Phosphorus Availability in Peat-Sand Media Fertilized with Several Phosphorus Sources[1]

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Abstract

Treble superphosphate 20% P (0-46-0), MagAmp 7N-17.6P-5K (7-40-6) and Osmocote 18N-2.6P-10K (18-6-12) failed to maintain phosphorus (P) at a level of 10 ppm in peat:sand media extracts during a full growing season under nursery conditions. A single surface application of Osmocote 14N-6.2P-11.6K (14-14-14) supplied the desired P level for 18 weeks.

Index words: *Rhododendron* 'Roseum Elegans,' *Rhododendron stewartianum,* slow release fertilizers, nutrition, soilless media

Introduction

The general view of investigators is that most nursery plants in containers need about 10 ppm phosphorus (P) in media extract for optimum growth (1,2,8,10). This 10 ppm P level can be maintained through the growing season by regular applications of P in solution. However, many nurseries find it impractical to supply fertilizer in solution. A common nursery practice is to amend container media with superphosphate 9% P (0-20-0) or treble superphosphate 20% P (0-46-0). Laboratory studies have shown that P leaches rapidly from superphosphate amended media (3,4,9) and treble superphosphate is highly soluble in acid media to pH 6.0 (6). A pre-plant amendment resulted in less growth of 3 nursery plant species than maintaining the P level with regular applications in solution (1). Yeager and Wright (10) found that leaf P level was very low after 12 weeks in a superphosphate amended medium, and Meyer (5) showed that P stored in the plant from the previous season was a major contributor to spring growth. Furthermore, plants may remain 2 years in the same container, in which case the media originally amended with a readily leached P source would contain an extremely low P level the second year. Thus, a slow release form of P is needed (a) to insure a reliable level for optimum growth the first season, (b) to insure storage in the plant late in the season for optimum growth the following spring and (c) to use as a surface application for a P source the second season in the same container. The objective of this study was to find a commercially available form of phosphorus at moderate cost that would supply the plant needs in soilless media for a full growing season under nursery conditions.

[1]Received for publication March 2, 1985; in revised form June 18, 1985.

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Materials and Methods

Experiment 1. A growing medium of sphagnum peat and concrete grade sand (1:1 by vol) was amended with ground limestone at 1.8 kg/m^3 (3 lb/yd^3), Fritted Trace Elements[3] at 73 gm/m^3 (2 oz/yd^3) and Osmocote[4] 18N-2.6P-10K (18-6-12) at 3 kg/m^3 (5 lb/yd^3). The medium was further amended with treble superphosphate, 20% P (0-46-0), at 0, 0.52 kg/m^3 (14 oz/yd^3) or 1.0 kg/m^3 (1.7 lb/yd^3). The amended media were used for planting *Rhododendron* 'Roseum Elegans' liners in 3.5 l (Zarn 400) containers. On May 5, 1983, the containers were placed in a commercial nursery in a randomized complete block design with 6 single replicates. Irrigation averaged 1.3 cm (0.5 acre in) per day, except when rainfall made irrigation unnecessary. Leachate (drainage water) samples (8) were obtained every 3 or 4 weeks for 16 weeks and pH and P concentration (6) were determined.

Experiment 2. Experiment 2 was similar to Experiment 1 with the following exceptions. The growing medium was amended with ground limestone at a rate of 1.5 kg/m^3 (2.5 lb/yd^3). Four P treatments were used: 1) no additional P, 2) treble superphosphate incorporated at 1.0 kg/m^3 (1.7 lb/yd^3), 3) MagAmp[5] 7N-17.6P-5K (7-40-6), medium grade, incorporated at 0.6 kg/m^3 (1 lb/yd^3) and 4) MagAmp 2 gm on each container surface. Osmocote was not mixed with the media, but all treatments received Osmocote 18-6-12 at 13 gm on each container surface. The containers were placed in the nursery June 6, 1984, and leachate samples were collected at 3 week intervals.

Experiment 3. Rhododendron stewartianum had been grown in a commercial nursery 1 year in peat-sand (1:1 by vol) which had been amended by the grower with superphosphate and ground limestone. On April 8, 1983, 10 containers of 3.5 l (Zarn 400) received a surface application of 10 gm Osmocote 18-6-12 and another 10 containers received 10 gm Osmocote 14N-6.2P-11.6K (14-14-14). The containers received the normal nursery irrigation for the remainder of the growing season.

Leachate samples were collected every 4 or 5 weeks for 18 weeks and analyzed for P.

Results and Discussion

Experiment 1. Osmocote 18-6-12 alone could not maintain P levels in the media extracts at the recommended level of 10 ppm (Table 1) suggested for nursery crops (2,8,10). Media amended with treble superphosphate had P levels below 10 ppm by week 5 and were similar to Osmocote alone from week 9 to 16. There was little difference between the 2 rates of treble superphosphate. Our results are similar to those found by others (1,10) who noted that the level of P needed for most plants was not maintained in a superphosphate amended medium.

Experiment 2. Osmocote 18-6-12 applied to the surface of the media was unable to maintain sufficient levels of P (Table 2), which was similar to incorporated Osmocote in Experiment 1 (Table 1). Treble superphosphate supplied at least 10 ppm P through week 7, a few weeks longer than in Experiment 1. Periods of heavy rainfall early in Experiment 1 (1983) may have caused more rapid leaching than in Experiment 2 (1984). MagAmp, either mixed with the medium or placed on the surface was a small improvement over treble superphosphate, but failed to maintain the 10 ppm P level for the entire season. However, the results suggest that a small amount of MagAmp (about 1/2 teaspoon) might be applied to the surface of containers in mid-season as a P supplement. A course grade of MagAmp might give a longer period of availability, but a coarse grade could not be obtained.

