THE EFFECT OF SLOW- AND FAST-RELEASE UREA FERTILIZER RATIOS AND TIMINGS ON WHEAT GRAIN YIELD

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Management strategies to reduce soil N loss include improved timing of N fertilizer applications, better use of soil and plant testing procedures to determine N availability, application of nitrification or urease inhibitors, and use of N fertilizer sources that are suitable for local environmental conditions (Dinnes et al., 2002). The use of slow-release nitrogen (N) fertilizer for wheat may be a cost-effective management practice to increase crop performance and allow for a single N fertilizer application in the fall.

Research was conducted in Northeast Missouri from 2004 to 2007 determined the impact of polymer-coated urea (ESN) rates and application timings on wheat grain and frost-seeded clover forage yields. Grain yields with fall-applied polymer-coated urea (PCU) were similar to a split application in three of four years and were greater than a split application in one of four years (Nelson and Motavalli, 2007). Fall-applied polymer-coated urea had grain yields that were 4 to 24 bu/acre greater than non-coated urea in two of the four years. Polymer coated urea release was related to rainfall throughout the winter months in 2006 and 2007 (Figure 1). Differences in wheat response were related to variation in soil drainage among years. January and February PCU applications at Columbia increased grain yield 15 and 10 bu acre^{-1}, respectively, when compared to urea alone while later application timings reduced yield when compared to urea alone (Medeiros, 2006). However, heavy rainfall on frozen ground during this time may result in off-site movement of polymer coated fertilizer sources in transitional, temperate weather zones. Limited research has examined application timings of polymer coated urea and blend ratio combinations of polymer-coated urea (slow-release) with non-coated urea (fast-release). The objective of this research was to determine the impact of polymer-coated urea application timings and ratios of slow- and fast-release urea on wheat grain yield in Northeast Missouri.

Materials and Methods:
Research was conducted at the Greenley Research Center near Novelty, MO in 2008 and 2009. This research was arranged as a randomized complete block design with five replications in 10 by 30 ft plots. 'Pioneer 25R56' was no-till drilled following an application of 10-60-140 (N-P-K) on 5 October 2007 and 20-50-100 on 30 October 2008 at 120 lbs/acre in 7.5 in. rows. PCU release was determined using mesh bags that were deployed on nine different dates and recovered at subsequent dates, washed in cold water, dried, weighed, and percent release calculated (Figure 1 and 2). Polymer coated urea (PCU, ESN, Agrium), non-coated urea (NCU, fast release), 75:25 PCU:NCU, and 50:50 PCU:NCU fertilizer treatments were applied at 75 and 100 lbs N/acre on 7 application dates (Figures 3 and 4) in 2008 and 2009. Plots were harvested with a small-plot combine. Double-crop soybean, 'Asgrow 3602' and 'Pioneer 94Y01', was planted 7 July 2008 and 3 July 2009, respectively, to determine the effect of N management in wheat on subsequent soybean response. Grain moisture was adjusted to 13% prior to analysis.

All data were subjected to analysis of variance and means separated using Fisher's Protected LSD (P=0.05).

Results:

Rainfall and distribution of rainfall events were extensive in the fall and spring of both years. Over 40% of PCU applied from October to February was released by 15 June 2008 (Figure 1) and 2009 (Figure 2). Fertilizer release was dependent on application date with up to 80% of applied fertilizer released by 15 June. The non-treated check grain yield was 53 bu/acre in 2008 and 30 bu/acre in 2009. There was a significant grain yield to response to all N treatments in 2008 and all but 100% PCU applied in April, 2009 (Figures 3 and 4). Grain yields at 100 lbs N/acre averaged 5 bu/a greater than 75 lbs N/acre in 2008 while there was virtually no difference between rates in 2009 when averaged over all application timings (data not presented).

Wheat yield was ranked PCU = 75:25 PCU:NCU $\geq$ 50:50 PCU:NCU $\geq$ NCU for the October, November, December, January, February and March application timings (Figure 3). However, the April 14 application timing resulted in grain yield rankings of 50:50 PCU:NCU = NCU $\geq$ 75:25 PCU:NCU > PCU. Icy conditions at the December application timing and frozen conditions at the February application timing probably contributed to lower yields for these application timings. In general, there was a rate response to decreasing amounts of PCU for the October, January, and February application timings.

