It pays to use multiple sources of Nitrogen for crop production!

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The first question that would come to one's mind is why to use more than one source of nitrogen (N)? Why not the cheapest one? This is because a single N fertilizer at times may be too quick (e.g. urea) or too slow (ESN?) to release N as per crop requirements. More than one source of N could also supply other essential nutrients limiting crop yields (e.g. sulphur from ammonium sulphate). Urea is usually dissolved within hours and is converted into ammonium in 2 - 4 days and to nitrate form within 3 to 10 days. Whereas, the crop plants continue absorbing nutrients throughout their crop growth; though most of the uptake takes place before the reproductive stage. Total nutrient availability in soluble form at the early crop stage (e.g. urea), when nutrient uptake is slow/and limited could often lead to losses of N (volatilization, leaching and denitrification depending upon soil and weather conditions). About 50 % of N is taken by wheat in the first one month after seeding and most of N by wheat is taken by 60 days of crop growth. Corn takes about two months to absorb 50 % of its total N requirement. N release from ESN is ~8-15 % in the first 10 days, 40-60 % in the first month and 85-90 % within 60 days, matching closely with the crop needs. However, release of N from ESN is soil moisture and temperature dependent. Ammonium sulphate would split into ammonium and sulphate ions in the soil solution. The ammonium ions are absorbed by the clay/and organic matter in the soil and would be released over time, whereas the sulphate component is readily available. I therefore thought of blending quickly available N fertilizers with the slow release N fertilizers and comparing their effect on crop yields with the commonly used urea N fertilizer in systematic field experiments.

In an experiment on forage grasses (mixture of timothy, bromegrass and orchardgrass), averaged over two harvest years, it was found that (i) 105 kg N/ha wasn't the optimum rate of N for grass production, (ii) the grasses dry matter yield increased by increasing N application rate from 105 to 140 kg N/ha; and this increase by application of urea alone was 560 kg/ha, 728 kg/ha with urea (105 kg N/ha) + ESN (35 kg N/a) and 1,444 kg/ha with urea (85 kg N/ha) + ESN (35 kg N/ha) + ammonium sulphate (20 kg N/ha). At a price of $100/MT of hay, the extra returns by using three sources of N would be $144.40. Deducting extra cost of N (~$72.20) from the blend of urea, ESN and ammonium sulphate (as compared to urea alone) from the extra gain, one would get a net gain of $72.20. This means two dollars return on every dollar invested in multiple sources of N rather than using only urea.

In a straight comparison of fall application of ESN with fall/or spring application of urea (at the same rate of 105 kg N/ha; single application from ESN and two split applications of urea-70 kg N/ha for the first and 35 kg N/ha for the 2nd cut) in timothy and bromegrass, it was found that even though the dry matter yields (averaged over three years) from the two fertilizers were similar (5214, 5158 & 5122 kg/ha/year, respectively from fall ESN, fall urea and spring urea), protein content/and yield from ESN applied grasses was higher than those from urea applied grasses; economic analysis was as follows:

Protein yield from fall ESN: 738 kg/ha
Protein yield from spring urea (standard practice): 657 kg/ha
Value of additional Protein: $207/ha
Additional cost of ESN: $47/ha
Net benefit from ESN: $160/ha

In barley for silage, dry matter yield increase by using 50 kg N/ha from urea and 20 kg N/ha from ESN was 1,260 kg/ha higher than that from urea applied @ equal rate of N (70 kg N/ha). Barley grain yield increase (~170 kg/ha) by the same combination was relatively small though still economical. In spring wheat, fall application of N from ESN and urea, in 50:50 proportion, gave ~140 kg extra grain yield/ha than the spring applied urea at equal rate of N. Such an option would increase the window of fertilizer application and help to seed spring cereals early. The extra cost of 20 kg N/ha from ESN would be only $6/ha and that of 35 kg N/ha from ESN would be only ~$10.5 as compared to the same amount of N from urea. In MasterGraze corn ESN @ 100 kg Na/ha produced as much dry matter yield (8,235 kg/ha) as urea @ 150 or 200 kg N/ha (8,020 or 8,157 kg/ha). In silage corn, ESN @ 150 kg N/ha proved to be significantly better than urea @ 150 kg N/ha in warmer years and at higher levels of productions. In canola, applying one-third of 180 kg N/ha from ESN and the rest from urea gave almost 1 MT/ha extra yield than the total N applied through urea at LUARS Thunder Bay. I may also say that use of N from multiple sources could obviate the need for split application of N to crop plants.

It may be worth mentioning that (i) Canola King of Ontario (Jon Wiley) had used multiple sources of nitrogen (urea, ammonium sulphate and ESN) as well as boron and had a record canola seed yield of 4,912 lb/acre from Liberty 5440, and (ii) I was invited by Agromart Truro (now Sollio Agriculture) few years ago to make two presentations in their Biennial Crop Focus event; one on 'Multiple Nitrogen Sources for Forages' and another on 'Nitrogen for Corn and Small Grains' in recognition with my innovative work on efficient and economic use of fertilizer nutrients. Considering research findings from LUARS Thunder Bay over multiple years, I would recommend that to maximize economic returns from crop production, application of ammonium sulphate could match with the sulphur requirements of crops (higher for alfalfa and canola than cereals) and 1/4th to 1/3rd of the total N recommended to crops may be applied as ESN. ESN is best applied in the seed row at seeding! Because of polymer coating, ESN doesn't damage the seedlings and thus doesn't affect crop stand. N released in the seed row is quickly taken up by the roots.

Best Wishes for the Crop Season 2020 and Always!

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