POTATO TUBER CONDITION AND HARVESTER DAMAGE

by
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Much has been written and said about reduction of harvest damage. Considerable progress has been made in the Washington industry in general in bruise reduction. And yet, in spite of what we know about harvester operation and its effects on bruise, we hear about or are faced with the situation of everything we do during the harvest not resulting in the reduction of bruise desired. How does this happen if we are doing everything we can to operate the harvesting in what we know to be the proper manner -- why don't we get the reduced bruise level we need? In order to help understand something about how this can happen we need to relook at some of the factors that are involved in tuber damage at harvest.

There are at least 4 factors that influence bruise. They are 1) soil condition, 2) tuber condition, 3) temperature, and 4) harvester operation. In the past several years we have developed a series of visual and written information that has pretty well gotten the harvester operation story across. These, along with incentive and penalty contract clauses, have resulted in the application of low harvest-damage technology and this will not be a part of this discussion.

Soil condition, as such, will not be discussed in further detail here except as it is known to influence the condition of the potato tuber. Tuber condition and tuber temperature are the factors that will be discussed in order to help understand how they interrelate to each other and to total harvest damage.

When the term 'tuber condition' is used in this discussion, it means the degree of hydration of the tuber -- another way to say this is the crispness or lack of crispness of the tuber. There are at least 4 cultural practices that influence tuber condition. These are 1) fertility, 2) irrigation, 3) pest control, and 4) vine control. All of these cultural practices influence either tuber maturity or tuber turgidity (crispness).

In order to understand the tuber condition/bruise damage interaction, it is important to understand tuber bruising. There are really at least two specific and distinct types of tuber damage that result from a bruising force. Blackspots appear as discolored areas beneath the skin and are not visible until a potato is peeled. The discoloration is not present so that it can be observed easily until 24 to 48 hours after the injury occurs. A blackspot bruise usually does not penetrate very deeply into the tuber nor does it rupture the potato skin.

Shatter bruises appear as a break or breaks in the tuber surface with the flesh usually discoloring at the edges. Unlike blackspot, shatter bruises may penetrate deeply into the tuber. Shatter bruises can usually be detected by careful visual observation of the tubers.

Crisp or dehydrated potatoes are very susceptible to shatter bruise (Figure 1) and are quite resistent to blackspot (Figure 2). On the other hand, limp or dehydrated potatoes are resistant to shatter bruise (Figure 1) and highly susceptible to blackspot (Figure 2). At a given temperature there is a tuber hydration level at which bruise damage -- total bruise (both blackspot and shatter bruise) is at a minimum. In Figure 3, that point at 45-50^{O} F would be where the two lines cross near the center. Figure 4 shows the effect of all bruise (total of shatter and blackspot) at 45-50^{O} F. Note that this figure is a revision of Figure 3 showing not the two components of bruise -- shatter and blackspot independently, but the total harvest damage.

When the tuber temperature changes, the amount of shatter bruise or blackspot which results from a bruise force changes; therefore, total damage changes as is shown in Figure 5 for 55-60^{O} F tubers (compare Figure 4 with Figure 5).

Several differences should be noted between Figure 4 (45-50° F) and Figure 5 (55-60° F). First and most obvious, is that there is an overall decrease in amount of damage. The damage curve shifts downward. Second, the low damage point shifts to the right of the graph (compare point at dashed line on both figures). This means that potatoes which were in the lowest damage condition when harvested at 45-50° F would not be those in the lowest damage condition at 55-60° F.

If we look at tuber damage at an even higher temperature (Figure 6) it can be seen that the total damage level is even lower and the minimum damage point is also further to the right or at a different tuber condition than at either of the cooler tuber temperatures.

To fully understand the effect of both tuber condition and temperature on total bruise we need to look at the three total damage curves at each temperature on one graph (Figure 7). Note that at 65-70° the point of lowest total damage is to the extreme right of the graph -- potatoes quite crisp (point A). If the temperature drops during harvest from 65-70° to 55-60° the amount of damage increases and the point of lowest damage -- in terms of tuber condition, shifts to the left -- less turgid potatoes (point C). A further drop in temperature results in another increase in damage at all conditions, but also shifts the condition of least damage further toward dehydrated potatoes (below point D). One thing this means, which most potato growers are acquainted with, is that shatter bruise is the primary bruise problem with cold potatoes and blackspot is the main type of bruise when warm potatoes are harvested.

How can these graphs be used to understand and/or explain some of the potato harvest damage problems encountered by growers? Let's start with a harvest during the early fall when tuber temperatures are warm -- 65° or above. The lowest damage condition for the tubers is reasonably crisp (dashed line, Figure 7, point A). If the tubers are in the best condition for low-damage harvest and the temperature drops -- say to 50° (solid line, Figure 7, point B) the overall harvest damage is going to increase, since the tubers are in a susceptible condition for that temperature.