Head scab, Septoria leaf blotch, and common rust was prevalent in 2009 which reduced overall grain yields and test weight (data not presented). PCU applied at planting was similar or greater than all application timings of PCU alone which was related to reduced release later in the season (Figure 4). A mixture of PCU with NCU was required at the April application timing in 2009.

Fall applications of PCU or a blend of PCU:NCU at 75:25 had yields similar to or greater than spring applied N in 2008 while a 50:50 blend of PCU:NCU had the most consistent yields in 2009. PCU applications in Northeast Missouri from mid-March and later should include a greater amount of NCU in the blend to maintain maximum grain yields based on our results in 2008 and 2009. Grain yields prior to mid-March were more variable in the NCU treated wheat when compared to PCU or blends of NCU with PCU.

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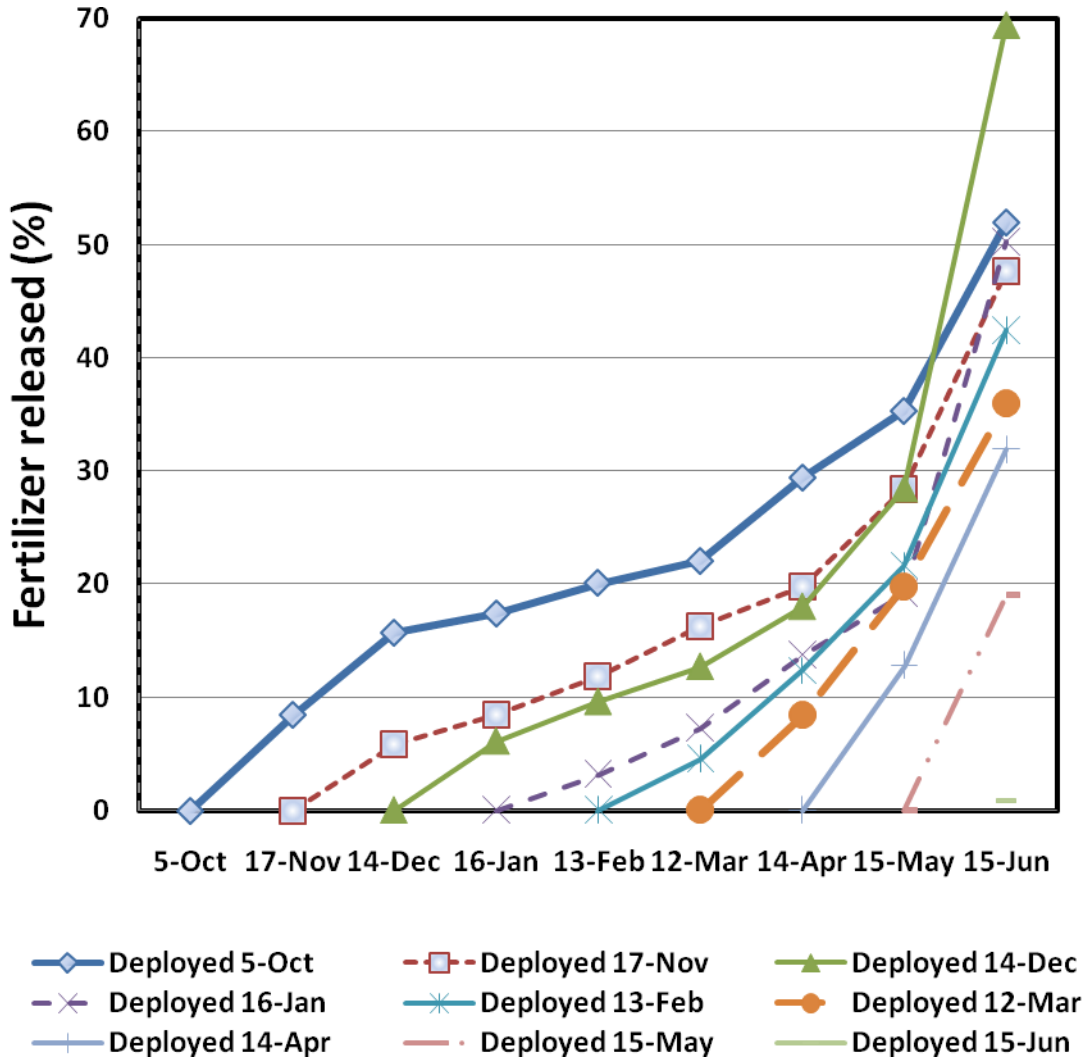

