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THE EFFECT OF HILLING ON YIELD AND QUALITY OF POTATOES

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INTRODUCTION

Traditionally, commercially grown potatoes are hilled in the production cycle between emergence and closure of the canopy. Hilling is usually accomplished with disks, sweep shovels, or similar tools that lift soil from between rows and deposit it beside and on top of the row.

Reasons for hilling may include: improved weed control, improved drainage, minimization of greening of tubers, and raising of soil temperatures. Proper management of each of these factors may result in an increase in quality and quantity of tuber yield.

Negative aspects of hilling have also been noted. Saffigna et al. (1976) reported that water distribution was uneven under potato hills, resulting in uneven availability of water to plants and increased loss of fertilizer due to leaching.

Hilling operations may also damage potato plants, and significant reductions in yield are known to result from hilling and other types of cultivation (Nelson and Giles, 1986). Many commercial growers wait until vines are 12 or more inches tall before hilling. This scheduling is preferred because at this time the danger of covering plants is minimal. However, the vines of larger plants may sustain greater damage from hilling than smaller plants. Also, the possibility of damaging roots and stolons increases as the plants increase in size, so there may be advantages to hilling when plants are younger and smaller.

Four different treatments including variations in time of hilling and height of hill were compared with no-hilling on four varieties of potato in the 1988 and 1989 growing seasons. This report contains a preliminary summary of data collected from these studies.

MATERIALS AND METHODS

Cut seed tubers of four potato varieties (Bake-King, Green Mountain, Kennebec, and Superior) were planted in field plots in mid-May of 1988 and 1989 at the Agricultural and Forestry Experiment Station (AFES) farm near Palmer.

Plots were mold board plowed in 1988 and chisel plowed in 1989, followed both years by tilling and packing prior to planting. Seed tubers were planted 11 inches apart with a single row assist-feed planter in rows spaced three feet apart. Granular fertilizer was placed with the planter in bands beside and below the seed pieces at the rate of 96 lbs per acre N, 304 lbs per acre P_2O_5, and 192 lbs per acre K_2O. The fertilizer was composed of monoammonium phosphate, muriate of potash, and urea.

Five hilling treatments were used in this study: no-hill, low-early, high-early, low-late, and high-late. Early hills were formed approximately seven weeks after planting, as soon as plants were large enough (4-6 inches high) to minimize

covering of the plants with soil. Late hills were formed approximately two weeks after early-hilling, and at this time vines were more than 12 inches tall, eliminating the risk of covering vines with soil. Hills were formed with a spider hiller attached to a tractor-mounted tool bar. The spider hiller is a toothed wheel that forms hills by rotating to move soil from between the rows. The tops of low hills were approximately six inches above adjacent furrows whereas the tops of high hills were approximately nine inches higher than adjacent furrows.

Low hills were approximately 15 inches wide at the top and 30 inches wide at the base. High hills were approximately nine inches wide at the top and 24 inches wide at the base. The high-late hilling treatment is similar to the hilling practices of many southcentral Alaska commercial potato growers.

Each hilling treatment with each variety consisted of a plot with 22 plants and was replicated four times in a randomized complete block design. Weeds were controlled with a pre-emergent application of Roundup® (glyphosate).

Plants were irrigated as needed with overhead sprinklers. Each year plots were harvested in early September. Tubers were lifted with a mechanical digger and picked by hand.

