SEED SPACING AND PREPLANT NITROGEN REQUIREMENTS OF THREE POTATO CULTIVARS

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Stylotically, over ninety percent of the potato acreage in Idaho is planted to the cultivar Russet Burbank. Consequently, a great deal of information has been amassed concerning the best management practices for optimizing returns from Russet Burbank (1,4,5,6). As new cultivars are released, little information is available to aid growers as they attempt to optimize growing conditions for these cultivars. The result of this lack of information is a dependence on recommendations made for Russet Burbank, regardless of whether such recommendations are appropriate.

Lemhi and Butte, recently released by the USDA potato breeding program at Aberdeen, Idaho, have gained some acceptance among Idaho potato growers. Very little research has been done to develop recommendations for fertilization and other management practices for these two cultivars. A research project was started in 1985 at Aberdeen to compare seed spacing and preplant nitrogen requirements of Lemhi and Butte with those of Russet Burbank.

In 1985, a trial using certified seed of Russet Burbank, Butte and Lemhi was planted in a field located at the Aberdeen Research and Extension Center, Aberdeen, Idaho. Soil tests showed the field to be low in phosphorus and potassium, and both were added according to UofI recommendations for potatoes. The soil test also showed residual nitrates to be 11.3 ppm in the top 12 inches and 38.8 ppm in the second 12 inches. The level of residual nitrates was fairly high and this strongly influenced the results of the study.

The trial was planted May 17 and managed typically for southeastern Idaho. Lemhi was used for insect control and Sencor for weed control. Vine kill occurred on September 16 and harvest was October 2. Preplant nitrogen rates used were 0, 50, 100 and 150 units/A. Three additional sprinkler-injected applications of 40 units/A each were made on all plots during the growing season. Preplant seed spacings used were 7, 10, and 13 inches. Row spacing was 36 inches for all plots. The information collected included yield and grade data, petiole nitrates, specific gravity and vine maturity.

EFFECT OF PREPLANT NITROGEN

Yield and Tuber Size. Figures 1, 2 and 3 show the effect of preplant nitrogen on total yield, yield of U.S. No. 1's and average tuber size, respectively. Surprisingly, Butte was the only cultivar to show any yield response and only at the 50 unit level. This appeared to be contradictory to previous research until the residual nitrogen present in the field was taken into account. Over 100 units/A of nitrates were already present in the top 2 ft of soil. This was adequate preplant nitrogen for Russet Burbank and Lemhi without further additions. The 10 lb of residual nitrates, in combination with the 120 lb later added though the irrigation system, closely matches UofI recommendations for Russet Burbank grown in southeastern Idaho.

Butte needed additional preplant nitrogen to reach its best yield potential. This is in close agreement with previous work done by Ohms et al. (3). Additions of 100 or more units/A of nitrogen to Butte had a detrimental effect on yield. This is an unusual phenomenon since most yield curves tend to simply flatten rather than drop off. Excess nitrogen caused a reduction in tuber size with Butte, presumably due to a delay in tuber enlargement with a consequent reduction in yield (Fig. 3).

Petiole nitrates. Petiole nitrates were determined on July 11, 1985, just prior to the first application of nitrogen through the irrigation system. All three cultivars showed an increase in petiole nitrates with increased rates of preplant nitrogen (Fig. 4). Russet Burbank and Lemhi, however, were capable of producing the same yields with lower levels of petiole nitrates as they were with higher levels -10 to 15,000 ppm being adequate. Butte required nearly 20,000 ppm at this stage of growth to produce its best yields.

Specific gravity. All three cultivars showed an expected decrease in specific gravity with increasing rates of preplant nitrogen (Fig. 5). Lemhi had the least amount of tolerance for excess nitrogen; Butte had the greatest.

Vine maturity. All three cultivars showed delayed maturity with higher rates of nitrogen (Fig. 6). Butte was less affected than were Russet Burbank and Lemhi. Delayed vine maturity may result in extra expenditures for vine killing and may also cause immature tubers with the associated reduction in russetting, increased skinning and increased storage problems.

Net Returns. Net returns for the nitrogen rates were computed using 1985 cost of production figures, a $0.30/unit price for nitrogen and Simplometric's pricing formula, including quality incentives, with a $4.05 base price. Butte showed the only gain in net returns and then only at the

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50 unit/A preplant nitrogen rate. This was due almost entirely to the corresponding increase in yield. Although Russet Burbank and Lemhi showed some variation in net returns, the changes were not significant.

**EFFECT OF SEED SPACING**

**Yield and Tuber Size.** Reductions in seed spacing led to a corresponding increase in total yield for all three cultivars (Fig. 8). Yield of U.S. No. 1’s was increased significantly only with Russet Burbank at the closer spacings (Fig. 9). All three cultivars showed a decrease in average tuber size with corresponding decreases in seed spacing (Fig. 10). The decrease in tuber size of Lemhi and Butte was less than for Russet Burbank.

