

EFFECT OF FERTILITY AND IRRIGATION ON POTATO QUALITY

by

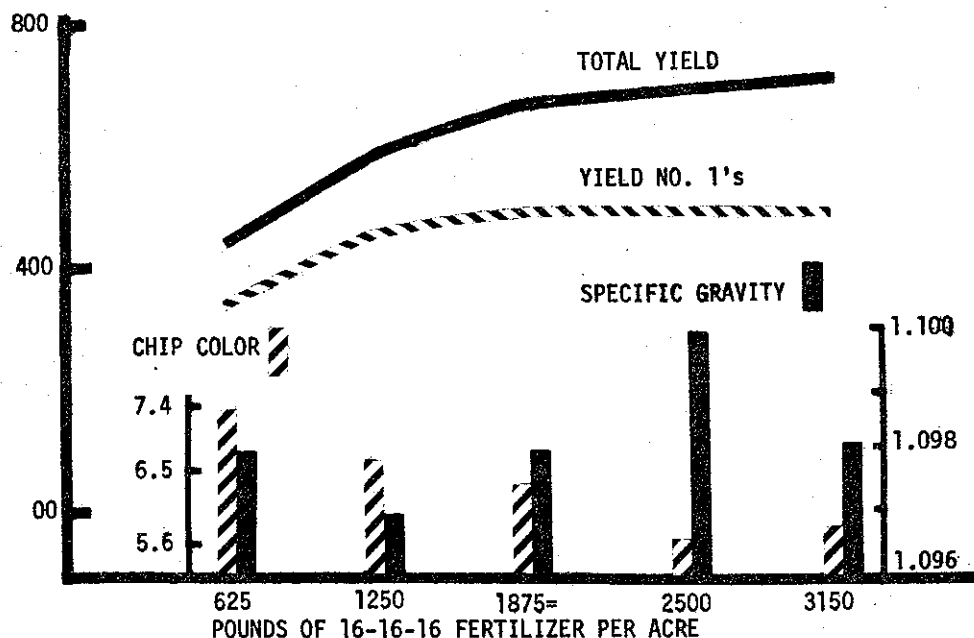
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Because of the long planting and harvesting period in Washington's Columbia Basin and the diversity of uses of the potatoes, potato production is more complex than in most other potato growing areas. Some Washington potatoes go directly from the field to fresh market, others go from field to storage from whence some go to processing and others to fresh market.

Not long ago the most important factor was "eye appeal" and "reputation". With 83 percent of the potatoes being processed and the further expansion of potato processing seeming almost imminent, it becomes paramount that we learn how to produce processing potatoes. That means high yields of high dry matter, low sugar content potatoes. Strange as it may seem, when this objective is achieved, the fresh market requirements of potatoes are simultaneously achieved as shown in Figure 1.

Figure 1: Large quantities of fertilizer can produce maximum yields of potatoes without seriously affecting the yield, grade, specific gravity, or color of chips.



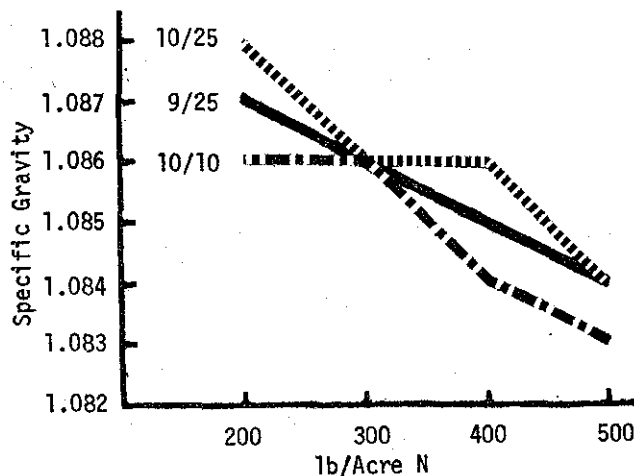
From data presented later the explanation for the results shown in Figure 1 is that the proper amount of irrigation water was applied for the fertilizer rates used. Most of the obvious factors like bugs, length of growing season, ample nutrients, above ground diseases, etc. are constantly watched for. The extent of the cost from insidious maladies which are not easily seen such as mites, wireworms, rhyzoctonia, root feeding nematodes and root rotting diseases generally are often overlooked. More recently soil compaction from the use of heavy equipment was added to the list. To control only one factor does not make a potato yield. Many factors such as seed piece size, plant population, nutrients and available water must be integrated to make a potato grower successful.

