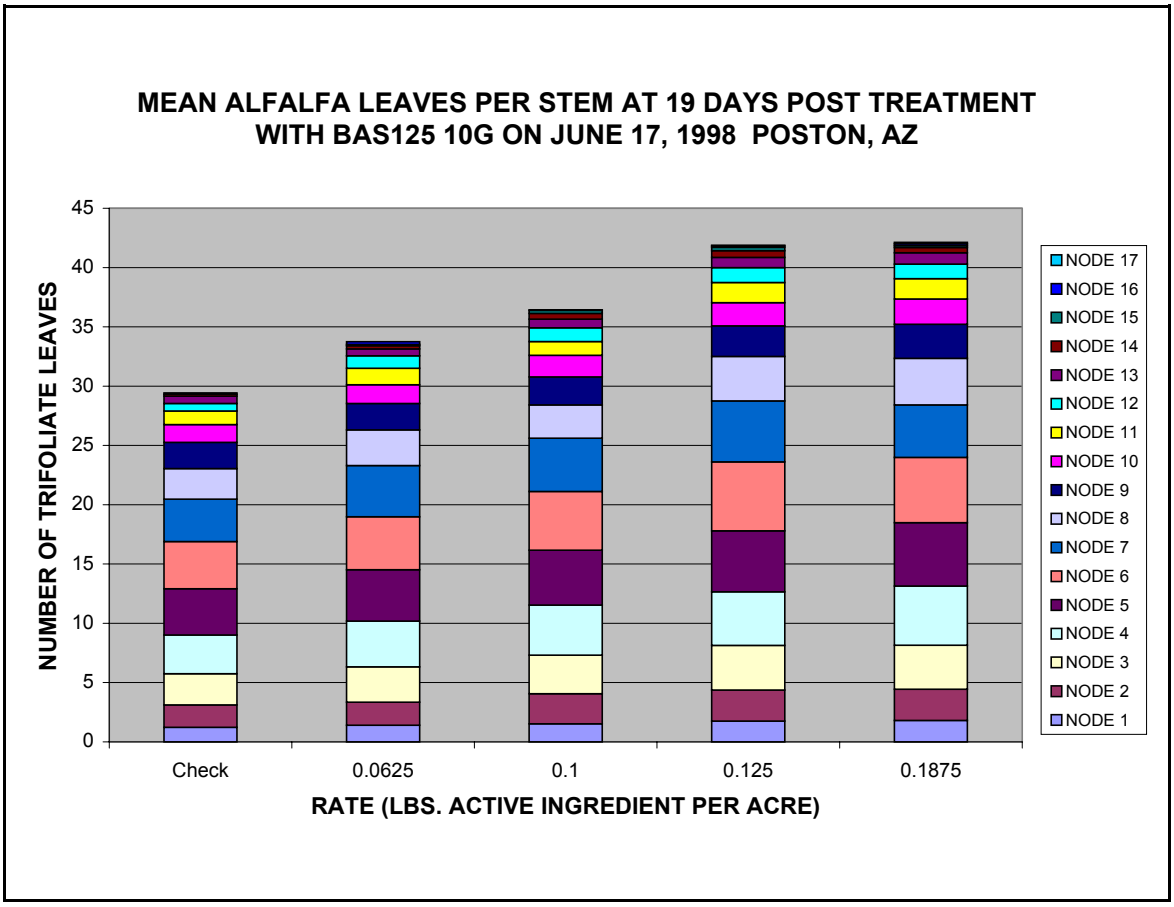


ALFALFA REGROWTH AT 27 DAYS POST TREATMENT WITH BAS125 ON JUNE 17, 1998 POSTON, AZ




LEAVES PER ALFALFA STEM 5 DAYS AFTER BAS125
10G TREATMENT ON JUNE 17, 1998, POSTON, AZ
NUMBER OF TRIFOLIATE LEAVES
0
2
4
6
8
10
12
14
16
18
Check
0.0625
0.1
0.125
0.1875
RATE (LBS. ACTIVE INGREDIENT PER ACRE)
NODE 10
NODE 9
NODE 8
NODE 7
NODE 6
NODE 5
NODE 4
NODE 3
NODE 2
NODE 1


LEAVES PER ALFALFA STEM 12 DAYS AFTER BAS125
10G TREAMENT ON JUNE 17, 1998, POSTON, AZ
NUMBER OF TRIFOLIATE LEAVES
0
5
10
15
20
25
30
Check
0.0625
0.1
0.125
0.1875
RATE (LBS. ACTIVE INGREDIENT PER ACRE)
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


MEAN ALFALFA LEAVES PER STEM AT 19 DAYS POST TREATMENT
WITH BAS125 10G ON JUNE 17, 1998 POSTON, AZ
NUMBER OF TRIFOLIATE LEAVES
45
40
35
30
25
20
15
10
5
0
Check
0.0625
0.1
0.125
0.1875
RATE (LBS. ACTIVE INGREDIENT PER ACRE)
NODE 17
NODE 16
NODE 15
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