FALL APPLIED NITROGEN SOURCES FOR ONIONS

Brad Brown
Parma R & E Center, University of Idaho

ABSTRACT

Onion field trials were conducted for three years (2000-02) to compare fall broadcast incorporated conventional and slow release N fertilizers that might replace one or more sidedressings to onions the following spring. Fertilizers applied at 100 or 200 lb N/A included fall broadcast conventional urea, Polyon polymer coated urea, Trikote sulfur coated urea (SCU), and split applications of Polyon in the fall and spring or conventional Solution 32 sidedressed twice in spring. Measurements included nitrates in bed centers through the early season, onion stands, N uptake at bulb initiation (mid season) and as tops were going down (late season), maturity (% of tops down), yield, and grade. Fall broadcast conventional urea was less effective than fall broadcast slow release N sources or N sidedressed in the spring at providing season long N for onions. November broadcast conventional urea significantly reduced onion stands in April which in turn reduced measured N uptake and yield. Split (fall and spring) applied Polyon consistently matched the N uptake and yield of two spring sidedressings of Solution 32, but fall broadcast slow release N alone did not always yield as well or preclude the need for spring sidedressing N.

INTRODUCTION

Treasure Valley onions are typically sidedressed one to three times during early growth in the spring. Conventional N sources of urea or Solution 32 are used in the sidedress applications. The onions are fall bedded and frequently fumigated. Spring preplant N is generally less effective than split or later applications unless the N source has slow release properties (Brown et al. 1988; Drost et al., 2001).

An effective single fall N application would preclude the need for multiple sidedressings and may be cost effective for growers as it would save time and labor costs. It would probably reduce wheel row compaction as well. For fertilizer companies, eliminating the need for as much rolling stock as currently necessary for spring sidedressed N would offer advantages also. The effectiveness of fall applied N would depend on a delayed release of N in a manner to meet the N requirements of onions during bulbing the following late spring and summer. Whereas selected slow release materials have been evaluated for onions to a limited extent as early spring applications in the Treasure Valley (Brown, 1988; Jensen, 2001) or in Utah (Drost, et al., 2001), there are few evaluations of slow release materials applied in the fall, four or more months prior to planting onions in the spring.

The purpose of this study was to determine if fall broadcast Polyon and SCU slow release N would preclude the need for one or more spring sidedressings.

METHODS

An onion field study was conducted for three years (2000-02) at the Parma R & E Center on a silt loam previously cropped to wheat (1999 and 2001) or corn (2000) to compare fall broadcast N sources including urea, Polyon polymer coated urea, Tri-Kote (SCU) with conventional multiple spring sidedressings of Solution 32. Treatments were arranged in a randomized complete block with six replications. Fall applied treatments were broadcast November 9-10 in 1999, November 21 in 2000, and November 16, 2001 and all were incorporated during fall bedding. Individual plots were 22' wide (twelve 22" beds) and 40' long. Beds were prepared and left over winter. Onion double rows (spaced 4") planted March 22, 27, and 22 in 2000, 2001, and 2002 respectively, were centered on the original beds after leveling the tops of the beds.

Soil samples (0-12" and 12-24") collected prior to fall bedding indicated background soil fertility levels were adequate for all nutrients other than N. Pre-bedding residual NO_3-N (0-12") measured only 4.1 ppm in 1999, 27.7 ppm in 2000, and 11.0 ppm in 2001. Composite bed center (0-12" in 2000; 0-12" and 12-24" in other years) soil samples (12 cores per treatment, two from each rep) were collected monthly in the spring to bulb initiation to indicate nitrification for each treatment. Buried bags were also extracted periodically through the season for a measure of background N mineralization.

