Urea Phosphate Applied by Subsurface Drip Irrigation Increases Availability of Soil Nitrogen and Phosphorus

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Summary

Application of water and fertilizer through buried drip lines shows promise for vegetable production in Arizona. Use of an acidic product is necessary if phosphorus is added through the system. Urea phosphate was shown to be a satisfactory product for injecting into buried drip lines for squash and cabbage.

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Drip irrigation is recognized as a practice which allows precise application of water and fertilizer and improvement of crop yields. Roots are known to concentrate in the zone of the emitters with below and above ground systems. Applications of nitrogen fertilizers are commonly made through the drip systems but there is a fear of using phosphorus (P) materials due to their lower solubility in alkaline irrigation waters. If P can be applied through below ground drip systems, improved availability should result from the direct placement in the root zone. Acidic materials are commonly injected into drip systems in order to reduce the precipitation of lime and clogging of emitters.

The objectives of this research were to determine the suitability of urea phosphate (UP), a new fertilizer developed by the Tennessee Valley Authority, as a source of nitrogen (N) and P for drip-irrigated squash and cabbage. The report gives results of soil tests taken after the application of urea phosphate.

Materials and Methods

The study was conducted at the University of Arizona Agricultural Center at Marana on a Grabe clay loam soil. Squash and cabbage were double cropped using a below ground drip system with lines at two and six inches deep as well as a conventional furrow system as a control. Half of the furrow-irrigated rows were injected with 15-60-0 below the seed row. Urea phosphate was applied through the drip system. Analysis of the treated water showed a very low pH (1.8), a high EC (9.1dS/m) and no bicarbonates when compared to untreated water. Soil samples were taken from cross sections of the beds at harvest time. Typical results are given in Table 1.

Results

The drip irrigation system appears to be an efficient means of adding N fertilizer. Tissue analyses showed higher nitrate concentrations from the drip treatments than either unfertilized or fertilized furrow. Urea added in this manner moves with the water until it is hydrolyzed to ammonium-N, when it becomes attached to the clays and organic matter, until nitrified to nitrate, when it again becomes mobile. Thus the N generally remains in the zone where the roots are most concentrated.

High soil P concentrations were measured around the emitters at both depths, but no evidence of residual P was found with the banded treatment. It was also apparent that P moved a distance as far as 8 inches from the emitters. While it is known that P is generally immobile in soil, there is evidence from other locations that when a large quantity is applied at a point such as in this study, the P fixing sites are satisfied and some mobilityis expected.

Table 1. Analysis of Soil Samples Taken After the Last Harvest of Squash

Sample Depth (in)	Treatment: Unfertilized Furrow	Fertilized Furrow	Shallow Drip	Deep Drip
	sodium bicarbonate extractable P			
0 - 2	16	15	131	36
2 - 4	15	13	84	84
4 - 6	18	15	48	120
6 - 8	10	13	20	108
	soil pH values			
0 - 2	7.9	7.8	7.4	7.8
2 - 4	7.9	7.9	7.5	7.5
4 - 6	7.9	7.9	7.8	7.6
6 - 8	7.9	7.9	7.8	7.4
	soil salinity, dS/m			
0 - 2	1.80	2.00	3.00	3.50
2 - 4	1.80	1.80	1.65	1.60
4 - 6	1.75	1.75	1.30	1.30
6 - 8	1.50	1.60	1.10	1.20

The UP reduced soil pH by about 0.5 units around the emitters at both depths, but no effect was found with the banded furrow treatment. Lowering the pH can be important in preventing iron and zinc deficiency on calcareous soils although plantanalysis in this study showed ample levels of iron and zinc. The lower pH would also favorably influence P availability.

Soil salinity was slightly lower around the emitters than from similar locations in the furrow irrigated plots. It should be remembered than this location generally has low salinity due to good water quality and well drained soil conditions.

The UP is still an experimental material, but it is similar to some of the commercial urea sulfuric acid and urea phosphoric acid materials on the market. While extremely acidic, they are not as hazardous as sulfuric and phosphoric acids. These materials should be seriously considered as fertilizers as well as water amendments for drip irrigation systems.