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Control soil crusting with phosphoric acid

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Soil crusting is often a serious problem in obtaining adequate and uniform sugarbeet stands in many areas of Idaho. Poor stands often necessitate reseeding or seeding to another crop.

A promising method has been developed to prevent soil crusting on the Portneuf soil series in southern Idaho. Agricultural grade phosphoric acid, which is available through many liquid fertilizer outlets, is diluted to 12-14% phosphoric acid solution, and sprayed in 3-inch bands on the seeded sugarbeet row directly behind the planter. The chemical reactions between the soil components and the acid prevent the soil in the bands from crusting, but do not injure the seedlings.

Two phosphoric acid spray treatments (70 gal. of 24% and 140 gal. of 12% acid per acre) increased sugarbeet stands on field plots in 1968 (Table 1). The phosphorus applied by this method was as available to the crop as were equivalent amounts of concentrated superphosphate plowed under before seeding (Table 2). Again in 1970, sugarbeet stands were increased by the acid spray treatment (Table 3).

The low stand counts after thinning on plots receiving no phosphoric acid resulted from non-uniform low stands before thinning. The crust that formed was about ½ inch thick and cracks developed in random patterns, leaving uncracked sections ranging from 3 to 12 inches square. Where cracks formed along the seeded row, seedlings emerged through the cracks. In other areas, few seedlings emerged, resulting in skips up to 20 feet long that decreased the stand uniformity after thinning.

Agricultural grade phosphoric acid (often referred to as green acid) is available from custom fertilizer applicators who use it in their liquid fertilizer formulations. Phosphorus from this source is competitive in price with that from other fertilizer sources. Thus, if P fertilizer is needed, the insurance against poor stands is a side benefit of fertilizer application with little additional cost. If crusting is not a problem during a particular growing season, the protection has been quite inexpensive. It is important to recognize that the phosphorus applied in the spray should be included in the fertilizer program of the crop rotation used. If 60 pounds of phosphorus is applied in the spray treatment, 60 pounds less can be applied by other means during the rotation.

The phosphorus concentration in the sugarbeet petioles throughout the growing season showed that where soil phosphorus was low, the total phosphorus needed by the crop could be applied in the spray treatment (Table 2). Such a practice will prevent soil crusting and eliminate the need to apply additional phosphorus. Where adequate phosphorus is available in the soil to produce the crop, no immediate fertilizer benefit will be realized from the phosphoric acid spray application.

The method appears promising, based on results obtained from field plots at several locations, but all advantages and disadvantages will not become evident until it is tried by sugarbeet growers on a field basis. The practice will require adapting equipment, handling relatively large volumes of liquid, and perhaps changing fertilizer programs.

Equipment

The application equipment was constructed from acid-resistant components available from most commercial spray equipment dealers. The pump was nickel-coated and designed for pumping dilute acid. The hoses were

Phosphoric acid treatment control soil crusting, improves sugarbeet stands.

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neoprene, and all connections and nozzles were nylon or stainless steel. Fiberglass or plastic tanks were used to hold the phosphoric acid. An acid-resistant control pressure regulator was located beside the operator so that pressure and liquid flow could be controlled at all times. Simple strap iron mounts were used to place the narrow angle nozzles behind the planter press wheels and over the seeded row.

Handling

Precautions were employed to avoid contact with eyes and excessive contact with skin and clothing. After each use, all equipment was rinsed with water, with sodium bicarbonate solution, and again with water. No particular hazards were encountered in handling and applying the phosphoric acid when reasonable care was used.

Liquid Volume Important

The liquid volume is an important factor in the use of the phosphoric acid spray. The acid concentration should not be greater than 25%, and the liquid volume not less than 50 gal. per acre – preferably not less than 70 gal. per acre. If the acid is too concentrated, the chemical reactions are too severe and a cementing effect results. If the liquid volume is too low, penetration is not sufficient for the proper chemical action.

Other Factors

To be effective, the phosphoric acid must be applied before a crust forms. This is a crust-preventive treatment and will not break up a crust that has already formed.

Neutral ammonium phosphate solution will not prevent crust formation. The acid effect on the carbonate in the soil seems to be an important factor in the crust prevention. Sulfuric acid has been successfully used to control soil crusting on calcareous soils, but it is not recommended because of the health hazards and corrosiveness to equipment. Nitric acid also would be hazardous to handle and corrosive to equipment.

This treatment should control soil crusting on the calcareous soils such as the Portneuf series, but could not be expected to overcome emergence problems on soils where poor emergence results from soil compaction or lack of stable soil aggregates.

Soil crusting control and phosphorus fertilization by this combined method may be equally effective for other small seeded row crops on calcareous soils where crusting inhibits seedling emergence.

Mount narrow angle nozzles behind planter press wheels.

Table 1. The effects of phosphoric acid (H_3PO_4) spray treatments on sugarbeet stands in 1968.

P applied	H_3PO_4 concentration	Solution volume	Sugarbeet plants	
			Before thinning	*After thinning
lbs/A	%	gal/A	1000/A	
62	24	70	49	17
62	12	140	53	20
62	as 0-45-0		35	15
0	0		35	15

* Ideal stand after thinning for the 24-inch row spacing used is considered to be 26,000 plants /A, or 10-inch spacing between beets in the row.

Table 2. The phosphorus concentrations in sugarbeet petioles in 1968 as influenced by method of application and dates of sampling.

Treatment		Phosphorus in petioles		
P applied	Solution volume	8 July	28 August	15 October
lbs/A	gal/A	%		
24% phosphoric acid				
62	70	0.185	0.107	0.112
12% phosphoric acid				
62	140	.179	.104	.114
Control				
62	as 0-45-0	.174	.100	.114
0	0	.074	.073	.071

Table 3. The effects of phosphoric acid spray treatments on sugarbeet stands in 1970.

P applied	H_3PO_4 concentration	Solution volume	Sugarbeet plants	
			Before thinning	*After thinning
lbs/A	%	gal/A	1000/A	
62	24	70	62	22
62	12	140	62	21
0	0	0	35	15

* Ideal stands after thinning for the 22-inch row spacing used is considered to be 29,000 plants/A, or 10-inch spacing between beets in the row.

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