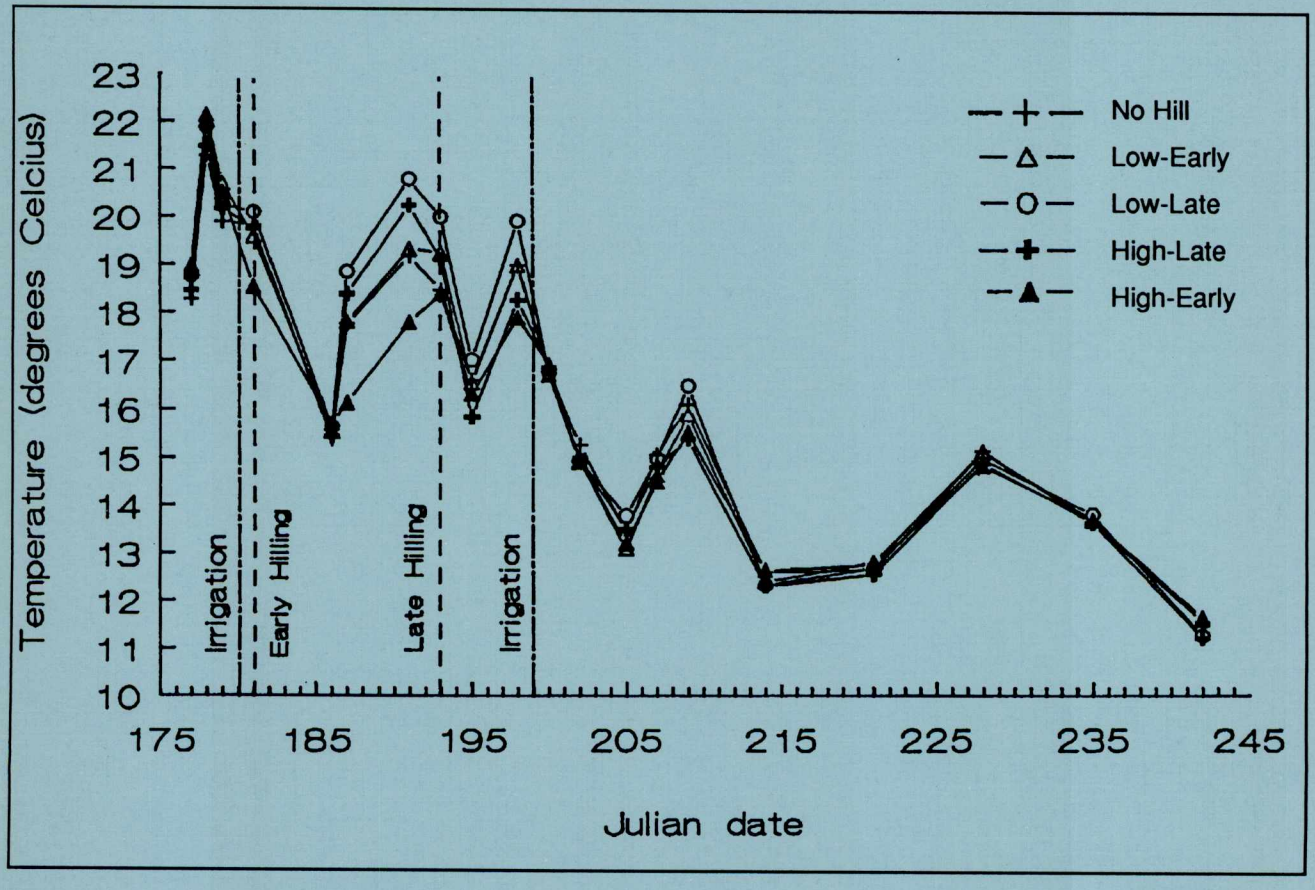
Tubers were kept in a refrigerated storage until they were graded approximately six weeks after harvest.

In 1989, soil temperature in the hills was measured with thermistors placed in the hill at the level of the seed piece, and was recorded in mid-afternoon one, two, or three times weekly throughout the growing season.

RESULTS AND DISCUSSION

Soil temperatures ranged from 22°C in late June, 1989 to 12°C in late August, 1989 (Figure 1). Soil temperature dropped rapidly in all treatments at several times during the season and often increased again in the days following a steep decline. These large changes in temperature were related to weather changes rather than to hilling treatment or irrigation. Soil temperatures rose rapidly when the sun was shining and

Figure 1. Effect of hilling treatments on soil temperature in the hill at various times during the 1989 growing season.



air temperature was high. Conversely, on cloudy days when air temperatures were lower soil temperatures declined. Early in the growing season, the rate and extent of increase in soil temperature was greatest for the low-late hilling treatment where temperature was approximately 3°C above the high-early hilling treatment.

The late hilling treatments appeared not to affect soil temperatures. During the later part of the season variation in soil temperatures among treatments was much less, due perhaps to the shading produced by closure of the canopy. Effects of hilling treatments on tuber yield and quality did not appear to be related to soil temperature.