Figure 1. Polymer-coated urea (PCU, ESN) fertilizer release for individual application dates from fall, 2007 to spring, 2008. The LSD ($P \leq 0.05$) was 5.

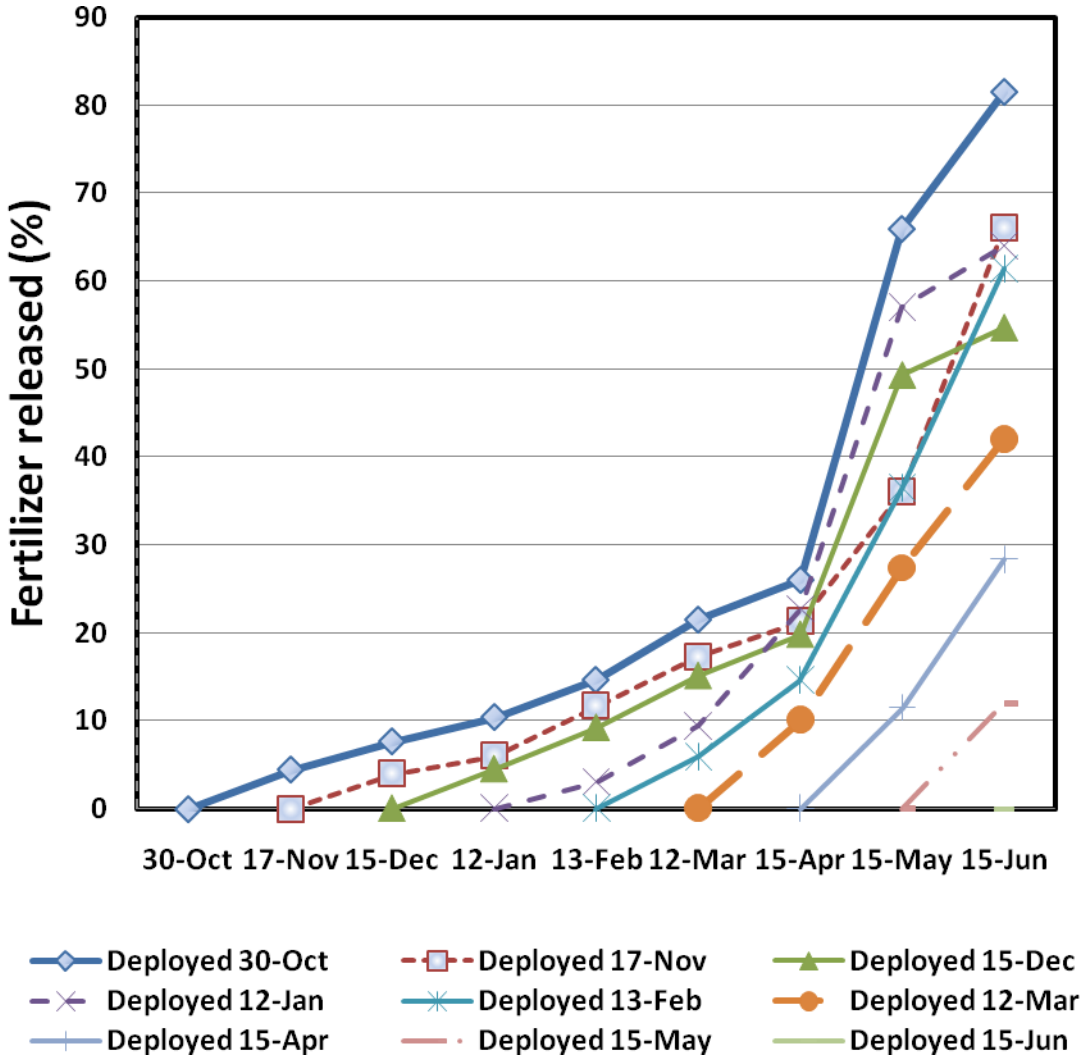

Figure 2. Polymer-coated urea (PCU, ESN) fertilizer release for individual application