EFFECT OF PHOSPHITE FERTILIZER FORMULATIONS ON ONION YIELD AND QUALITY

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Introduction

Biagro Western (Visalia, CA) manufactures formulations of phosphite fertilizer. They claim that phosphorus (P) in the form of phosphite (PO_3) is to be more easily absorbed by plants than P in the form of phosphate (PO_4). This trial tested three phosphite fertilizer formulations for their effect on onion plant P content, and onion yield and grade.

Materials and Methods

The onions were grown at the Malheur Experiment Station, Ontario, Oregon on an Owyhee silt loam previously planted to wheat. In the fall of 2002, the wheat stubble was shredded, and the field was disked, irrigated, ripped, moldboard-plowed, roller-harrowed, fumigated with Telone C-17 at 20 gal/acre, and bedded. Soil analysis indicated the need for 100 lb P_2O_5/acre, 150 lb K /acre, 6 lb Mn/acre, 2 lb Cu/acre, and 1 lb B/acre, which was broadcast in the fall. A soil sample taken on May 9 showed a pH of 7.7, 1.4 percent organic matter, 0.2 percent lime, 20 ppm nitrate-N, 29 ppm P (Olsen test, sodium bicarbonate extractant), and 216 ppm K.

Onion (cv. 'Vaquero', Sunseeds, Morgan Hill, CA) was planted in two double rows, spaced 22 inches apart (center of double row to center of double row) in 44-inch beds on March 17, 2003. The two rows in the double row were spaced 3 inches apart. Onion was planted at 150,000 seeds/acre. Drip tape (T-tape, T-systems International, San Diego, CA) was laid at 6-inch depth between the two double onion rows on March 28. The distance between the tape and the double row was 11 inches. The drip tape had emitters spaced 12 inches apart and a flow rate of 0.22 gal/min/100 ft.

Immediately after planting the onion rows received 3.7 oz of Lorsban 15G per 1,000 ft of row (0.82 lb ai/acre), and the soil surface was rolled. Onion emergence started on April 7. The trial was irrigated on April 14 with a minisprinkler system (R10 Turbo Rotator, Nelson Irrigation Corp., Walla Walla, WA) for even stand establishment. Risers were spaced 25 ft apart along the flexible polyethylene hose laterals that were spaced 30 ft apart.

The experimental design was a randomized complete block with five replicates. There were four treatments: an untreated check and three fertilizer formulations. The fertilizer

formulations were manufactured by Biagro Western and were Magnum Nutri-phite (2-40-16) foliar (3 pints/acre/application), Sulfone Nutri-phite (5-20-15-14) foliar (3 lb/acre/application), and P Soil Hi-Grade (0-60-0) drip injected (2 quarts/acre/application). Each fertilizer treatment was applied three times as follows: first application: bulb at 0.5 inch (June 10); second application: 3 weeks after first application (July 1); third application: 6 weeks after first application (July 17). The two foliar applied formulations were applied at 40 gal/acre with a backpack sprayer with four 8004 nozzles at 30 PSI. The drip-injected formulation was applied through the drip tape at an injection rate of 2.5 percent using a Dosmatic A30 injector (Dosmatic USA, Carrolton, TX). All treatments including the check received standard fertilizer applications based on soil and tissue analyses.

Onion tissue was sampled for nutrient content on June 4 and 19. The roots from four onion plants in each check plot were washed with deionized water and analyzed for nutrient content by Western Labs, Parma, Idaho. The onions in all treatments were fertilized according to the nutrient analyses. Onion root P concentration for the check treatment was 0.40 and 0.59 percent on June 4 and 19, respectively. Fertilizer was applied through the drip tape: ammonium sulfate at 25 lb N/acre on May 30; urea ammonium nitrate solution at 25 lb N/acre on June 5, 16, and 25; and zinc chelate at 0.25 lb Zn/acre and copper chelate at 0.2 lb Cu/acre on June 25.

Onion tissue was also sampled from all treatments for comparison of P contents on July 3, July 19, and August 8. Five onion plants from outside the harvest area from each plot of each treatment were combined to make one sample per treatment. Each sample was separated into roots, bulbs, and leaves. The roots and leaves were weighed, dried in a forced-air oven at 150°F for 4 days and weighed. The bulbs were weighed and shredded. A subsample of the shredded bulbs was weighed, dried in a forced-air oven at 150°F for 4 days, and weighed. The dried roots, bulbs, and leaves were ground and analyzed for total P content.