Another example -- assume the tubers are in the right condition for harvest at 55°, that is, in best condition for low-damage harvest (dash/dot line, Figure 7, point C). Irrigation has been discontinued so the labor force can be used in harvest and deliveries are not made over a weekend. In addition the temperature warms up to 65° F. Normally with an increase in temperature, a decrease in bruise would be expected, but with the lack of irrigation over the period of time of the warming tuber temperatures, the tubers become more dehydrated (dashed line, Figure 7, point D) and the result is an increase in total tuber damage and a bewildered harvester operator.

The biggest weakness in all this is that at this point we do not have any way to identify the condition of the tubers along the bottom line of these graphs except at the extreme ends -- either dehydrated or hydrated. There is work going on to try to identify and/or develop a management tool with which to do this but at this time none is available.

In the meantime, it's important to realize that HARVESTER DAMAGE DUE TO IMPROPER MACHINE ADJUSTMENT IS IN ADDITION TO DAMAGE RESULTING FROM IMPROPER TUBER CONDITION AND TUBER TEMPERATURE. In other words, proper harvester operation can reduce tuber damage regardless of tuber condition and temperature. Where tuber condition indicates possible high level of damage, proper harvester operation is extremely critical (Figure 8).

Since we know little about the manipulation of tuber condition and can't manage potatoes to move them from the susceptible line in Figure 8 to the resistant one, and we know considerable about proper harvester operation, management must be focused on moving damage downward by moving along the operation line (bottom line of Figure 8).

Figure 1.

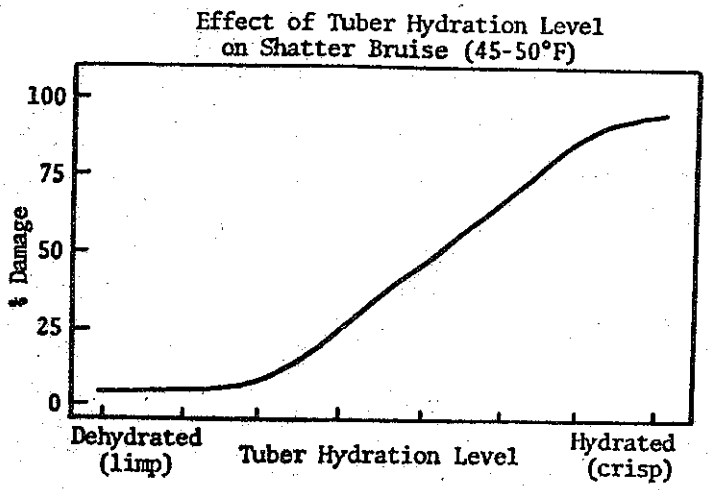

Figure 2.

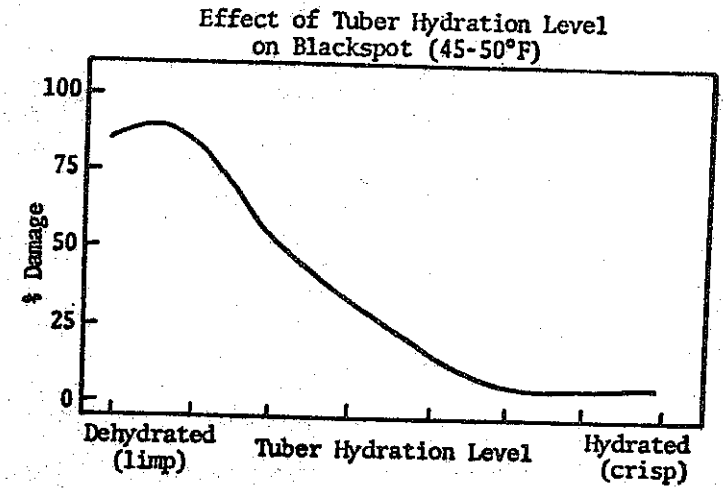

Figure 3.

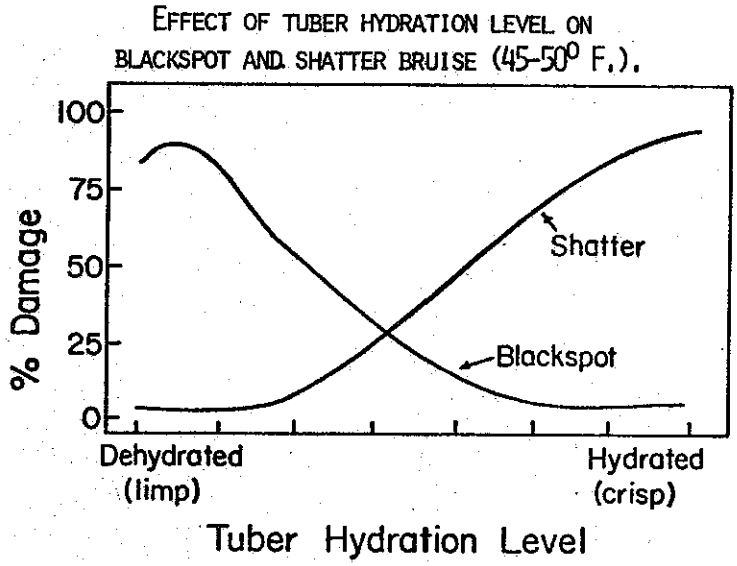

Figure 4.

