TUBER YIELD AND QUALITY IN VARIOUS POTATO HILL STRUCTURES

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The state of Washington produces some of the highest tuber yields in the United States. These yields are achieved despite maximum daily air temperatures that frequently exceed 100°F and occasionally exceed 110°F. These high air temperatures increase temperatures in the soil around the tubers, reducing tuber quality and yield. Tuber initiation and tuber development have been shown to be sensitive to high soil temperatures (Epstein, 1966). The optimum range of soil temperature reported (Bodlaender, 1963) for tuber development is 60 to 75°F. We have recorded soil temperatures as high as 102°F beneath determinate potato varieties. According to Bodlaender very little or no tuber formation will occur above 84°F.

The diurnal increase in soil temperature is less in wet soil than in dry soil. It is, however, difficult to maintain adequate soil water in potato hills because, 1) a substantial portion of sprinkler applied irrigation water (as high as 50% in preliminary studies) is shed into the furrow where fewer potato roots and no tubers are located, 2) the sandy soils on which many potatoes are produced have a low water holding capacity, and 3) hills present a greater surface area for evaporation and absorption of radiate energy. These effects are more pronounced for determinate varieties because a complete canopy is often not produced.

If tubers are grown without hilling, or with modified hilling, soil temperatures will be reduced and water distribution around the tubers and the plant roots will be improved. This should improve tuber quality and yield as well as reduced inputs of water and nutrients.

The objectives of the study were to 1) to measure diurnal soil temperatures in the tuber zone when the plants are grown without hilling and with modified hilling; 2) to measure soil water in the tuber zone when the plants are grown without hilling and with modified hilling; 3) to compare the parameters measured in 1) and 2) with conventionally grown potatoes; and 4) to assess the effects of the parameters measured in 1) and 2) on tuber quality.

In 1991 an indeterminate variety, Russet Burbank, and a determinate variety, HiLite, were planted in conventional hills, 2-row beds, pitted furrows, and with no hills to assess soil temperature and soil temperature effects in the tuber zone.

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Soil temperatures as high as 91°F and 95°F were recorded in the tuber zones of Russet and HiLite, respectively. The research was conducted on Quincy sand soil on land provided by AgriNorthwest near Plymouth, Washington.

Soil temperatures were examined during three periods with high air temperatures (Figure 1), July 1-5 (highest temperature, 104° F),, July 27-31 (high temperatures each day between 95 and 97° F), and August 16-22 (high temperatures of 99 to 102° F). The HiLites were harvested before August 16. During the two earlier periods soil temperatures in the tuber zone of the HiLites were 2 to 4° F lower for flat planted than for 2-row beds and conventional hills.

The canopy of the Russet Burbanks was in good condition for the first two periods and was beginning to decline slightly by the third period. During the hot period in early July soil temperatures in the tuber zone of this variety were 2 to 4°F higher in the conventional hills than in the tuber zone of the other hill structures. During the late July period temperatures in the tuber zone were 4°F higher for conventional hills and for flat planted than for the other two hill shapes. During the mid August period temperatures in the tuber zone were 5°F higher for conventional and flat planted than for the 2-row bed and 4°F higher than for the pitted furrows.

Total yields (Figure 2) were significantly different for Russet but not for HiLite. Flat planting produced the highest (Russets: 679 cwt/A and HiLite: 602 cwt/A) and conventional hills the lowest yields (Russets: 604 cwt/A and HiLites: 530 cwt/A) for both cultivars. Yield of #1 and #2 followed much the same trend as total yields among hill types but HiLite produced a much higher percentage of marketable tubers than did Russet Burbank. Yields of U.S. #1's (Figure 3) were significantly different for hill types in both Russets and HiLites with no hills producing the highest (Russets: 392 cwt/A and HiLite: 476 cwt/A) and conventional hills the lowest yields (Russets: 302 cwt/A and HiLites: 368 cwt/A).

Specific gravities (Figure 4) for the HiLites ranged from 1.065 to 1.070 with conventional hills producing tubers at the low end of the range and the other configurations producing tubers near the upper end of the range. The range of specific gravities for the Russet Burbank variety was from 1.073 to 1.075 with flat planted tubers at the upper end of the range and the other three configurations at the lower end of the range.

