

# HAWAII FARM SCIENCE

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## The Response of

Yield increases of potatoes have been reported from banding phosphorus (P) at 26 and 52 lb/acre in California,<sup>1</sup> and from broadcasting P at 40 and 80 lb/acre in Quebec.<sup>2</sup> However, P adsorption isotherms and field trial results on corn, lettuce, Chinese cabbage, and desmodium on several Hawaii soils<sup>3</sup> indicate that levels of P below 100 lb/acre would be sub-optimum.

This experiment was conducted to determine the effects of banding and broadcasting several rates of P and also to determine the effectiveness of a windbreak on potato production.

### MATERIALS AND METHODS

A P fertilization trial was initiated on May 18, 1972, at the Mealani Research Station, Kamuela, Hawaii, using the potato, *Solanum tuberosum* L. 'Pele.' The soil is a silty clay loam of the Maile series, which is a Hydric Dystrandept. Table 1 shows the P treatments. Broadcast treatments were incorporated with a rototiller, and band treatments were used to apply one or two bands of P 2 inches below and 2 inches to the side of the potato seed piece. Plots were 18 × 25 feet with 3 feet between rows and 1 foot between plants. Plots were arranged in a randomized complete block with 3 replications.

Prior to the experiment, the soil analysis revealed: pH 5.8, P 4 ppm,

<sup>1</sup>Tyler, K. B., O. A. Lorenz, and F. S. Fullmer. 1960. I. Plant and soil analyses as guides in potato nutrition. California Agricultural Experiment Station Bulletin 781: 4-15.

<sup>2</sup>Chamberland, E., and A. Scott. 1968. N-P-K Experiments with potatoes in the lower St. Lawrence region of Quebec. American Potato Journal 45:93-102.

<sup>3</sup>Fox, R. L., R. K. Nishimoto, J. R. Thompson, and R. S. de la Pena. 1974. Comparative external phosphorus requirements of plants growing in tropical soils. Transactions X International Congress of Soil Science. Moscow. (In press)

# Potatoes to Phosphorus and Windbreak

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TABLE 1. Effect of phosphorus applied on tissue percent P and on soil extractable P

Treatment (lb/acre)		P <sup>1</sup>	P <sup>2</sup>
Band	Broadcast	(%)	(ppm)
0	120	0.30 bcd	8.5 a
120	0	0.23 a	8.6 a
0	240	0.32 cd	11.1 ab
240	0	0.21 a	10.7 ab
120	120	0.28 bc	11.9 b
0	360	0.32 cd	12.9 bc
240	120	0.27 b	13.0 bc
120	240	0.31 cd	15.4 cd
0	480	0.32 cd	16.6 d
240	240	0.32 cd	15.2 cd

<sup>1</sup>Tissue percent phosphorus.

<sup>2</sup>Soil extractable phosphorus.

Any two numbers followed by the same letter(s) are not significantly different from each other at  $P < .05$  by Duncan's multiple range test.

potassium (K) 275 ppm, calcium (Ca) 4100 ppm, and magnesium (Mg) 480 ppm. All plots received the following broadcast preplant fertilizer treatments: K 145 lb/acre, Mg 50 lb/acre, boron (B) 15 lb/acre, copper (Cu) 15 lb/acre, zinc (Zn) 20 lb/acre, and nitrogen (N) 100 lb/acre. Additional N at 100 lb/acre was applied one month after planting.

Plots were harvested November 20, 1972, and potato weights and grades (U.S. No. 1, off-grade, and culls) were recorded.

The first replicate was 25 feet from a windbreak of wild olive (*Olea europaea* L.) trees, 15 to 20 feet tall. These trees were 5 years old and planted in two staggered rows with 5 feet between rows and 6 feet between trees. The second and third

the 120 and 240 lb/acre broadcast treatments looked much healthier and more lush than the band treatments at the same rates. The appearance of a band-plus-broadcast treatment was as good as the broadcast treatments and much better than banding alone as shown in Figures 2, 3, and 4. This may be due to root distribution where, early in the season, roots were exposed to the small banded areas with a high level of P. Later in the season, a larger proportion of the roots extended beyond the band where soil P was very low.

Potato yields are shown in Figure 1. Since there was no significant difference between one and two-band treatments, their yields were averaged. Broadcast treatments yielded 23 and 26 more cwt per acre than did banded treatments where P was applied at 120 and 240 lb/acre respectively. A band-plus-broadcast treatment was as good or better than either alone ex-

TABLE 2. The effect of a wild olive windbreak on potato production

Distance from windbreak (feet)	Yield (lb/acre)	Soil Moisture (percentage)
25	17,118 b	67.4 b
53	15,224 a	65.2 b
81	14,476 a	55.9 a

Any two numbers in the same column followed by the same letter are not significantly different from each other at  $P < .05$  by Duncan's multiple range test.

cept for the treatment using P at 240 lb/acre broadcast plus 120 lb/acre band, whose yield was lower for some unexplainable reason.

We recommend that banding alone should not be considered for this type of soil unless the soil P is at a high level. As a rule, the yield increased with increasing rate of total P (Figure 1); it appears that additional yield increases could be obtained with rates of P higher than 480 lb/acre. The highest yield obtained was 191 cwt/acre where the P rate was 240 lb/acre broadcast plus 240 lb/acre band. This is an increase of 83 cwt, or 77 percent, in yield over the 120 lb/acre band treatment.