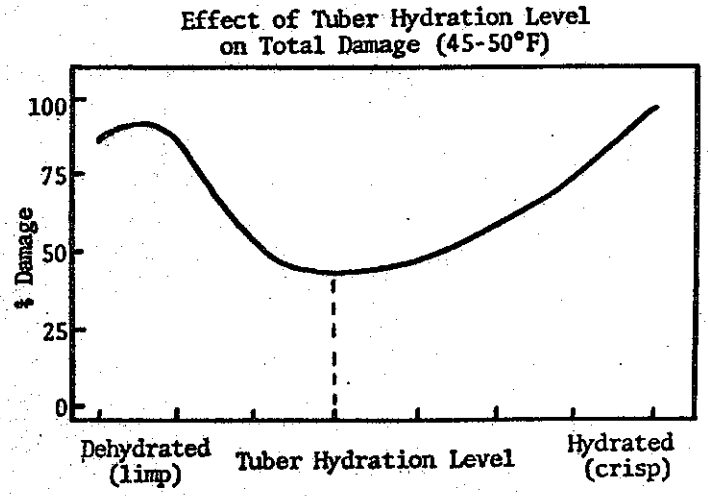

Figure 5.

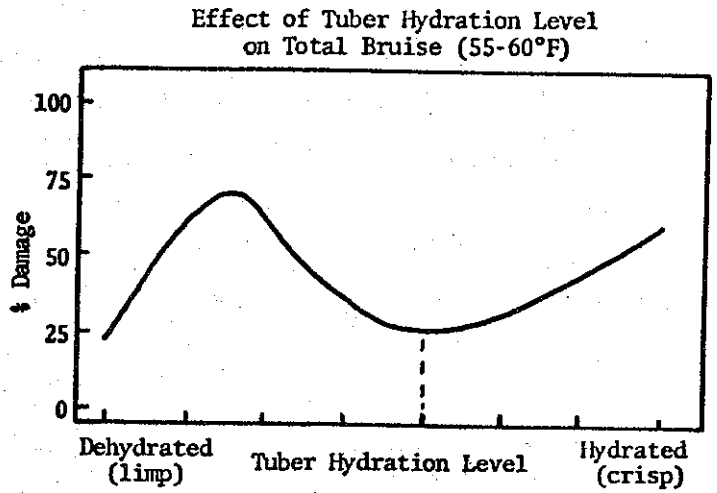

Figure 6.

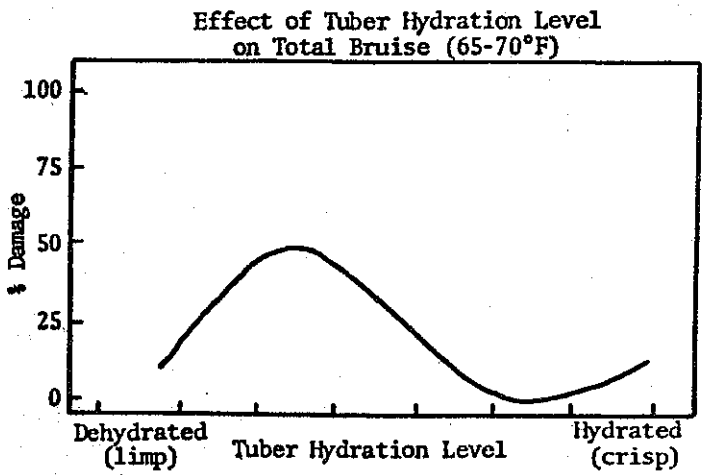

Figure 7.

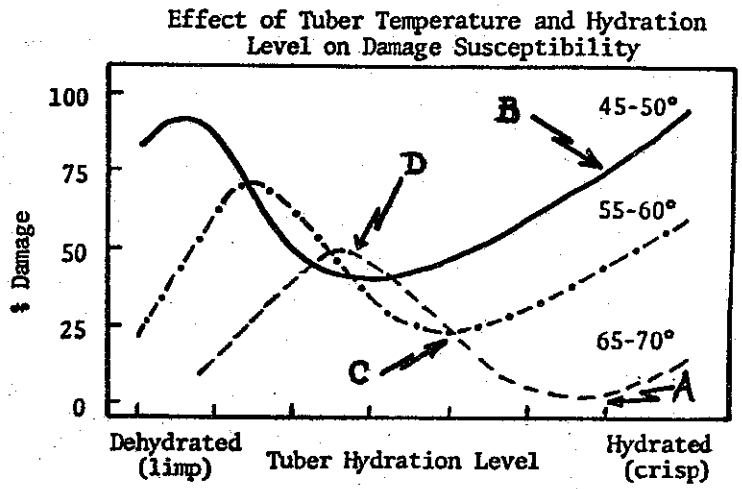

Figure 8.