Aqua and Anhydrous Ammonia

good sources of nitrogen fertilizers but materials should be placed well away from plants to lessen chance of injury

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Plant injury resulting from the use of aqua ammonia or anhydrous ammonia as sources of nitrogen has occurred when the materials were placed relatively close to young plants and—usually—at high rate of application. Ammonia injury reduces plant growth, delays maturity and yields are unsatisfactory. Usually injury is characterized by a burning-off of the smaller plant roots and by a yellowing or browning of the larger roots.

A characteristic discoloration of the conductive tissue—particularly within the larger roots—is produced in some crops. Injury has been known to cause rotting of the entire center of the tap root of lettuce. Practically no differences in plant growth or in plant toxicity between aqua ammonia and anhydrous ammonia have been observed.

Anhydrous ammonia—ammonia gas —contains 83% nitrogen by weight and can be injected directly into the soil or it can be dissolved in the irrigation water. Ammonia gas dissolved in water becomes aqua ammonia and it, too, can be injected into the soil or applied in irrigation water. Aqua ammonia is often marketed as a solution containing 20% nitrogen by weight.

Effect of Soil Type

Why aqua ammonia and anhydrous ammonia may injure plants while ammonium sulfate may not is not definitely known. However, under alkaline soil conditions, there is greater movement in the soil of the ammonia from anhydrous and aqua than from ammonium sulfate.

In some light-textured soils ammonium sulfate was found to move only about 3″ from where it was banded into the soil, while under comparable conditions ammonia from aqua and anhydrous moved as much as 6″.

Actually—when dealing with alkaline soils—it is not the same kind of nitrogen from aqua and anhydrous ammonia as from ammonium sulfate even though all three materials supply ammonia nitrogen.

Aqua ammonia consists of ammonia molecules dissolved in water, while nitrogen of ammonium sulfate exists as the ammonium ion. It is highly possible that the ammonium ion is much less toxic than the ammonia molecule.

To lessen or eliminate possible plant injury from aqua and anhydrous ammonia the materials usually should be placed 6″ or 7″ deep in the soil instead of only 4″. In some tests placement of the materials as little as several inches out from the plant row has greatly reduced the plant toxicity. Smaller increments of fertilizers applied several times during the growing season will lessen the injury. Crops that require some nitrogen close to the plants at the time of planting should be treated with materials like ammonium sulfate, ammonium nitrate or calcium nitrate at planting. After the crop is established the remainder of the nitrogen can be applied as a side-dressing with aqua or anhydrous ammonia.

In some tests it has been possible to apply as little as one-fifth of the nitrogen at planting and still obtain maximum yields. Also, aqua and anhydrous ammonia could be applied sometime previous to crop planting time. It is not known how far ahead of planting the applications need to be made, but it is known that 30 days is not enough in some cases.

Considerable research work has been conducted in California and elsewhere by many individuals relative to the use of aqua and anhydrous ammonia. They have found that the depth of penetration of ammonia applied in the irrigation water is dependent primarily upon soil texture. In a coarse, sandy soil penetration may be as deep as 6″ or more. In a clay there is little penetration below 1″ and practically none below 2″.

Even in a loam soil little or no penetration can be expected below 2″. The lack of penetration means that there will be no, or practically no, losses of ammonia from the soil due to leaching by the irrigation water.

Soil Alkalinity Temporary

The immediate effect of adding either aqua or anhydrous ammonia is to make the soil alkaline. The alkalinity is temporary, and may last for only several days in some cases, or for as long as several weeks in others.

When aqua ammonia has been injected in bands in cool moist soils the soil in the area of the band has remained alkaline for as long as several weeks. After the ammonia applied to the soil nitrifies, it will make the soil more acid than it was originally.

The rate of conversion of ammonia to nitrate in the soil depends largely on how the ammonia is applied. If it is applied in the irrigation water, where it is dispersed in a large volume of soil, it is practically all nitrified within three weeks or less under warm conditions. In contrast, when these materials were banded in the shoulder of the bed during cool weather, considerable quantities existed as ammonia after being in the ground for as long as three months.

Aqua ammonia, injected as a band, will nitrify under most conditions much less rapidly than when it is applied in the irrigation water. Also, in some soils, ammonium sulfate nitrifies less rapidly than does aqua ammonia. This is probably related to the fact that ammonia sulfate diffuses less in alkaline soils, and thus remains more concentrated near the area of application. The importance of rate of nitrification may be exaggerated, however, because it is known that plants can use ammoniacal nitrogen directly. It does not need to be converted to nitrate nitrogen before plants can use it.

Application of aqua ammonia in the sprinkler irrigation water is usually not satisfactory. If the ammonia concentration in the sprinkler water is 20 pounds or more per acre inch of water, as much as 60% of it may be lost to the atmosphere by volatilization.

Placement Important

Losses of ammonia from any ammonia salt applied in the sprinkler irrigation water will be too great when the solution has a relative alkalinity above pH 8.0. When the solution is as alkaline as pH 10, half of the ammonia may be lost by volatilization. Relative alkalinity-acidity—pH—of 7 is neutral.

Both aqua ammonia and anhydrous ammonia are good sources of nitrogen fertilizers and their use presents no special problems. However, they should be placed farther away from the plant and deeper in the soil than most of the other nitrogen fertilizers.

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