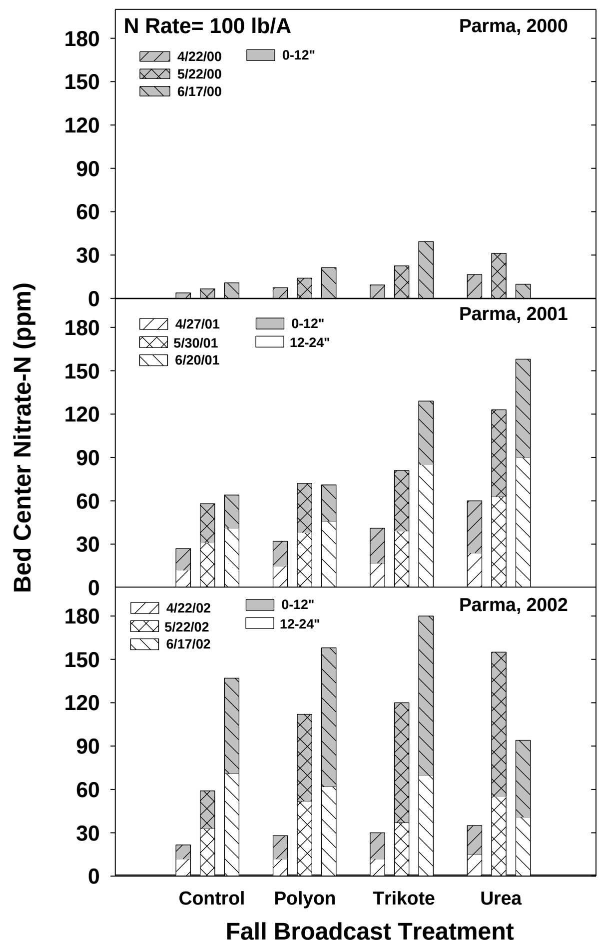

Figure 1. Bed center nitrate-N during the pre-bulbing period as affected by N sources fall broadcast prior to onions planted the following spring. The N sources were compared at the 100 lb N/A rate.

Onion plant N contents were measured at or shortly after bulb initiation in June and as tops were going down in late August. All soil and plant analyses were done at the UI Analytical Services Lab. Onion maturity was monitored by recording estimates of the percentage of tops down in late August. Onions were harvested for yield and grade using eight 35' rows (total area = >513ft^2) on September 24-25, September 25-26, and October 8-12 in 2000, 2001, and 2002, respectively. All data were analyzed using Analysis of Variance (SAS version 7.0).

RESULTS

Nitrates in the first foot of bed centers in March ranged from 80% (2002) to 235% (2000) greater for fall broadcast urea than for fall broadcast slow release N sources (data not shown). In April, nitrates were lowest in the untreated control and highest with fall broadcast urea (Fig. 1). Nitrates in the control and fall broadcast urea differed less in 2002 than in previous years by the end of April. SCU or Polyon, were similar in April and typically lower than fall broadcast urea reflecting their slower release properties.

In the May sampling and after several irrigations, bed center nitrates increased two to four fold depending on the year and treatment, with fall broadcast urea the highest through May in all years. SCU and Polyon did not differ appreciably in bed center nitrates through May in most years, with the possible exception of 2000 when nitrates for SCU appeared to be greater.

In June after additional irrigations, bed center nitrates increased further for all treatments with notable exceptions in 2000 and 2002 for fall broadcast urea which declined from May to June, especially in 2002. June bed center nitrates for fall broadcast urea may have been flushed beyond bed centers or leached to lower depths. SCU nitrates appeared to be higher than Polyon nitrates in June in all years. Bed center nitrates measured in the second foot increased by June in all treatments other than urea in 2001.

Background mineralized N using buried bags (from the control) in the first foot during the season each year measured 22.5 ppm in 2000, 21.2 ppm in 2001, and 27.3 ppm N in 2002. Mineralized N in the second foot was lower and averaged from 4.2 to 5.3 ppm.