Table 1 shows the tissue percent P. As the total amount of P added

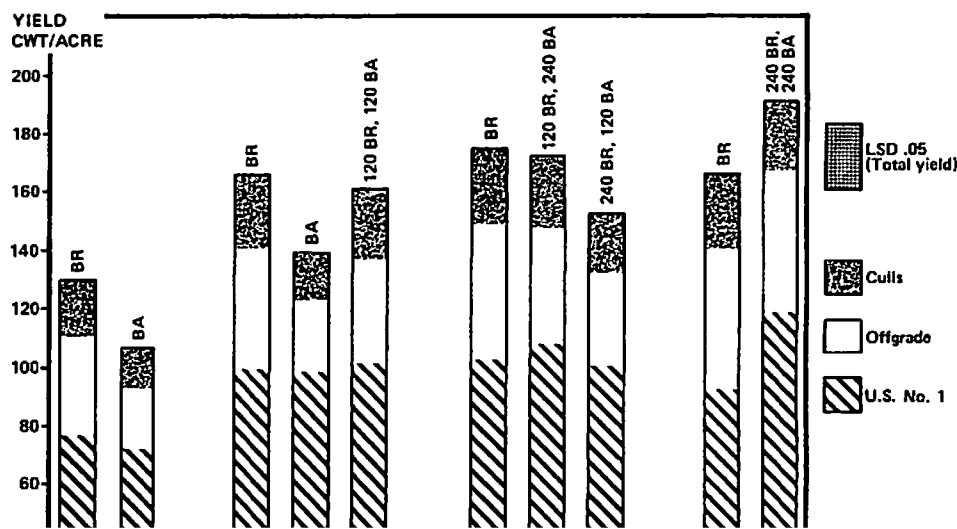




Figure 2. Band plus broadcast.

was increased, the tissue content of N, P, K, Ca, and Mg also increased. There was no direct significant correlation between tissue P and yield, although the means of both tissue P and yield increased with increasing total P application. Tissue content of N, P, and Zn was greater for the broadcast treatments at 120 and 240 lb/acre than that for banding. Tissue content of K, Mg, and Cu was significantly greater for the broadcast treatment at 240 lb/acre than that of band treatment at the same rate, but the method of application did not affect these elements at 120 lb/acre. The 120 and 240 lb/acre band treatments had a higher tissue concentration of B and Fe than did the corresponding broadcast treatments.

Table 1 shows the analysis of soil P after harvesting the crop. P broadcasted at 480 lb/acre provided the highest soil level of 16.6 ppm P. In adjacent experiments on pangola and kikuyu grass, the highest P application (1000 lb/acre) netted the highest yield.<sup>4</sup> Extractable P in these plots had a mean of 75 ppm P. If potatoes

<sup>4</sup>Tamimi, Y. N. 1972, rev. Response of kikuyu and pangola grasses to rates of nitrogen, phosphorus and potassium: II. Effect of high rates. Proceedings, 7th Annual Beef Cattle Field Day, September 18, 1971. Hawaii Cooperative Extension Service, Miscellaneous Publication 81:85-92.

react similarly, further yield increases could be expected from applications of P at a larger rate than 480 lb/acre.

Table 2 shows effect of a 15 to 20 feet tall wild olive windbreak on potato production and on soil moisture. The replicate closest to the windbreak (25 feet) yielded 19 and 26 more cwt per acre than did the two replicates located 53 and 81 feet, respectively, from the windbreak. Likewise, soil moisture content was lower as distance from the windbreak increased (Table 2).

#### SUMMARY

Broadcasting P or a split application of broadcast plus banding proved to

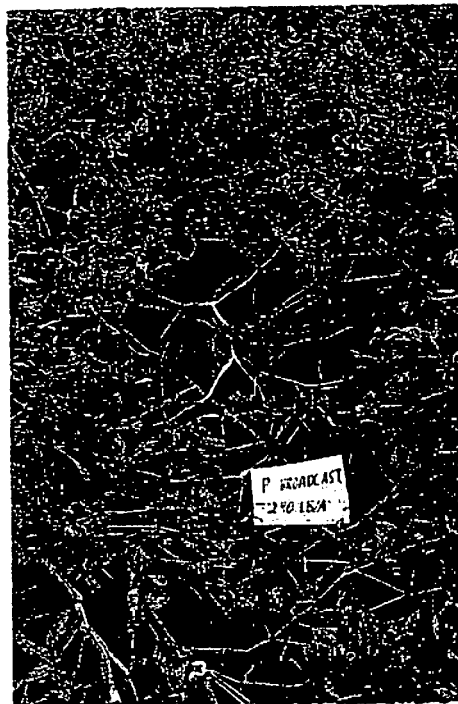


Figure 3. Broadcast alone.



Figure 4. Banding alone—iffy.

be superior to banding alone. Banding alone should not be considered for Maile series soil types unless the level of soil P is high. Yields increased as the amount of P added increased, even at the 480 lb/acre rate, and further yield increases could be expected with additional P applications. Potato yield and soil moisture decreased with increasing distance from "a wild olive windbreak, 15 to 20 feet high." In the windy areas, establishment of windbreaks is highly recommended.

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