Results from the first year of this study suggest that, for sandy soils, modifying or eliminating the hill around the tuber zone improves the yield and quality of both Russet Burbank and HiLite. In 1991 planting the seed at a depth of 7 inches with no hill produced the highest yields and the best quality for both varieties. Both the 2-row beds and the pitted furrows appear to have advantages in yield and quality over the conventional hill for both Russet Burbank and HiLite.

REFERENCES:

Bodlaender, K. B. A. 1963. Influence of temperature, radiation, and photoperiod on development and yield. In J.D. Ivins and F. L. Milthorpe (eds.). The growth of the potato. Butterworth, London.

Epstein, E. 1966. Effect of soil temperature at different growth stages on growth and development of potato plants. Agron. J. 58:169-171.

Figure 1. Air Temperatures near Paterson, Washington.

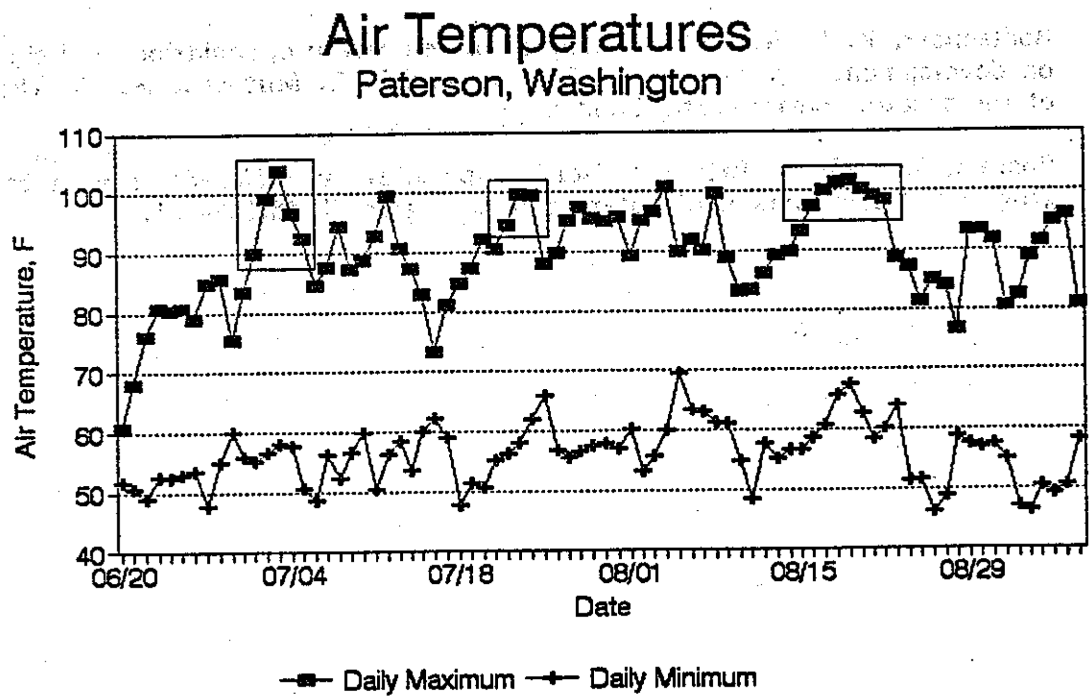

Figure 2. Tuber Yield for 1991 Hill-Temperature Study.