Onion stands did not appear affected by treatments in 2000 and were not measured. In contrast, onion stands as a percent of the best treatment were adversely affected by some fall N sources in 2001 and 2002, particularly at the higher N rate. Fall broadcast urea reduced stands over 40% at the higher N rate in 2001 and by 60% in 2002. Stands were also reduced in 2001 by fall broadcast SCU at the 200 lb N rate. No significant stand reduction resulted from the fall broadcast Polyon treatment at the same high N rate. Stand reductions may be due to excess NH_3 at the seeding depth. Ammonium-N (NH_4-N) concentrations in soil collected in March from the first 12 inches in affected treatments were several fold higher than in treatments that were unaffected. The NH_4-N in the first foot measured in the 200 lb N rate were 17.5 ppm and 21.0 ppm for urea in 2001 and 2002 respectively. Stand reductions in 2000 may not have been as severe if they occurred at all due to an earlier fall broadcast, greater nitrification, and lower preplant NH_4-N concentrations.

Using slow release N sources have risks of not releasing N rapidly enough for rapidly developing crops. Onions typically take up less than 5-10% of their total N by bulb initiation in June. Nitrogen applied, including fall broadcast urea, increased onion N uptake in June at bulb initiation, particularly with slow release sources or split spring applications in 2000 (Fig. 3). Uptake of N at the 100 lb N rate did not differ from the control for any of the applied N treatments in 2001, and in 2002 only the SCU and split spring application resulted in higher N uptake than the control by bulb initiation. At the 200 lb N rate the only treatment differing from the others was the fall broadcast urea which was lower in 2001 due to the reduced stands.

Near the end of the growing season, N uptake in onions did not differ among applied N treatments at either the 100 or 200 lb N rates in 2000, or the 100 rate in 2001. Treatments

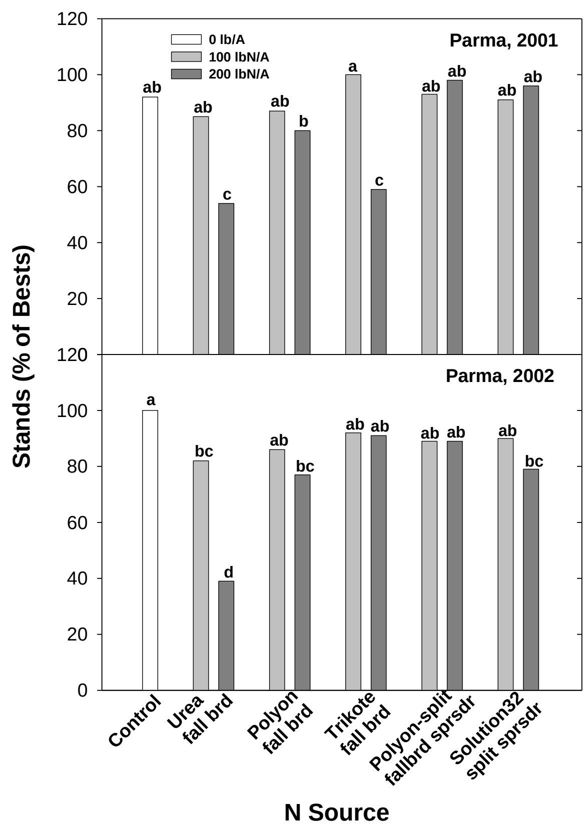

Figure 2. Onion stands as affected by fall and spring applied N sources.

involving a spring sidedress tended to be higher in N uptake than fall applied treatments at the 200 lb rate in 2001. None of the applied N treatments differed from the control in 2002 but there were differences among applied N treatments. Fall applied urea and Polyon both tended to result in less N uptake than fall applied SCU.

Onions matured earlier in 2000 with applied N regardless of source and earliest maturity occurred with the N rates above 100 lb/A (Fig. 4). In other years, while all N sources other than urea fall broadcast averaged higher in tops down, only fall broadcast Polyon consistently differed significantly (P>0.1) from the control in both 2001 and 2002. Onions treated with fall broadcast urea at the 100 lb rate did not differ in maturity from the control but at the 200 lb N rate maturity of onions with fall broadcast urea was delayed compared to the control. Onions treated with fall broadcast Polyon and SCU consistently matured as early as with split N applications in spring.

