

Comparative performance of urea and polymer coated urea (ESN) in timothy, and winter and spring wheat at Thunder Bay and New Liskeard

*Dr. Tarlok Singh Sahota CCA and John Rowsell
TBARS Thunder Bay and NLARS New Liskeard*

Nitrogen is the major limiting nutrient for crop production and it needs to be applied invariably to non-legume crops. Escalating natural gas prices have increased the fertilizer prices warranting their efficient use. High analysis fertilizers, such as urea, supply N at relatively low cost as compared to other N fertilizers, except liquid ammonia. Urea accounts for more than 50% of N consumption in Ontario/and Canada. Since urea hydrolyses quickly, N supply from urea usually exceeds the slow initial crop demand for N. During this period N could be lost as volatilization, denitrification, leaching and surface run off, more so from the broadcast urea, with an adverse effect on the environment. Polymer coated urea (PCU, popularly known as its brand name ESN) has the potential to release nitrogen as the soil warms and would prevent nitrogen losses during cold weather periods when the crop is not actively growing. As the weather warms and the crop grows, N would release from the coating and be available to the crop. Slow and steady N availability from ESN could improve the yield and protein content of hay and grains ensuring higher production of quality feed/food per unit of applied N. Since the work done on polymer coated urea in the western Canada on spring wheat and canola indicated that its effect varied with the locations/rainfall, and there was apparent lack of information on the use of polymer coated urea in field crops of Ontario, we studied the effect of coated and uncoated urea, at Thunder Bay and New Liskeard, during 2006 – 2010 on timothy, winter wheat, and spring wheat that cover over two million acres in Ontario, and in which urea is invariably surface applied. This research was funded jointly by OMAFRA and Agrium Inc. Calgary, AB.

Timothy: The results revealed that the treatments effects were better marked in later years than in first harvest year at both the locations. This could be due to relatively slower transformation of the two N fertilizers in the cold northern environments and cumulative effect of the residual and applied N. Application of urea and ESN increased timothy dry matter yield almost linearly up to 105 kg N/ha, which is traditionally thought to be the optimum rate of N application to forage grasses. Our research indicates that N at rates higher than 105 kg/ha need to be tried in timothy to work out maximum economic rate of N application (MERN). Averaged over three years, dry matter yield and N removal by timothy at Thunder Bay were almost the same with urea and ESN. At New Liskeard, yield and N removal with urea were higher than that with ESN. Thunder Bay is relatively colder than New Liskeard; therefore urea at Thunder Bay urea too probably acted like a slow release fertilizer. Protein content in timothy was (up to 1.7 %) higher with ESN as compared to urea at both the locations though not in all the years. Application of N from urea/ or ESN didn't increase the post harvest residual mineral N content in the soil profile (0-90 cm; ~75 % in 0-60 cm soil) as compared to the check (No N) at Thunder Bay, where the residual mineral N was a little higher with ESN than that with urea. At New Liskeard, application of higher rates of N from the two fertilizers increased residual mineral N in the soil (0-90 cm) as compared to the check (77 % mineral N in 0-60 cm soil), though the residual mineral N from the

two fertilizers was similar. The results show that there wasn't any adverse environmental impact from N application to timothy, more so at Thunder Bay.

Residual effect of the treatments applied in 2006-2009 was studied at Thunder Bay in 2010. ESN resulted in significantly higher dry matter yield of timothy than urea and the effect increased with the increasing rates of N application, from 0 to 105 kg/ha, almost linearly. N removal was higher with ESN than that with urea even though protein content was similar with the two fertilizers.

When urea and ESN applied singly were compared with application of blends of the two fertilizers, each @ 70 kg N/ha, a 75:25 blend of urea and ESN, on N basis, produced the highest dry matter yield of timothy at both the locations. Averaged over the years, the blend gave ~400 kg/ha/year higher yield than urea applied alone and over 500 kg/ha higher yield than ESN applied alone at Thunder Bay. At New Liskeard, timothy yield with this blend was not significantly better than urea applied alone, but was ~1,200 kg/ha higher than ESN. Protein content in timothy at Thunder Bay was highest (10 %) when 75 % of N supplied was from ESN and 25 % from urea. At New Liskeard, this blend was second (best) in timothy protein content to ESN applied alone. N removal by timothy at Thunder Bay was highest (82 kg/ha) with 75:25 urea ESN blend on N basis. At New Liskeard, different blends of urea with ESN didn't increase N removal by timothy as compared to urea alone, though the blends resulted in 10-13 kg/ha higher N removal than that by ESN applied alone.

