PHOSPHORUS AND COPPER FERTILIZATION EFFECTS ON CHIEFTAN AND DANVER ONIONS[1/]

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Phosphorus (P) is a critical factor affecting production in onion growing areas of Oregon. Previous unpublished data has shown marked responses from band application of P on Lake Labish peat soils (about 10 miles north of Salem, Oregon) when P soil analyses values (Bray P1) were above 100 μg P/g (ppm) of soil.

Recent research in Texas (Mulkey et al., 1979) has shown better increases in yield from P applications banded below the seed at planting than from P applications that were broadcast and worked into the seed bed before planting. Phosphorus analyses of leaf samples were not completed in these experiments.

The management problems of establishing experiments to compare band vs. broadcast P applications in grower's fields prompted us to establish experiments on the Medford Experiment Station where we could compare P applications that were banded under the seed or broadcast and disced under before planting on the yield, and P and Cu concentrations in onion leaf samples grown on a soil that was known to be P deficient.

Three major objectives were identified for experiments established in 1978 and 1979 at the Southern Oregon Experiment Station near Medford. These were:

1. To compare effects of band versus preplant broadcast P applications on yield, size grade, and P concentrations in onion leaves.

2. To establish a critical P level in leaf samples for Danver and Chieftan onions that could be used to predict P response on farmer's fields.

3. To evaluate possible effects of P fertilization on Cu (copper) response by these onion varieties.

MATERIALS AND METHODS

Experiments were established in 1978 and 1979 on a soil with a pH of 6.3, extractable K, Ca, Mg values of 0.20, 13.0, 3.1 meq/100 g of soil, respectively.

A split plot design was used on both years with 0, 22, and 44 lb P/A in 1978 and 0 or 44 lb P/A in 1979 broadcast and disced into the seed bed before planting as the main plots. Rates of 0, 22 and 44 lb P/A were banded about 2 inches deep as the first subplot; onions were

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planted that day, with a hand pushed planet Jr. planter, directly over the banded fertilizer. Phosphorus was applied as monocalcium (concentrated super) phosphate. Three rows were planted to Danver onions and 3 rows to Chieftan onions on each plot; this allowed the 2 center rows on each variety to be used as harvest rows. All treatments received 200 lbs N/A as a combination of 500 lbs of ammonium sulfate pluts 200 lbs of potassium chloride per acre at planting and 250 lbs of ammonium nitrate broadcast during the growing season.

Leaf samples were collected, the third leaf from the top, as the onions were starting to bulb and after the larger bulbs had reached 3/4 to 1 inch in size. Leaf samples were dried, ground, and digested with perchloric acid for chemical analyses. Cations were measured with atomic adsorption with P by Vanadomolybdo phosphoric acid colorimetric procedure.

Yields were measured for each treatment with onions graded into 4" plus, 3-4", 2-3", and smaller size classes.

RESULTS

Yield of onions and chemical analyses of leaf samples from the 1979 experiment are given in Table 1. Response from P, relationship between P concentration in leaf samples and yield response from applied P for 1978 and 1979 were very similar.

The effects of P and Cu fertilizer treatments on yield and P and Cu concentration for Danver and Chieftan onion varieties are shown in Table 1.

Twenty two lbs P/A banded under the seed at planting has consistently increased total yield, yield of large onions, and % P in leaf samples more than 44 lbs P/A broadcast and disced in before planting. Yield of #1 onions was 735 bags versus 665 bags for Danver and 1,094 versus 996 for Chieftan for this band versus broadcast comparison, respectively (treatments 2 versus 4, and 12 versus 14). Relative increases in yield from P application are greater when the large size onions are considered. Yields of 2-3 and 3-4 inch onions were increased from 244 to 588 and from 2 to 150 bags, respectively, for Danver variety (treatment 7 vs. 10). Yield of large size onions 3-4 and 4+ inch were increased from 177 to 688 and from 0 to 92 bags, respectively, for the Chieftan variety (treatment 17 vs. 20).

Phosphorus concentrations for leaf samples (third leaf from the top when onion bulbs were 3/4" diameter) were 0.37 versus 0.39% for Danver and 0.40 versus 0.36% P for Chieftan for 22 lbs P/A band treatment than with the 44 lbs P/A disced in before planting.

The maximum yield of 2 inch and larger Danver onions was produced with 44 lbs P/A disced in before planting, plus the 44 lbs P/A rate banded below the seed; increases in yield from application of copper were not evident with Danver onions. This high rate of P application apparently increased vegetative growth of Chieftan enough to dilute Cu to the critical level. Treatments 18 and 19 with Cu added increased the yield and larger sized onions above comparable P rates without Cu (treatments 13 and 16). Note that high rates of P apparently produced more vegetative growth and more stress on Cu for Chieftan than for Danver variety. Copper levels were lower for both sampling dates for the Chieftan variety; treatments 13 and 16 average 8 ppm Cu for Chieftan while treatments 3 and 6 averaged 9.5 ppm Cu for Danver. These data confirm our earlier observaitons on Lake Labish experiments that established 7 ppm Cu as a critical level for third leaf from the top when onion bulbs were 3/4 to 1" diameter.