Despite following wheat or corn, onion yield increased with applied N in only two seasons. Total onion yield in 2000 was the most responsive to N of any year and was consistently higher with applied N, but fall broadcast urea was the least effective of the applied N treatments (Fig. 5). Fall broadcast urea at the 200 N rate significantly reduced total yield in 2001 and 2002 due to its adverse affect on stand.

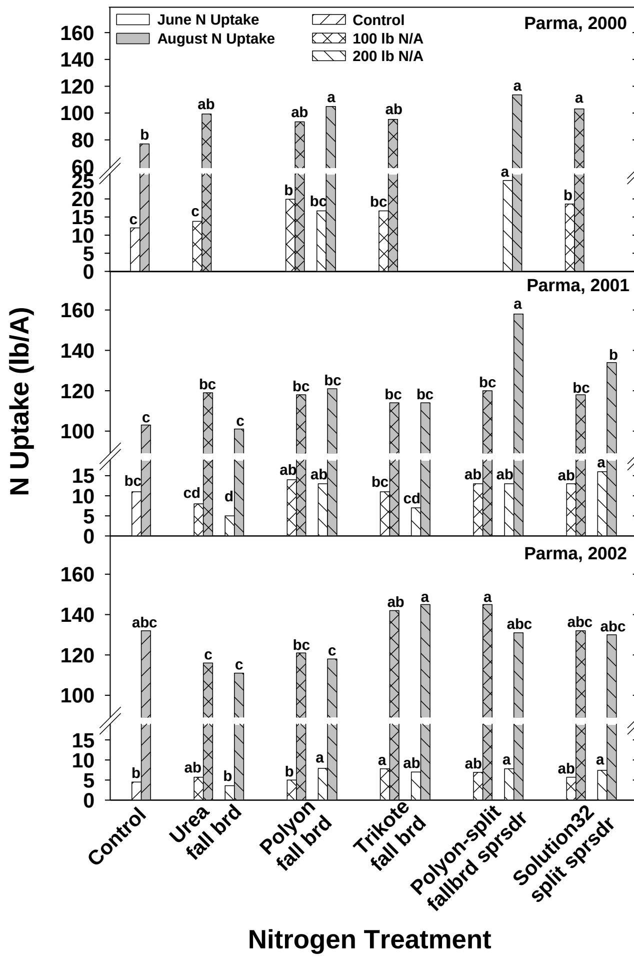

Figure 3. Nitrogen uptake by onions each year at bulb initiation in June (white filled bars) and as tops were falling late season in August (gray filled bars) as affected by fall broadcast and spring sidedressed N sources at two N rates (100 and 200 lb/A).

Fall broadcast slow release N sources (Polyon and SCU) in 2000 were lower in yield than any treatment involving a spring N sidedress at both 100 and 200 lb N rates. Only split N applications, either Polyon applied in fall and spring or Solution 32 split applied in spring increased total yield in 2001 over that of the control. Sources of N other than fall broadcast urea did not differ from the control in 2002.

Most of the total yield was comprised of jumbo or colossal onions. Colossals typically command the highest price. Much of the yield increase in 2000 and 2001 with N was due to higher colossal yields.

In years when available N limited production, fall applied urea was less productive than fall applied slow release N or spring sidedressed N. Polyon split applied (fall broadcast, spring sidedress) was the only treatment that performed consistently as well as two spring sidedress