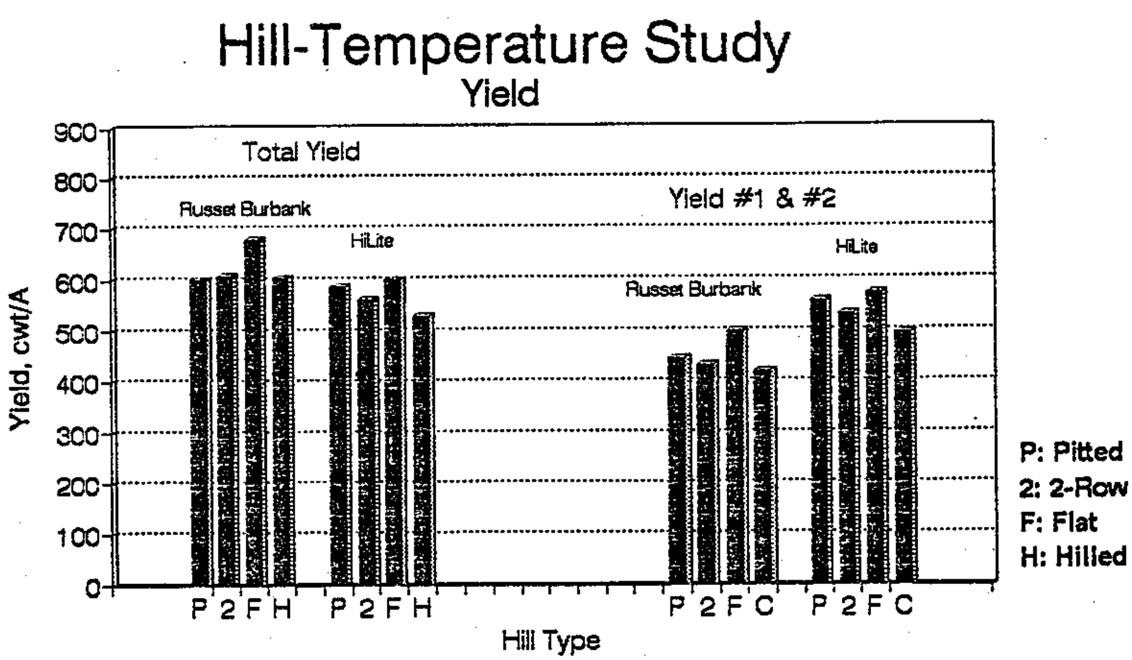

Figure 3. Yield of U.S. #1 Tubers.

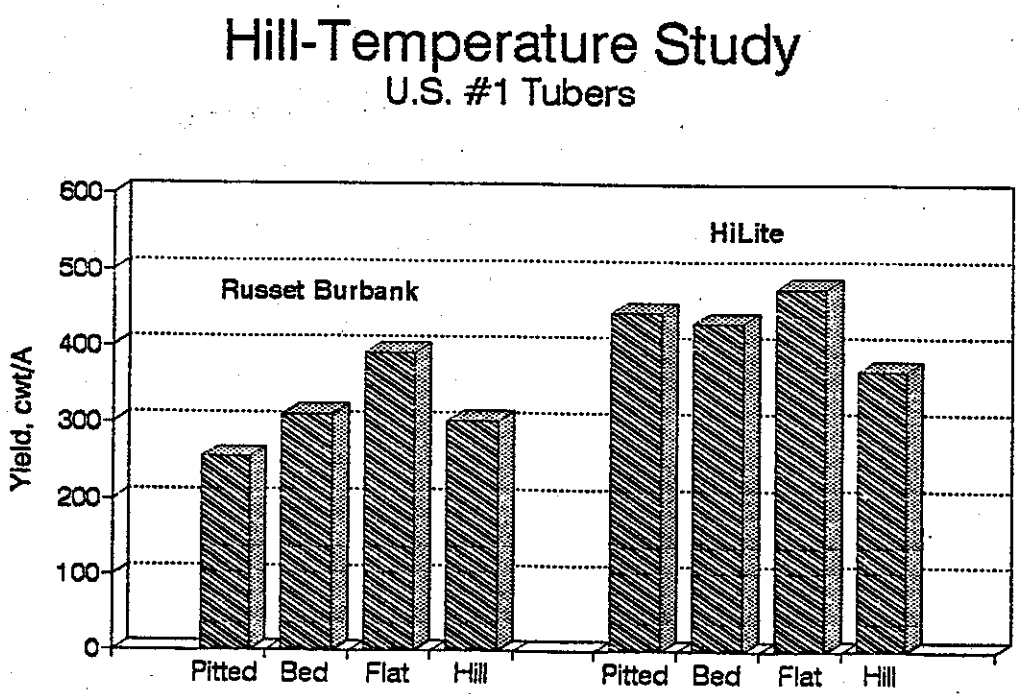

Figure 4. Specific Gravities for Russet Burbank and HiLite.