The field was irrigated automatically twice per day based on soil water potential readings. Soil water potential was measured with four granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co., Riverside, CA) installed at 8-inch depth in the center of the double row in each of four adjacent plots. Sensors were calibrated to SWP (Shock et al. 1998). The GMS were connected to a datalogger with three multiplexers (AM 410 multiplexer, Campbell Scientific, Logan, UT). The datalogger read the sensors and recorded the soil water potential every hour. The irrigations were controlled by the datalogger using a relay driver (A21 REL, Campbell Scientific, Logan, UT) connected to a solenoid valve. Irrigation decisions were made every 12 hours by the datalogger: if the average soil water potential at 8-inch depth was -20 kPa or less the field was irrigated for 4 hours. The pressure in the drip lines was maintained at 10 psi by a pressure regulator. Irrigations were terminated on September 2.

Roundup at 24 oz/acre was sprayed on March 28. The field had Prowl (1lb ai/acre) broadcast on April 21 for postemergence weed control. Approximately 0.4 inch of water was applied through the minisprinkler system on April 21 to incorporate the Prowl. The

field had Buctril at 0.12 lb ai/acre and Poast at 0.4 lb ai/acre applied on April 28. Thrips were controlled with one aerial application of Warrior on June 5 and two aerial applications of Warrior (0.03 lb ai/acre) plus Lannate (0.4 lb ai/acre) on July 16 and August 4.

On September 11 the onions were lifted to field cure. On September 17, onions in the central 40 ft of the middle two double rows in each subplot were topped and bagged. The bags were placed into storage on September 29. The storage shed was managed to maintain an air temperature of approximately 34°F. On December 11 the onions were graded. Bulbs were separated according to quality: bulbs without blemishes (No. 1s), double bulbs (No. 2s), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *Aspergillus niger*). The No. 1 bulbs were graded according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and supercolossal (>4¼ inches). Bulb counts per 50 lb of supercolossal onions were determined for each plot of every variety by weighing and counting all supercolossal bulbs during grading.

After grading, 50 bulbs ranging in diameter from 3.5 to 4.25 inches from each plot were rated for single centers and translucent scale. The onions were cut equatorially through the bulb middle and, if multiple centered, the long axis of the inside diameter of the first single ring was measured. These multiple-centered onions were ranked according to the diameter of the first single ring: "small double" had diameters <1½ inch, "intermediate double" had diameters from 1½ to 2¼ inches, and "blowout" had diameters >2 ¼ inch Single-centered onions were classed as a "bullet". Onions were considered functionally single centered for processing if they were a "bullet" or "small double." The number and location of translucent scales in each bulb was also recorded.

Results and Discussion

The automated drip-irrigation system maintained the soil water potential close to -20 kPa during the season (Fig. 1). The onions treated with the three phosphite fertilizer formulations had increased levels of bulb P on the first two sampling dates (Table 1). Definitive conclusions on differences in tissue P levels between treatments cannot be made due to a lack of tissue sample replication.

There was no significant difference in onion yield or grade between the phosphite fertilizer formulations and the check (Table 2). There was no significant difference in onion single centeredness between the phosphite fertilizer formulations and the check (Table 3).

The May 9 soil test showed 29 ppm P. According to the "Nutrient Management Guide for Onions in the Pacific Northwest" (Sullivan et al. 2001), P fertilizer would not have been necessary. Although limited data exist to interpret onion tissue P, Sullivan et al. (2001) suggests a sufficiency range from 0.2 to 0.35 percent root P. Western Labs uses a

sufficiency range for onion root P of 0.32 to 0.7 percent. Root P for the check treatment onions was 0.40 percent on June 4 and 0.59 percent on June 19.

To increase the probability of onion response to the phosphite fertilizers, this trial should have been conducted in a field without fall-applied P, and preferably on a soil more prone to P deficiencies, such as a Nyssa silt loam. In addition, onions are more prone to P deficiency early in the season when the soils are colder, which hinders the uptake of P by the roots. Despite the preexisting limitations of the field used in this trial, the manufacturer opted for the site and for the late applications.

References

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Sullivan, D.M., B.D. Brown, C.C. Shock, D.A. Horneck, R.G. Stevens, G.Q. Pelter, and E.B.G. Feibert. 2001. Nutrient Management for onions in the Pacific Northwest. Pacific Northwest Extension Publication PNW 546. 26p.