Analyses of leaf samples have shown a consistent decrease in P concentration of 0.05 to 0.10% P between the time the bulb starts to form and the time it reaches 3/4 to 1" diameter; this generally takes about 2 weeks. Therefore, sampling time is important when evaluating adequacy of a P fertilizer prgoram with chemical analyses of leaf samples.

Our present data from the Southern Oregon Exp. Sta. indicate that we should have more than 0.40% P in leaf samples (third leaf from top) when onion bulbs are 3/4 to 1" diameter. Phosphorus levels are probably adequate when leaf samples contain 0.45% P at this stage of growth. Experiments are planned to confirm this for Willamette Valley peat soils during 1980 and 1981.

Analyses of plant samples for both 1978 and 1979 showed that Cu levels in leaf samples were reduced with high rates of applied P. This resulted in a response from Cu on Chieftan variety in 1979. Possible stress on Cu nutrition from the high rates of P application could explain the lower yield in 1977 experiments (data not reported here). Detailed Cu analyses were not completed on those samples; however, P levels were above 0.50% for the higher fertilizer rates on both sample dates in 1977.

Research work in other areas has established that zinc and iron micronutrient deficiencies frequently accompany very high levels of P (0.60% P, and especially levels above 0.75% P) and suggests that high levels of P fertilization may cause micronutrient deficiencies.

Micronutrient decreases in Cu concentraion were greater than the relative decreases in Zn concentration of leaf tissue when P treatments were added.

Micronutrient interactions are complex, especially when 3 or 4 nutrients might be involved. A discussion of these interactions is beyond the scope of this paper. Individuals interested in a discussion of these effects are referred to the chapter by Olsen (1972) in "Micronutrients in Agriculture."

Experiments for 1980 are designed to evaluate the effects of P fertilization on total amount of Cu taken up by corn and onions.

LITERATURE CITED

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Mulkey, J. R., E. L. Albach, E. Dainello. 1979. Response of onions to P placement. Agronomy Journal 71:1037-1040.

Olsen, S. R. 1972. Micronutrient Ineractions. _In_ Micronutrients in agriculture, J. J. Mortvedt, P. M. Giordana, W. L. Lindsay (eds.), Soil Sci. Soc. of Amer., Madison, Wisc.

Table 1. Effect of P and Cu treatments on yield and nutrient composition of onion leaf samples. Southern Oregon Exp. Sta. 1979.

	Treatment: Phosphorus Bdcast	Phosphorus Band	Cu	Yield #1 onions: 4"+	3-4"	2-3"	Total	Nutrient Concentration leaf samples[1/]: June 10 P	June 10 Cu	June 25 P	June 25 Cu	June 25 Mn
	lb P/A			50 lb bags/A				%	ppm	%	ppm	
						DANVER VARIETY						
1	0	0	0		3	292	433	.33	13	.34	11	40
2	0	22	0		113	543	735	.42	11	.37	11	38
3	0	44	0		138	502	706	.48	10	.40	10	28
4	44	0	0		40	525	664	.40	13	.39	11	34
5	44	22	0		147	567	912	.46	10	.37	10	32
6	44	44	0		155	607	846	.54	9	.43	9	30
7	0	0	10		2	244	389	.31	14	.37	12	32
8	0	44	10		179	578	823	.47	10	.38	9	36
9	44	0	10		44	501	663	.42	12	.44	12	42
10	44	44	10		150	588	808	.53	10	.39	8	28
						CHIEFTAIN VARIETY						
11	0	0	0	8	190	452	710	.30	13	.34	11	34
12	0	22	0	38	581	444	1094	.43	11	.40	10	38
13	0	44	0	52	549	390	1016	.45	9	.41	7	38
14	44	0	0	4	410	559	996	.37	13	.36	12	38
15	44	22	0	71	657	415	1177	.47	10	.41	8	30
16	44	44	0	45	579	415	1072	.58	7	.45	8	32
17	0	0	10	0	177	560	783	.32	11	.33	12	40
18	0	44	10	53	606	470	1179	.49	10	.42	9	38
19	44	0	10	10	393	487	919	.43	13	.42	12	42
20	44	44	10	92	688	395	1203	.48	12	.40	7	24

[1/] K, Ca, and Mg analyses were 3.5% K, 0.70% Ca and 0.22% Mg for trt. 6 and 3.8% K, 0.90% Ca, and 0.25% Mg for trt. 16. K analyses decreased from 5.8 and 5.1% K for trts. 1 and 11, respectively, showing a marked dilution effect as yields were increased with P fertilization; there was essentially no change in Ca and Mg analyses.