Averaged over years, post harvest mineral N in soil profile (0-90 cm) ranged from 33 -37 ppm at Thunder Bay (75 % in 0-60 cm), and 49-53 ppm at New Liskeard (73 % in 0-60 cm).

Residual effects of these treatments applied in 2006-2009 on the 2010 timothy crop at Thunder Bay revealed that the highest dry matter yield was obtained with ESN @ 70 kg N/ha, which was 650 kg/ha higher than urea at the same rate of N. Protein content in timothy with ESN @ 70 kg N/ha was either the same or higher than other treatments.

Total mineral N in soil in early spring was only 1.5-2.0 ppm higher with urea than that with ESN/ or its blends with urea. Amongst the blends of the two fertilizers, 75% N from ESN and 25% N from urea appeared to be the best!

Considering the significant favourable residual effect of ESN, its cost could be spread over a longer period as compared to urea.

Winter wheat: Grain, straw and biomass yields, grain protein content and N removal by grain and straw of **winter wheat** at **Thunder Bay** were similar with urea and ESN. Grain yield seemed to increase by less or more than 200 kg/ha with each increment of N from 40 to 120 kg/ha. Increase in grain protein content of 0.6 and 1.4 % points, as compared to No N was recorded only at higher rates of N (80 and 120 kg N/ha). Taking both the grain yield and grain protein content into account, 120 kg N/ha could be considered as the maximum economic rate of N (MERN) application in winter wheat at Thunder Bay.

Average N removal by winter wheat grains was 106 kg N/ha and ranged from 95 kg N/ha in check (No N) to 119 kg N/ha with urea @ 120 kg N/ha and 114 kg N/ha with ESN @ 120 kg N/ha). Post harvest residual mineral N (nitrate, ammoniacal or total) at any of the soil depths (0-30,

30-60 and 60-90 cm) didn't vary much with the type of fertilizer or the rate of N application in any of the years. Proportion of nitrate and ammoniacal N in the soil profile (0-90 cm) was almost equal i.e. 50:50; 77 % of total mineral N was in 0-60 cm soil.

At **New Liskeard**, ESN out yielded urea by ~300 kg grains/ha; grain protein content was similar with the two N fertilizers. There appeared to be no significant effect of rates of N application (0-120 kg N/ha) on **winter wheat** grain yield or N content in grains.

It appears that more work will need to be done to work out the maximum economic rate of N (MERN) application in winter wheat at New Liskeard.

Average N removal by winter wheat grains was 120 kg N/ha; 7 kg/ha higher with ESN than that with urea. Total N removal by grains + straw was ~180 kg/ha (14 kg/ha higher with ESN as compared to urea).

Residual nitrate N was only marginally higher with urea than that with ESN and was highest at the highest rate of N (120 kg N/ha) from the two fertilizers. Nitrate N accounted for two-third of the total mineral (residual) N in the soil. This indicates higher N mineralization rate of fertilizer N at New Liskeard as compared to that at Thunder Bay. About 73 % of total mineral N was in 0-60 cm soil.

Spring wheat: Urea and ESN were compared @ 0, 40, 80 and 120 kg N/ha during 2007-2010 at Thunder Bay and in 2009 at New Liskeard. With the exception of higher straw yield with urea than that with ESN in 2008 (Thunder Bay), grain, straw and biomass yields didn't vary with the two fertilizers in any of the years/locations. Application of N @ 120 kg N/ha did not improve grain yield as compared to its lower rates, except in 2009 at Thunder Bay. Straw yield increased with the increasing rates of N up to 120 kg/ha in 2008 and up to 80 kg/ha in 2009 at Thunder Bay. Grain N/protein content was not influenced by the sources of N in any of the years/or locations. In the first two years, application of N @ 80 or 120 kg/ha improved grain protein content up to 1 % point or more at Thunder Bay. At New Liskeard, application of N @ 40-120 kg/ha increased the grain protein content by 2-3 % point. In normal years, spring wheat removed ~200 kg N/ha at Thunder Bay and 170 kg N/ha at New Liskeard. Post harvest residual nitrate N was generally higher from urea than that from ESN; the reverse was true for ammoniacal N. Total residual N (nitrate + ammoniacal) from the two fertilizers was more or less the same. This indicates slower transformation and availability of N from ESN as compared to urea in the spring season. The experiment at Thunder Bay in 2010 revealed that ESN @ 120 kg N/ha could be applied to spring wheat in the seed row without any adverse effect on crop stand or yield.

Published in Northwest Link, July 2011, Pages 8-9 & Northwest Link, August 2011, Pages 11-12.