Table 1. Onion tissue phosphorus levels (percent dry weight) for onions treated with three phosphite fertilizer formulations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

	July 3			July 19			August 8		
Treatment	Roots	Bulbs	Leaves	Roots	Bulbs	Leaves	Roots	Bulbs	Leaves
Check	0.66	0.35	0.44	0.42	0.52	0.31	0.49	0.48	0.19
Magnum Nutri-Phite	0.66	0.59	0.46	0.47	0.76	0.35	0.58	0.51	0.27
Sulfone Nutri-Phite	0.61	0.57	0.41	0.56	0.61	0.35	0.42	0.45	0.23
P Soil Hi-Grade	0.65	0.57	0.45	0.49	0.50	0.36	0.56	0.48	0.24

Table 2. Onion yield and grade response to three phosphite fertilizer formulations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

	Total	Marketable yield by grade					Non-marketable yield		
Treatment	yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Rot	No. 2s	Small
	cwt/acre						%	-- cwt/acre --	
Check	837.6	815.2	9.7	152.3	632.6	20.6	2.1	2.3	5.4
Magnum Nutri-Phite	778.3	754.3	5.6	128.9	597.5	22.3	2.5	1.2	4.2
Sulfone Nutri-Phite	871.0	849.6	13.0	167.6	650.2	18.8	2.2	3.1	2.3
P Soil Hi-Grade	839.5	810.3	7.0	163.4	620.8	19.1	3.1	3.5	3.8
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Single-center rating for onions treated with three phosphite fertilizer formulations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Treatment	Blowout	Intermediate double	Small double	Bullet	Functionally single centered "Bullet + small double"
	---------- % ----------				
Check	2.5	14	14	69.5	83.5
Magnum Nutri-Phite	4.4	17.2	18.8	59.6	78.4
Sulfone Nutri-Phite	2.8	13.2	17.6	66.4	84
P Soil Hi-Grade	6.4	15.6	18.8	59.2	78
LSD (0.05)	NS	NS	NS	NS	NS

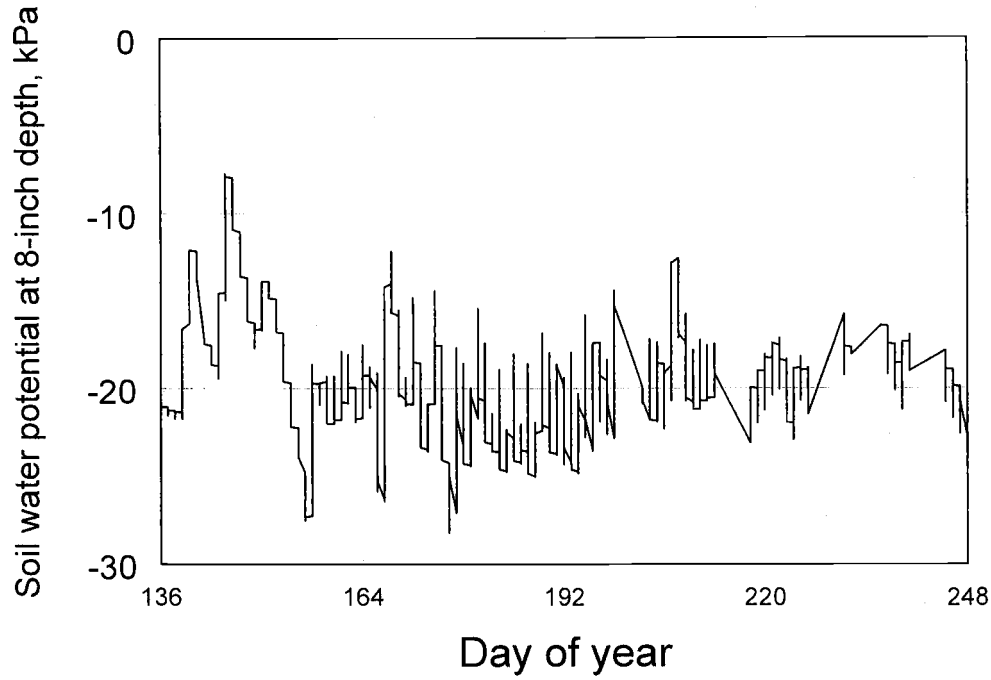

Figure 1. Soil water potential at 8-inch depth for onions irrigated with an automated subsurface drip-irrigation system, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.