The adequate and proper use of water has not received enough attention until recently because what was actually happening in the potato plant was not recognized. Everybody knows that

when potatoes cook soggy and have low dry matter it is because of too much water. The solution to the problem seems obvious, "take away some of the water", but as will become evident, this could be all wrong.

Another cause of low dry matter -- low specific gravity -- is the use of too much fertilizer, especially nitrogen, Figure 2.

Figure 2: Specific gravity of the tubers is generally reduced when more nitrogen is applied than is needed for the length of the growing season.



Evidence now strongly indicates that the reason nitrogen or high fertilizer per se reduces specific gravity is, "too much nitrogen for the length of the growing season", or not enough water to compensate for the added transpiration resulting from the increased plant growth. When insufficient water is applied the first main effect is for the plant to draw water from the tubers which results in loss of weight and loss of turgor pressure. The second main effect is to close the stomata during the heat of the day, when photosynthesis should be going on most rapidly, thereby reducing the potential dry matter content. Third, an extreme water deficit causes a change in the enzyme systems which changes starches to sugar and makes the reconversion difficult.

The effect of moisture on specific gravity is evident from a 1973 study with five levels of nitrogen. As expected, as nitrogen applied increased beyond that needed, there was a decrease in specific gravity, but the reduction was less with high moisture than with low moisture even though yield was not affected, Figure 3.

In a study conducted in 1972 in cooperation with Dr. Gaylon Campbell, the influence of adequate water on grade and specific gravity was most evident. When water was adequate to keep the stomata open, high fertilizer increased the grade out without decreasing the specific gravity even though total yield was not affected. When water was in short supply, the grade out for the fertility levels was the same and specific gravity decreased. When water was limiting, both the grade out and the specific gravity were greatly reduced, Table 1.

As a potato plant gets older the cells develop cellulose and lignin type compounds which cause the plants to remain erect even when under moisture stress, but young plants will wilt and lie on the ground almost as flat as sugar beet leaves. It is often difficult to apply sufficient water to keep the plant growing at a maximum rate without leaching soluble nutrients beyond the root zone. It can be a mistake to equate soil water content with plant water stress, because the soil may seem wet but water may not be moving rapidly.

Figure 3: Specific gravity of the tubers was reduced less when the soil moisture was high than when it was low even though yield was not affected.

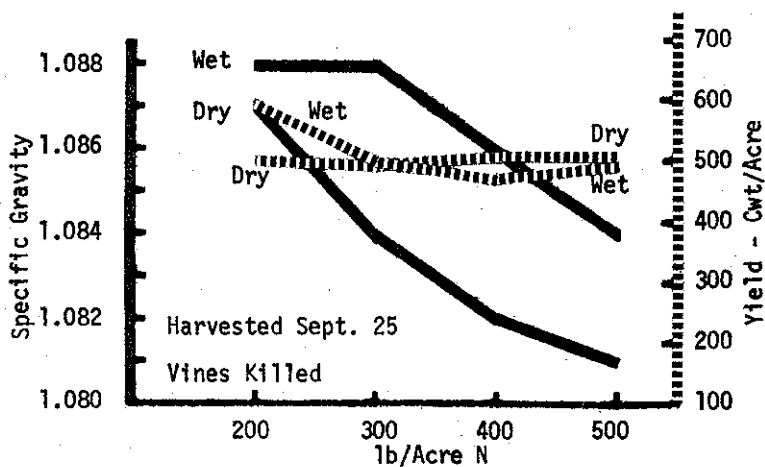


Table 1. 1972 Effects of irrigation and fertility on grade and specific gravity*

Alternate Furrows	lb/Acre 16-16-16	Percent No. 1's	Specific Gravity
24 hours, every 2 days	1250	67	1.080
	2500	74	1.078
24 hours, every 4 days	1250	69	1.080
	2500	69	1.076
24 hours, every 6 days	1250	70	1.080
	2500	58	1.073

*Planted April 25; Frost killed vines September 26;
Irrigation treatments started July 12.