Total and US #1 yields from the 1988 and 1989 crops are presented in Table 1. There was no significant difference among the US #1 yield of the four hilled treatments, but all four hilled treatments yielded significantly more than the treatment that was not hilled. An insignificant trend toward greater yields of US #1 tubers was observed in both early and late high-hill treatments. This trend was even more pronounced in total yield where the low-late hilling treatment yielded significantly less than the other three hilled treatments. Not only were total yields from the no-hill treatment less, but the percent US#1 was also less, further reducing the total quantity of saleable potatoes. Compared to an average of 86.4 percent among the four hilled treatments, 78.7 percent of the no-hill treatment qualified as US #1 grade tubers.

Table 1. *Yields of US #1, total, and green tubers, and percent US #1 tubers, produced by potatoes subjected to five hilling treatments.*[1]

Hilling treatment	Yield			
	US #1	Total	Green	%US #1
high-early	14.7 a[2]	17.0 a	0.4 c	86.5
high-late	14.5 a	17.0 ab	0.3 c	85.3
low-early	14.3 a	16.6 ab	0.4 c	86.5
low-late	14.2 a	16.3 b	0.6 b	87.1
no hill	11.8 b	15.0 c	1.5 a	78.7

[1] Yields are expressed in tons per acre and are averages for four varieties (Bake-King, Green Mountain, Kennebec, Superior) in 1988 and 1989.

[2] Numbers in columns followed by the same letter are not significantly different, LSD=0.05.

A portion of the grade out consisted of tubers that were green as a result of exposure to the sun prior to digging. Significantly more no-hill treatment tubers were green than in all other treatments (Table 1). Additionally, more green tubers were harvested from the low-late hilled treatment than from the other hilled treatments, indicating this type of hill was less effective in preventing greening in tubers.

Not all of the four varieties produced green tubers in response to hilling treatment (Table 2). Bake-King produced very few or no green tubers regardless of hilling treatment. Green Mountain produced a small amount but then only when plants were not hilled. However, Superior and Kennebec each produced many green tubers when plants were not hilled, significantly more than any of the hilled treatments. Additionally, Superior and Kennebec produced some green tubers under all hilling treatments, indicating these two varieties are predisposed to greening.

These data suggest that not hilling, or producing low hills relatively late in the season are practices that should be avoided by growers using Superior or Kennebec. Other categories of grade out (including shatter cracking, growth cracking, second growth, etc.) did not change in response to hilling treatment. However, in 1988 there were significantly more undersized tubers in the no-hill treatment than all others. In 1988 and 1989 there were significantly more oversized tubers in the deep early treatment than in all others. These observations indicate that tuber size was being influenced by some hilling treatments, though not necessarily in a negative way.

Table 2. *Yield of green tubers by four varieties of potato subjected to five hilling treatments.*[1]

Hilling treatment	Variety			
	Bake-K	Sup.	Kenn.	Gr.Mt.
high-late	0.0 a[2]	0.3 c	0.6 c	0.1 b
high-early	0.0 a	0.6 b	0.8 c	0.0 b
low-late	0.1 a	0.6 b	1.6 b	0.2 b
low-early	0.0 a	0.6 b	0.8 c	0.1 b
no hill	0.2 a	2.2 a	2.8 a	0.8 a

[1] Yields are averages for 1988 and 1989 and are expressed in tons per acre of green tubers.

[2] Numbers in columns followed by the same letter are not significantly different, LSD=0.05.

SUMMARY

1. All four treatments where plants were hilled produced more US #1 and total tubers than the treatment that was not hilled.
2. High hilling, whether early or late, had a slight though generally non-significant positive effect on yield.
3. Percent of US #1 tubers was lower when plants were not hilled.
4. More green tubers were produced when plants are not hilled.
5. Superior and Kennebec produced more green tubers than Bake-King or Green Mountain, regardless of hilling treatment.
6. The lowest amount of green tubers were produced when the high-late hilling treatment was used.

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NOTE: Research Progress Reports are published by the Alaska Agricultural and Forestry Experiment Station to provide information prior to the final interpretations of data obtained over several years. They are published to report research in progress but may not represent final conclusions.

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