**Petiole Nitrates.** Spacing did not influence petiole nitrates for any of the three cultivars. The early-season nitrogen supply was adequate regardless of plant density.

**Specific Gravity.** Lemhi demonstrated a distinctly higher specific gravity at the 7-inch spacing than at the 10 or 13-inch spacings (Fig. 11). The specific gravity of Russet Burbank and Butte were affected to a lesser extent. The reason for the influence of spacing on specific gravity is probably due to an increase in competition for nutrients late in the growing season at the closer spacings.

**Vine Maturity.** Vine maturity was not affected by spacing for any of the three cultivars.

**Net Returns.** Net returns for seed spacing were computed using a $1.50/cwt price for seed and the same formula previously described. Differences in net returns due to seed spacing were insignificant for all three cultivars. Increases in yield at the closer spacings were counterbalanced by increases in seed cost.

**SUMMARY AND CONCLUSIONS**

Some general recommendations can be made for the preplant nitrogen and seed spacing requirements of Lemhi and Butte as a result of this study. It should be recognized that this study was conducted in one location for a single year and additional research will undoubtedly modify these recommendations.

Butte requires more preplant nitrogen than Russet Burbank in order to increase tuber size and optimize yield. Including residual nitrogen, approximately fifty percent more nitrogen should be present in the soil at planting than would be recommended for Russet Burbank. Although requiring more nitrogen than Russet Burbank, Butte is also more sensitive to excess nitrogen. Excess nitrogen causes delayed tuber enlargement with a subsequent reduction in tuber size and yield. For this reason, Butte should respond well to split applications of nitrogen as opposed to a single, large preplant application. Ohms (3) demonstrated that, in areas of the state with a long growing season, less concern can be given to the delay of tuber enlargement and there is less problem with excess nitrogen early in the season. At tuber set, Butte should have a petiole nitrate level near 20,000 ppm in order to optimize yield. This is in contrast to Russet Burbank which should have a petiole nitrate level near 15,000 ppm.

The optimum seed spacing for Butte grown in southeastern Idaho will have to be determined by individual growers for their own situation since no economic advantage was evident at any spacing. However, because the average tuber size of Butte is less affected by close spacing than is Russet Burbank, it should be possible to grow it at a reduced spacing (8 to 10 in) and still maintain good size. In the areas of the state with a longer growing season, Ohms (3) demonstrated that Butte gives its best net returns at a wider spacing (10 to 13 in) because many of the later set tubers have time to enlarge.

Lemhi responded to preplant nitrogen in the same manner as Russet Burbank. The nitrogen rates and petiole nitrate levels recommended for Russet Burbank should be adequate for Lemhi. Excess nitrogen is not detrimental to the yield of Lemhi, but will markedly decrease specific gravity.

As with Butte, no particular seed spacing proved to be economically advantageous with Lemhi. However, the specific gravity of Lemhi was increased by reducing the spacing and a close spacing has been shown to reduce hollow heart (2), which can be an occasional problem with Lemhi. For these reasons, growing Lemhi at a closer spacing (7 to 9 in) may be advisable. Close seed spacing did not reduce Lemhi's average tuber size as much as Russet Burbank's, making closer seed spacing a viable alternative.
REFERENCES


Fig. 1. Effect of preplant nitrogen on total yield of the potato cultivars Russet Burbank, Lemhi, and Butte.

Fig. 2. Effect of preplant nitrogen on yield of U.S. #1 tubers of the potato cultivars Russet Burbank, Lemhi, and Butte.
Fig. 3. Effect of preplant nitrogen on average tuber size of the potato cultivars Russet Burbank, Lemhi and Butte.

Fig. 4. Effect of preplant nitrogen on petiole nitrate levels of the potato cultivars Russet Burbank, Lemhi and Butte.
Fig. 5. Effect of preplant nitrogen on specific gravity of the potato cultivars Russet Burbank, Lemhi and Butte.

Fig. 6. Effect of preplant nitrogen on vine maturity of the potato cultivars Russet Burbank, Lemhi and Butte.
Fig. 1. Effect of preplant nitrogen on net returns from the potato cultivars Russet Burbank, Lemhi and Butte.

Fig. 8. Effect of in-row seed spacing on total yield yield of the potato cultivars Russet Burbank, Lemhi and Butte.
Fig. 9. Effect of in-row seed spacing on average tuber size of the potato cultivars Russet Burbank, Lemhi and Butte.

Fig. 10. Effect of in-row seed spacing on average tuber size of the potato cultivars Russet Burbank, Lemhi and Butte.
Fig. 11. Effect of in-row seed spacing on specific gravity of the potato cultivars Russet Burbank, Lemhi and Butte.

Fig. 12. Effect of in-row seed spacing on net returns from the potato cultivars Russet Burbank, Lemhi and Butte.