Experiment 3. As in Experiments 1 and 2, Osmocote 18-6-12 resulted in media P levels well below the desired 10 ppm (Table 3). On the other hand, Osmocote 14-14-14 maintained P levels between 12 and 18 ppm for the entire 18 week period. The Osmocote products consist of dry fertilizer granules coated with a plastic resin, which reduces the rate of fertilizer release. The 14-14-14, due to a thinner coating, releases faster than the 18-6-12 product. At 10 gm per container, 273 and 630 mg P were applied in the 18-6-12 and 14-14-14 products, respectively. It is possible that both the thinner coating and the larger amount of P accounted for the adequate season-long supply from Osmocote 14-14-14.

Growth of the *Rhododendron* plants was not noticeably affected by the treatments. Testing the growth of plants from different sources of P was not an objective of this study. Plants were used to produce realistic conditions in the nursery for measuring the supply charac-

Table 1. Extract phosphorus from peat:sand container media amended with Osmocote[z] and treble superphosphate 0N-20P-0K (0-46-0).

Rate of treble super			Weeks in nursery				
			2	5	9	12	16
kg/m³	(lb/yd³)	pH	P concentration (ppm)				
0.0	**(0.0)**	**6.0**	**7.5 ± 3.0[y]**	3.5 ± 1.2	5.1 ± 0.8	3.8 ± 2.0	1.4 ± 0.1
0.52	(0.87)	6.0	20.0 ± 2.2	5.5 ± 0.9	5.5 ± 0.6	4.6 ± 0.6	1.0 ± 0.0
1.0	(1.7)	6.0	28.0 ± 5.6	6.4 ± 0.5	5.8 ± 0.3	4.5 ± 0.4	1.4 ± 0.2

[z]All media amended with Osmocote 18N-2.6P-10K (18-6-12) at the rate of 3.0 kg/m³ (5.0 lb/yd³).

[y] ± value is standard error of the mean.

Table 2. Extract phosphorus (ppm) from peat:sand container medium following application of Osmocote 18-6-12, treble superphosphate 0-46-0 or MagAmp 7-40-6.

Phosphorus source	Method of application	pH	Weeks in nursery 1	4	7	10	13	16
			P concentration (ppm)					
Osmocote	Surface[z]	5.8	4.5 ± 2.1[u]	7.0 ± 3.1	3.2 ± 2.2	2.8 ± 1.0	1.5 ± 0.6	1.1 ± 0.6
Osmocote Treble super	Surface Mixed[y]	5.6	58.0 ± 19.1	20.0 ± 9.2	11.0 ± 3.8	5.8 ± 0.9	3.1 ± 0.4	2.7 ± 1.8
Osmocote MagAmp	Surface Mixed[x]	5.5	34.0 ± 4.5	27.0 ± 8.7	15.0 ± 4.2	7.2 ± 3.4	3.3 ± 1.6	2.4 ± 2.0
Osmocote MagAmp	Surface Surface[w]	5.3	23.0 ± 6.5	21.0 ± 6.9	16.0 ± 4.4	13.0 ± 5.4	5.3 ± 2.8	3.1 ± 1.5

[z]13 gm of Osmocote were applied to the surface of 3.5 l (Zarn 400) containers.

[y]Treble superphosphate was mixed at 1 kg/m³ (1.7 lb/yd³).

[x]MagAmp was mixed at 0.6 kg/m³ (1.0 lb/yd³).

[w]2 gm of MagAmp were applied to the surface of 3.5 l (Zarn 400) containers.

[u] ± value is standard error of the mean.

Table 3. Extract phosphorus from peat:sand container media following a 10 gm surface application of either Osmocote 18N-2.6P-10K (18-6-12) or Osmocote 14N-6.2P-11.6K (14-14-14) per 3.5 l (Zarn 400) container.

		Weeks in nursery			
		5	9	14	18
Osmocote analysis	pH	P concentration (ppm)			
18-6-12	6.2	2.5 ± 1.5^{z}	1.7 ± 0.8	5.2 ± 1.4	3.8 ± 3.7
14-14-14	6.0	16.0 ± 5.3	17.7 ± 4.9	15.3 ± 1.5	12.7 ± 2.5

^{z} ± value is standard error of the mean.

teristics of the P fertilizers. Most experiments on P requirement have been conducted on small size plants in the greenhouse using constant P levels for about 10 weeks (2,10). The P requirement for production of nursery crops in containers with dry fertilizers has not been satisfactorily defined. We recommend that plant responses to P levels be studied for a period of years, i.e., the entire growing time in the nursery. This would allow observations not only of early growth, but later development of quality factors.

Significance to the Nursery Industry

The previously reported rapid decrease in available phosphorus from treble superphosphate (0-46-0) amended medium was confirmed under nursery conditions. Phosphorus was at deficient levels after a few weeks. The use of a coated phosphorus appears to be the most promising approach to season-long availability. Osmocote 14-14-14 maintained the desired level for 18 weeks in our study. However, Osmocote 18-6-12, which has a thicker coating as well as less phosphorus, failed to release the needed P level into the medium. Because of its relatively fast release, Osmocote 14-14-14 may need to be supplemented by a mid-season application of slow release nitrogen in order to maintain adequate nitrogen through the growing season. Surface applied medium grade MagAmp (7-40-6) at about 1/2 teaspoon per container (#2) was a promising treatment, but would need to be reapplied after about 3 months.

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