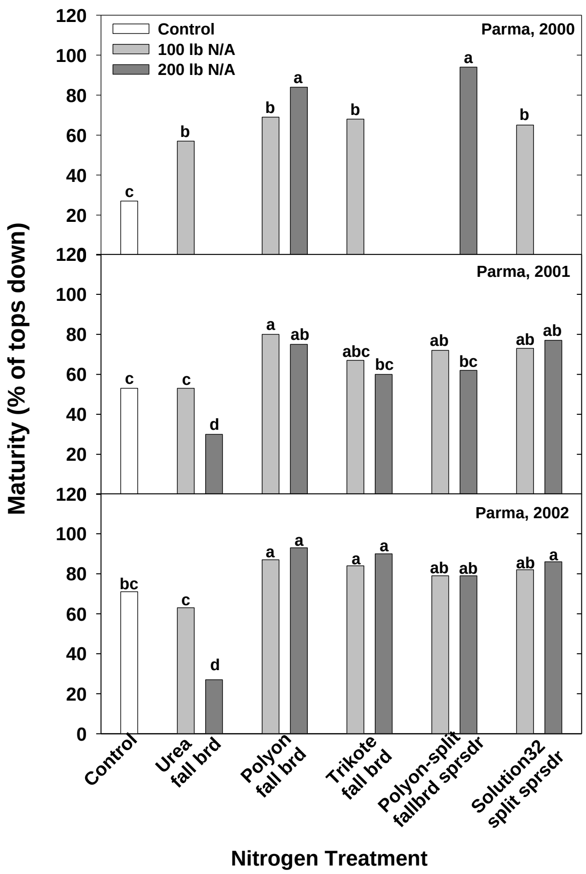

Figure 4. Onion maturity in late August each year as affected by N source and timing. Maturity was measured as the percentage of tops fallen over.

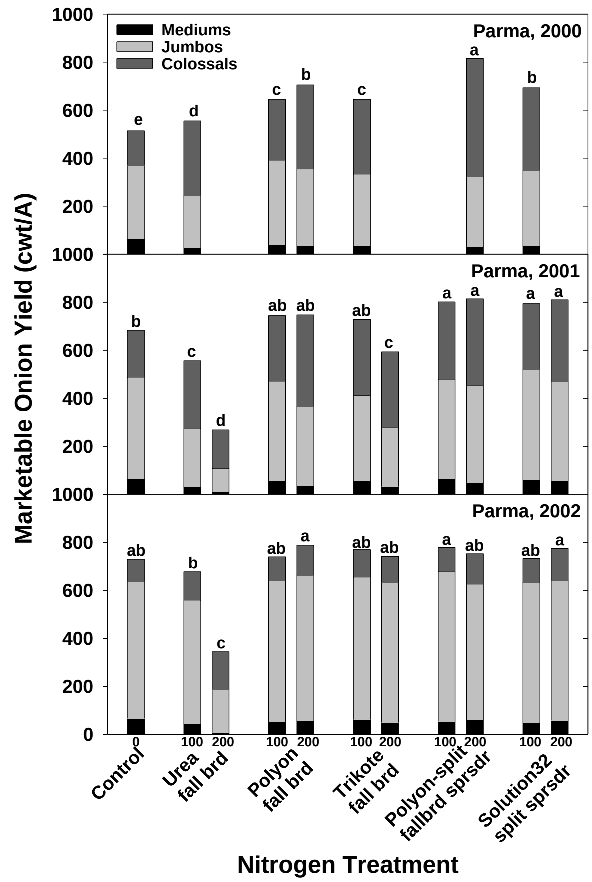

Figure 5. Marketable onion yield by grade as affected by N source and rate in each year.

applications of Solution 32, suggesting that one sidedress in spring may be avoided. Onion stands were particularly susceptible to fall applied urea and possibly higher rates of some slow release N sources. The poorer effectiveness of fall applied N is likely due to a combination of leaching, immobilization, and displacement of nitrates beyond onion roots with the wetting front prior to onion bulbing when most of the N is taken up.

REFERENCES

Brown, Bradford D., Albert J. Hornbacher and Denny V. Naylor. 1988. Sulfur-coated Urea as a Slow-release Nitrogen Source for Onions. J. Amer. Soc. Hort. Sci. 113:864-869.

Drost, Dan and Rich Koenig. 2001. Improving Onion Production and N Use Efficiency with a Polymer Coated Nitrogen Source. *In* Brown, B.D. (editor), Western Nutrient Management Conference Proceedings, . Salt Lake City, UT. March 8-9. pp 39-46.

Jensen, Lynn and Lamont Saunders. 2001. *In* Brown, B.D. (editor), Western Nutrient Management Conference Proceedings. Salt Lake City, UT. March 8-9. pp 219-222.