

Liquid Phosphoric Acid as a Fertilizer

R. A. JONES and JESSE GREEN¹

Because of the slight movement of phosphorus from solid phosphate fertilizers in the soil there has been a search for some compound of phosphorus or some method by which this element could be made to penetrate the soil and be more accessible to plants. In the fertilization of citrus trees in the Southwest the need for greater penetration is especially important, and phosphoric acid in the irrigation water has solved the problem of getting the fertilizer to the roots of the trees.

Following the success with phosphoric acid on trees the practice is now used for all other crops, especially the deep-rooted crops such as sugar beets and alfalfa,

Method of Application

Liquid phosphoric acid containing 54 percent P_2O_5 is produced commercially. It is shipped in tank cars and distributed in smaller lots in iron drums. The acid is run from the drums into irrigation water at the head of the lands to be irrigated and fertilized. The rate of flow of acid is regulated so as to deliver a given number of pounds to the water as it is covering a given number of acres. No particular difficulty is experienced in getting the distribution of a specified amount of P_2O_5 per acre on the land.

The acid must, of course, be added to the irrigation water some little distance above where it is diverted into the various rows or lands so as to get uniform mixing. This is best accomplished by placing the drums containing the acid on a bridge or on timbers laid across the ditch so as to deliver the acid near the center of the irrigation stream. It is advantageous to have the mixture of water and acid turn at least one sharp bend in the ditch to insure good mixing.

At the present time phosphoric acid is applied at the rate of 100 to 200 pounds per acre. In all probability this rate will be increased in the future, or more than one application will be made on a crop.

Advantages

The advantages of the method are better penetration, better dispersion of plant food, conversion of the natural phosphates in the soil to more soluble compounds, saving in labor and equipment in distribution, and exact timing of the application to meet the need of the crop.

¹Manager and Field Assistant, respectively, Anaconda Copper Mining Company, Fertilizer Department, Anaconda, Mont.

Penetration

Penetration varies according to the type and condition of the soil. In open sandy soils it is obviously much greater than in close-packed, alkaline, clay soils. In most soils the phosphorus is retained in the first foot, but in some cases it is found to penetrate as much as 20 to 30 inches.

Dispersion

Because of better penetration of the liquid fertilizer there is almost complete dispersion of the added phosphorus throughout the root zone. As the very dilute phosphoric acid flows into the soil it is fixed by the bases present. In the past, fixation has been considered a very serious change occurring to phosphate fertilizers, but more recent observations in which we see the effect of one application of phosphate continuing from 2 to 4 years indicates that the losses are not as much as was formerly believed. In fact fixation is a very important provision of nature to prevent losses of the valuable element, phosphorus.

With any form of phosphorus fixation must occur, and we must rely on the plant to give off acid in the form of carbon dioxide from its roots to redissolve the solid phosphates. In the case of liquid fertilizers the dilution is so great that phosphorus may be taken up by the growing plant without going through the solid stage. However, the greater part of the phosphorus used in irrigation water is precipitated in a finely divided state throughout the entire root zone where it will be subject to the action of carbon dioxide from all the roots of the plant, rather than only a few roots as when solid fertilizer is applied.

The practice of feeding crops by side dressing as they need plant food has been widely used with varying success. When solid phosphates are placed near enough to a growing plant to be of value there is usually pruning of new roots. Often this injury offsets any advantage gained by the added plant food. With liquid fertilizer the new material moves in and around the roots with the irrigation water without disturbing the plant at all. Also the new food material is so dilute that no root has to grow through or combat a concentrated zone of fertilizer material as when the material is applied in the solid state with a side dressing tool.

Conversion of Natural Phosphates

When phosphoric acid moves into the soil it is fixed temporarily as described above. This change is brought about by the bases in the soil acting with the phosphoric acid. A portion of these bases are natural phosphates resembling raw rock phosphate which are converted by the acid to more soluble forms of phosphorus. The effect is the same

as that carried out in the production of treble superphosphate in the manufacturing plant where phosphoric acid is added to raw rock phosphate.

Saving in Cost of Application

The saving in cost of application of liquid fertilizers over the application of solid fertilizers is considerable. Irrigation must be carried on in any event, and after the drums are placed over the ditch it is only a small effort to regulate the flow of acid. No drills or expensive equipment are required to apply liquid fertilizer; only a small device to go into the opening of the drums to regulate the flow of acid. This device costs about 25 cents.

Exact Timing of Fertilizer Application

Another outstanding advantage of liquid fertilizer is that it may be applied to a crop at any stage of development. As formerly stated a growing crop can use a portion of the liquid fertilizer at once, and the remainder is placed in a very advantageous position about the roots. Effects of the fertilizer can begin immediately, whereas with solid fertilizers there is delayed action. With some crops, and especially with sugar beets, it is important that the plants have their phosphate early in life. To meet this situation a system known as pre-irrigation is practiced; that is, the land is irrigated and phosphoric acid applied before planting. In some localities pre-irrigation is practical, or in other districts where beets are irrigated up the use of liquid fertilizer will fit into the plan of operation. Phosphoric acid applied early to beets has the best opportunity to aid the crop.

Evidence is accumulating which indicates that seeds germinate better when crops are irrigated up with water containing liquid phosphoric acid. Continued observations are being made on this effect of liquid fertilizer.

In Practice

In the field it has been difficult to get actual comparisons of solid versus liquid phosphates. A serious effort is now being made to get these data. Recently the writers conferred with users of liquid phosphoric acid in the Salinas and Imperial Valleys of California and the Salt River and Yuma Valleys of Arizona. The prevailing opinion is much in favor of liquid phosphoric acid. Its use on crops in these areas has reached well beyond the experimental stage. At present the alfalfa crop represents the greatest acreage fertilized with liquid phosphate.

On beets some measurements of the results of the use of phosphoric acid have been made. On the Tsabell-Hartner farm at Phoenix an increase of over 800 pounds of beet seed, per acre was produced with an application of 200 pounds of phosphoric acid.

Tests conducted in the Delta region of Utah on alfalfa last season gave outstanding results. Also in Montana comparative tests with phosphoric acid versus treble superphosphate were conducted on potatoes at the Donick ranch at Deerlodge. The phosphoric acid gave an increased yield of 27 sacks per acre as against 13 sacks from the treble superphosphate. With trees the actual results of a given fertilizer must be observed over a long period of time and because there are usually various combinations of fertilizers used it is difficult to evaluate the results. On the Frank Cihak place at El Centro, Calif., a grapefruit orchard produced over 27 tons of fruit following a 3-year treatment with phosphoric acid and other fertilizers. This is said to be one of the highest production records in the district.

Perhaps the best results from the use of phosphoric acid has been on vegetable crops and alfalfa. On the whole, the use of phosphoric acid represents a step forward with fertilizers to increase agricultural production.