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Urea Fertilizer in Crop Production

Urea is a fertilizer material used for direct application to crops or in the preparation of blended fertilizers. Under most circumstances, it is equivalent to or superior than most other nitrogen sources. To understand the significance of urea, as opposed to other sources of nitrogen, one must examine the nature of commercial fertilizers and how they are blended.

Commercial fertilizers are complex mixtures of various blended materials that contain at least the minimum level of nutrients, as per the label guarantee. In the case of nitrogen, there is usually more than one form of nitrogen, and often more than one source of nitrogen used in any blend.

The two major forms of nitrogen found in most blends are **nitrate-nitrogen** (nitrate-N) and **ammonium-nitrogen** (ammonium-N). Nitrate-N is the form directly utilized by plants. However, it is not readily held by soil particles and, if present in excess, is readily lost by leaching and/or conversion to nitrogenous gases (through denitrification). Ammonium-N, on the other hand, is not normally utilized by plants directly and is not subject to losses by leaching or denitrification. Most ammonium-N is converted, however, during the growing season, to nitrate-N by soil microorganisms. Under some conditions, ammonium-N can be volatilized to the atmosphere, although this often occurs within high pH soils or when large amounts of ammonium/ammonia are not worked into the soil at application.

Under ideal conditions, therefore, it would be desirable for a fertilizer to supply only enough nitrate-N to get a crop growing early in the season and then enough ammonium-N for conversion to nitrate-N over the course of the season, as the crop needs it. Unfortunately it is difficult to achieve this ideal balance of nitrate-N and ammonium-N in a fertilizer. It does point out, however, some advantages of having different forms of nitrogen in most fertilizer blends.

What is Urea?

Worldwide, urea is one of the most widely used dry granular sources of nitrogen. It is preferred by the fertilizer manufacturing industry since it is relatively easy to manufacture. Urea also has a high nitrogen content (46%), in comparison to other popular nitrogen sources (i.e. ammonium nitrate). On a tonne-for-tonne basis, urea contains 35% more nitrogen than ammonium nitrate. This has implications on the storage and transport of nitrogen fertilizer products. Urea is considered a relatively **stable** product to store and transport, and it is for this reason that the transportation of urea is considered very cost effective in comparison to its most common alternative, ammonium nitrate. Since ammonium nitrate is now classified as a hazardous product (because it can be used as an explosive), there are many restrictions and potential additional costs related to its transportation. For example, each tonne of urea contains 35% more nitrogen than a tonne of ammonium nitrate.

Why is Urea Different?

Urea is a somewhat unique fertilizer material because it contains neither nitrate-N nor ammonium-N, but nitrogen is applied in the form of urea-N. When placed in the soil, however, it quickly converts (usually within 2-10 days depending on soil temperature) to ammonium-N. Urea is, therefore, usually considered to be equivalent to an ammonium-N source.

It is extremely important to note that when the soil micro-organisms convert urea to ammonium-N, there can be a short term increase in pH in the area immediately around the fertilizer granule.

If the fertilizer is placed in a concentrated band, this pH shift can be significant, even if it only persists for several days. This effect is more pronounced at low soil moisture levels, high temperatures and in light sandy soils.

It is also important to understand that at pH levels above 7.5 (which are possible under the above conditions), the ammonium-N, produced by the breakdown of urea, can be partially converted to ammonia gas. This ammonia gas will usually dissolve in the available soil water and not pose any problems. If conditions are dry, however, free ammonia gas can persist in the soil pore space and this can damage plant roots when fertilizer has been banded near the root system. Ammonia can also escape to the atmosphere and be lost if the fertilizer is at or very near the soil surface.