dates from fall, 2008 to spring, 2009. The LSD ($P \leq 0.05$) was 9.

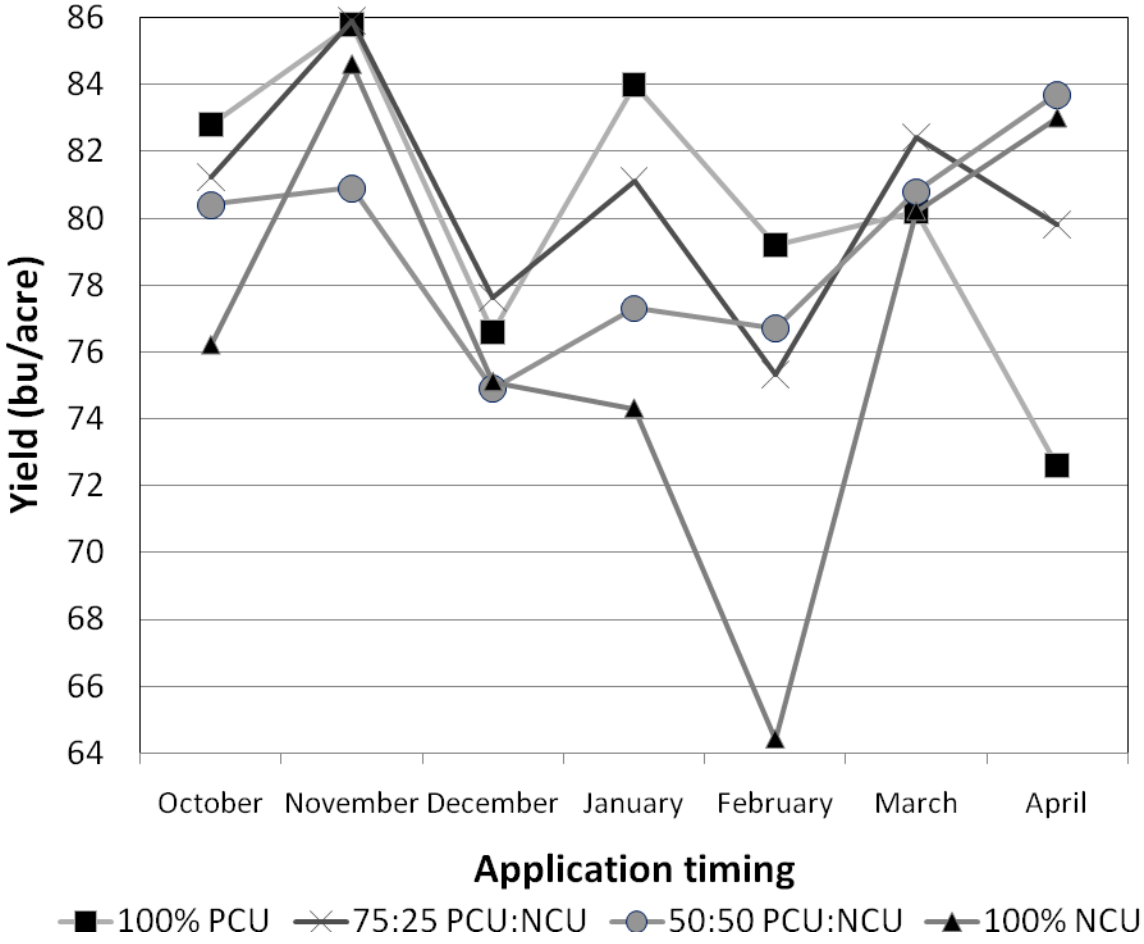

Figure 3. The effect of polymer- (PCU, ESN) and non-coated (NCU) urea application timings and ratios at 100 lbs N/acre on grain yield in 2008. LSD (p=0.05) was 4 bu/acre.

