# Fluid Dry Fertilizers

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## Agronomic Aspects of Fluid and Dry Fertilizers

Questions frequently arise concerning the relative agronomic merits of various physical and chemical forms of fertilizers. Two common questions center on whether fluid fertilizers are agronomically better than their dry counterparts and whether polyphosphates are agronomically better than orthophosphates. The polyphosphate question is pertinent to a discussion of fluid fertilizers because polyphosphates are most often encountered in fluids. The answers to these questions are often confusing because responders tend to include nonagronomic factors such as ease of application, uniformity of application, and economics in their agronomic evaluations. The answer should be based solely on crop yield obtained when materials are compared using similar rates of plant nutrients under similar methods of application.

## Agronomic Comparisons of Fluid and Dry Fertilizers

Although numerous field studies have been performed comparing fluid and dry fertilizers under similar conditions, very little of this research is reported in referred journals. Rather, it is usually found in experiment station annual reports which are not widely available. The comparisons most often made have been among solid urea, solid ammonium nitrate, and urea-ammonium nitrate (UAN) fluids; between dry ammonium phosphates and fluid ammonium phosphates; and between ammonium orthophosphates and ammonium polyphosphates.

Experimental data from a wide range of studies overwhelmingly support the conclusion that there are essentially no differences among the liquid, suspension, and dry fertilizers when they are compared over the long term under conditions of similar nutrient rates, placements, and chemical forms. The latter is particularly important when comparing phosphate fertilizers. For instance, it would not be valid to compare a highly water-soluble phosphate in fluids with a solid phosphate of low water solubility. However, when solids such as diammonium phosphate (DAP), monoammonium phosphate (MAP), or ammonium polyphosphate were compared with fluids such as 10-34-0, 8-24-0, or 11-37-0 under similar conditions, long-term studies have shown these to be essentially equal in nutritive value. Similarly, long-term studies have shown solid urea or ammonium nitrate to be essentially equal to nitrogen solutions, such as urea-ammonium nitrate. Essentially the same conclusions would be reached with dry and fluid NPK mixes.

## Cautions in Comparing Fertilizers

For valid comparisons, studies should be conducted for several years at the same location using the same experimental design to ensure that the variability inherent in field studies does not lead to faulty interpretations. If data are selected from one study, for one year, at one location, evidence can be cited to prove that solids are better than fluids, or vice versa, or that polyphosphates are better than orthophosphates, or vice versa. In the United States it is not unusual to encounter evidence in the marketplace or in advertising to support each of these claims.

Care must be exercised in comparing any solid or fluid fertilizers under field conditions. For example, concentrated superphosphate, 0-46-0 or CSP, can’t be compared directly with 10-34-0 solution or solid monoammonium phosphate, 11-48-0 or MAP, because the latter two contain nitrogen. A truly valid comparison of phosphorus utilization by plants can’t be made with these compounds because research has shown that nitrogen in association with phosphorus increases the availability of the latter. Therefore, even if added nitrogen is mixed with concentrated superphosphate, the results can be questioned.

The form of nitrogen must also be taken into account when comparing fertilizers. Urea-ammonium nitrate plus concentrated superphosphate will give different results than ammonium sulfate plus concentrated superphosphate, for example.

## Why are Fluids and Solids Equal Agronomically?

The relative equality of fluid and dry fertilizers should not be too surprising in light of the fact that the chemical constituents of the two physical forms are usually identical. For example, urea-ammonium nitrate solution or suspension contains both urea and ammonium nitrate, both popular dry materials. Likewise 8-24-0 solution is an ammonium orthophosphate material, just as monoammonium phosphate and diammonium phosphate are. Some of the ammonium phosphate fluids may contain ammonium polyphosphates; but this does not confuse the issue too much, as discussed below.

The matter of equality of various physical forms is even more predictable when one considers the limited variety of chemical forms presented to the plant root. Although a farmer may apply fertilizer nitrogen as anhydrous ammonia, urea, ammonium nitrate, urea-ammonium nitrate, calcium nitrate, or several other forms, the same farmer may be assured that, within a fairly short time, the roots of his crops will be confronted mainly with nitrogen in the nitrate form ($NO_3$). This is because various soil enzymes rapidly convert urea nitrogen to ammonium forms, and then soil microbiological processes fairly rapidly convert the ammonium forms to nitrate. So, for most of the growing season, plant roots "see" mainly nitrates unless a source of ammonium nitrogen is supplied during the season.

Despite the fact that farmers are offered a wide array of phosphorus-containing fertilizers, these farmers are assured that their crops are really confronted with a very limited variety of chemical forms of phosphorus. First, the phosphorus in most fertilizers is present in the orthophosphate form. When an orthophosphate-containing fluid fertilizer is applied or an orthophosphate-containing dry fertilizer dissolves in the soil solution, the plant roots are confronted mainly with two phosphate species ($H_2PO_4^-$ and $HPO_4^=$). If a fertilizer material containing polyphosphates is applied, the polyphosphate is fairly rapidly converted in most agricultural soils to the orthophosphate form. So, regardless of the physical or chemical form of phosphate fertilizer, after a short while in the soil, plant roots "see" only two very similar forms of phosphate.

Potassium fertilizers are even more uniform than either nitrogen or phosphate fertilizers. The dominant source of potassium for both fluid and dry fertilizers is potassium chloride. Even when other sources, such as potassium phosphate or potassium nitrate, are used, it is the potassium ion ($K^+$) which the plant root deals with in the soil solution.

# Implications of Equality

There are a number of logical reasons to expect fluid and dry fertilizers of comparable chemical makeup to be equal agronomically. Yet some proponents of either fluid or dry fertilizers feel that they are at a marketing disadvantage if they cannot claim agronomic superiority for their particular form. From a farmer’s viewpoint, however, the equality of the various forms is a powerful management tool. It frees the farmer to choose from a wide variety of materials using a multiplicity of nonagronomic factors as criteria for the decision.

In summary, fluid and dry fertilizers of comparable chemical constituency are essentially equal agronomically when applied at equivalent nutrient rates under similar placements at the same time. This equality gives farmers a large number of options in choosing fertilizer materials based on economics, convenience, and compatibility with other operations, dealer services, or regional availability.


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