In light of this somewhat unique chemistry of urea, there are several points which should be kept in mind relative to its use:

- When broadcast and worked into the soil, it performs similar to any other ammonium-N source of nitrogen.
- When banded or drilled near emerging seedlings, root damage can sometimes occur because of free ammonia gas produced by the initial breakdown of urea. Although urea or urea based fertilizers can be used successfully for these types of applications, certain criteria for maximum rates of application and placement must be followed. Examples are given in the “Specific Cropping Programs” section which follows.
- When broadcast on the surface and not incorporated into the soil, nitrogen losses due to ammonia volatilization can occur with urea or urea based fertilizers. Applications of this type should be avoided under the hot and dry conditions usually prevalent in mid-summer. If urea is applied in this manner, from mid-June through late-August, it should always be done immediately prior to a soaking rain so that it will dissolve and thus enter the soil.

What Fertilizers Contain Urea?

The characteristics of a blended fertilizer will pool the properties of all its component ingredients. **If a fertilizer contains less than approximately 30% of its nitrogen from urea, it need NOT be considered a urea blend**, and the amount of urea present will not seriously influence the properties of the final product. Such a mixture should not be included in discussions on special management techniques required when using urea blended fertilizers.

The major source of phosphorus used in fertilizer blends on Prince Edward Island is diammonium phosphate (DAP) which has a fertilizer analysis of 18-46-0. It should be noted, therefore, that DAP has an N:P ratio of 1.0:2.6. **This means that fertilizer blends, having an N:P ratio close to 1:2 will contain little urea because the DAP supplies almost all the nitrogen required in the blend.** In order to clarify which fertilizer blend fits in this category, the following general rules should be helpful:

- Blends which contain less than 30% of their nitrogen from urea or other single nitrogen sources include: 1:2:2, 1:2:1, 1:3:2, 1:4:4, and 1:5:2, (examples: 10-20-20, 10-20-10, 8-24-16, 5-20-20 and 3-15-6, respectively). These blends can be used on crops without regard to urea in their formulation.
- Blends which contain a significant amount of nitrogen from sources other than DAP, include: 1:1:1, 2:1:1, and 3:1:3, (examples: 15-15-15, 20-10-10, and 15-5-15, respectively). If these blends use urea in their formulation, the rules regarding the use of urea blend fertilizer must be considered.
- Blends other than those indicated above should be checked with your fertilizer supplier or staff of the PEI Dept. of Agriculture and Forestry to verify the potential urea levels in their formulation.

Specific Cropping Programs:

In the situations where fertilizers are broadcast and worked into the soil, there is little concern as to the source of nitrogen used. In cases where over 30% of the nitrogen in a fertilizer blend comes from urea, special considerations are sometimes necessary. The most common situations are as follows:

Established Forages

- Use urea blends with no restrictions in most cases.
- For very early grazing, blends containing predominantly nitrate-N are recommended, thus excluding most urea blends.
- For application during hot, dry, summer weather (usually after late-June), urea and urea blends should be applied only before a good soaking rain.

Cereals

- Fertilizer blends containing less than 30% of their nitrogen as urea should be applied as usual. (NOTE: Levels of banded N, P205, and K20 should never exceed 55 kg/ha, 110 kg/ha and 55 kg/ha respectively, regardless of source of nutrients).
- Fertilizer blends containing over 30% of their nitrogen as urea should not be drilled with the seed at nitrogen rates higher than 35-40 kg/ha. Nitrogen requirements over this level must be broadcast, either before or after seeding.
- For early spring application to winter cereals (soil temperature under 10°C), urea is not recommended.

Potato

- Fertilizer blends containing less than 30% of their nitrogen as urea may be applied as usual.
- Fertilizer blends containing over 30% of their nitrogen as urea should not be banded with the planter at nitrogen rates higher than 120-135 Kg/ha. Some varieties may tolerate a higher rate, however, it is recommended that the "safe" level be adhered to for all varieties. Nitrogen requirements over 120-135 kg/ha should be broadcast before planting or top-dressed after planting.
- If urea is used for top-dressing, it should be incorporated into the soil with a tillage operation within 12 hours of application or should be applied prior to a soaking rain.

Although the above guidelines do not cover all crops and/or all circumstances, they do apply to a large number of common situations. Producers should refer cases outside of these guidelines to their nearest District Agricultural Office for further information.

(Revised March 2014)