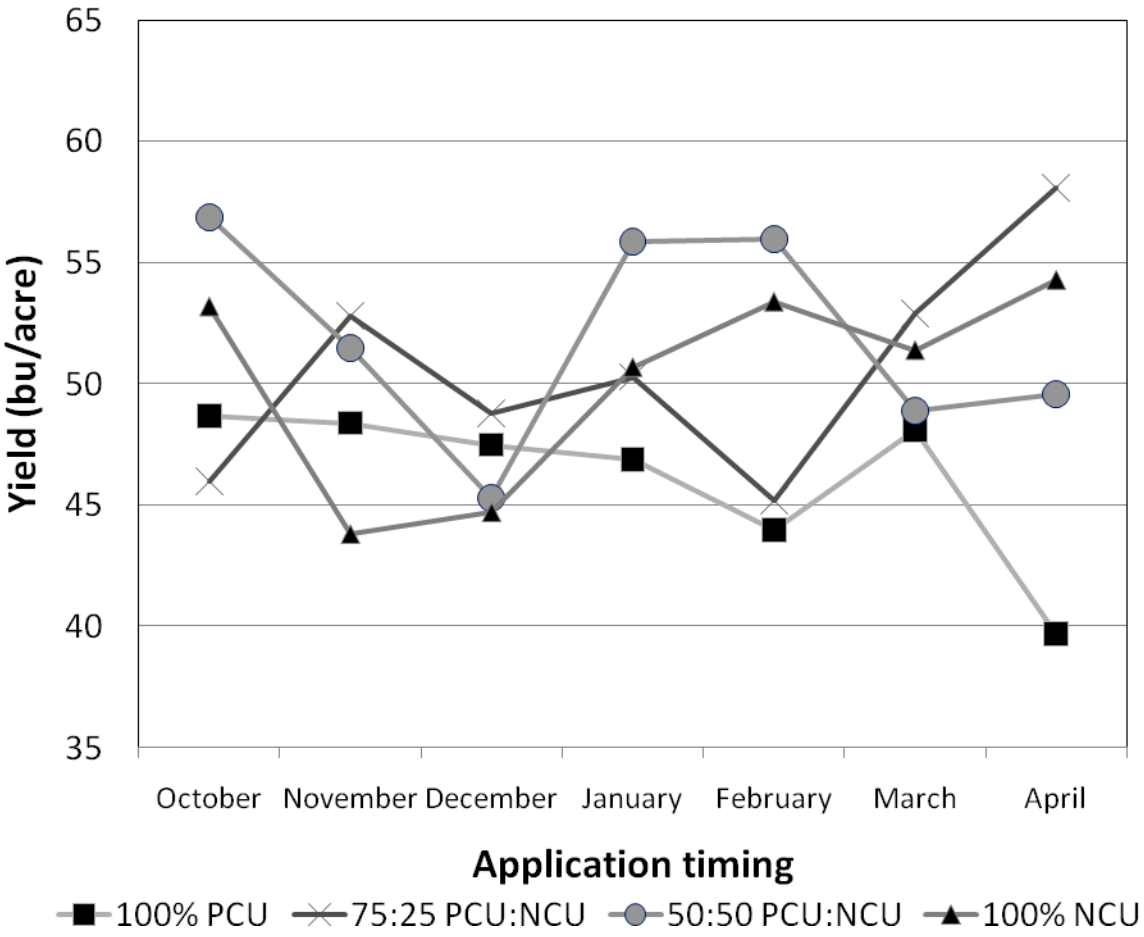

Figure 4. The effect of polymer- (PCU, ESN) and non-coated (NCU) urea application timings and ratios at 100 lbs N/acre on grain yield in 2009. LSD (p=0.05) was 11 bu/acre.