CONDITIONING POTATOES FOR HARVEST [1]

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A major concern to potato growers and processors is tuber damage during the harvesting and handling operations. The economic impact of tuber damage is substantial from reduced gross income from potatoes due to lower prices, increased weight loss, rot development during storage, and increased processing costs. Tuber bruising influences the design of harvesting and handling equipment to reduce the amount of bruising and the manipulation of the storage environment to insure wound healing of potato tubers.

Four factors which are known to determine the total amount of damage during harvest are soil condition, temperature, harvester operation, and tuber condition. The influence of each factor singly, as well as the interrelationships of all four, must be understood to minimize tuber damage.

The ideal soil condition is one that is medium to light texture with some moisture but with little compaction. Air and soil temperature at harvest affect tuber temperature and thereby influence the total amount of damage. Research by Washington State University personnel has provided valuable information concerning proper harvester operation. This information has been presented in previous Washington State Potato Conference Proceedings. In general, results have shown that damage from improper harvester operation is more severe when potatoes are bruise-susceptible than when they are resistant to bruising and is in addition to damage arising from improper tuber condition. Therefore, harvester operation is extremely important when other factors are not favorable. Recent studies at WSU indicate that change in harvester design will not be very effective until the operation of current machines to accomplish low harvest damage is utilized to its fullest.

The studies indicate that, when all operational factors are optimal, different levels of tuber damage will result because of differences in tuber condition. The relationship between tuber condition and bruise susceptibility has not been adequately determined, nor has it been possible to develop any measure to identify when tubers are in the least damage-susceptible condition. A combination of the physical, physiological, and chemical status of a potato tuber largely determines its susceptibility to bruise damage, tendency to wound heal after injury, and sugar accumulation, weight loss and rot development in storage. The physiological condition is affected by growing conditions and cultural practices plus temperature and turgidity of tubers. The relationship of tuber condition and bruise susceptibility is confounded due to the tremendous variations among individual tubers--tubers in a given field, or even the same hill, are not in the same condition.

Cultural practices which are known to influence tuber condition include fertility level, irrigation, pest control practices, and vine killing. Experimental efforts have been undertaken to further study the main effects and the interactions of these cultural practices as related to damage susceptibility of potato tubers. Also included in the study are time of harvest and tuber flesh temperature. The different treatment variables are listed in Table 1.

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Table 1. List of treatment variables included in the study on tuber conditioning for harvest. The dates given are for 1974.

	Number of treatments	Treatment Variable	Treatment description
A.	4	Fertility Level (Nitrogen)	200, 300, 400, 500 lbs N/acre (400 lbs/A P_2O_5 and K_2O plus 5 lb/A Zn constant)
B.	2	Moisture level	"Dry": irrigation stopped 2 weeks before first harvest. (Sept. 12)
			"Wet": irrigation not stopped until after second harvest. (Oct. 10)
C.	2	Vine kill	Check vs Vine kill (Dinitro) one week before first harvest.
		[16 treatment combinations x 6 replications = 96 plots]	
D.	4	Harvest date	Every two weeks beginning Sept. 25 (140 to 180 day growing season)
E.	2	Tuber flesh temperature	70° and 50°F
F.	2	Tuber bruise	Stem and bud end (sample of 10 tubers each bruised at 3 different places on both ends)

Measurements were obtained on the following parameters: vine condition, climatological data, soil moisture, yield, grade, and specific gravity at harvest time, percentage and intensity of discoloration from blackspot and shatter bruise damage; internal disorders such as brown center, hollow heart, stem end and vascular discoloration; sugar accumulation; and wound healing tendencies. Tubers were bruised by impact of a 100 gram plug from a height of 24 inches. Discoloration was allowed to develop for 24 hours at 70°F, at which time the bruised areas were peeled for damage measurements. The data are presently being summarized and analyzed. Positive conclusions cannot be presented at this time. The following should therefore be considered only as preliminary information.

The general effect of the cultural practices is assumed to be on tuber hydration--the crispness of the tubers. Hydrated, or crisp, tubers are normally more susceptible to shatter bruise but resistant to blackspot, whereas limp (dehydrated) tubers are resistant to shatter bruise. The dehydrated potatoes, however, are more susceptible to blackspot. The relative amounts of both types of bruise damage changes as the level of tuber hydration changes (Fig. 1). In addition, the flesh temperature of tubers at the time of impact influences the amount of both types of damage (Fig. 2), however, the temperature effect has not been consistent throughout the studies. The point of lowest total damage is at a different level of hydration depending on tuber temperature.

Generally, tuber damage susceptibility increases as temperature of the tuber decreases. For example, at 65-70°F, crisp potatoes have a relatively low amount of total damage; at 45-50°F, total damage is high. Conversely, potatoes that show the lowest damage at 45-50°F (dehydrated) are in a condition for the highest damage at temperatures of 65-70°F.

Figure 1. The effect of tuber hydration level on blackspot and shatter bruise (45-50°F). (6).

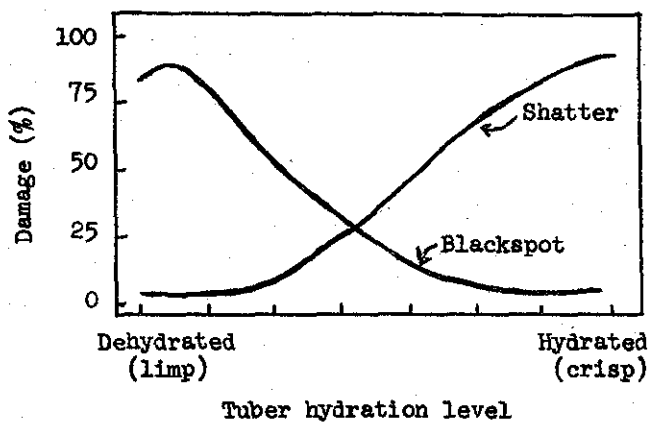
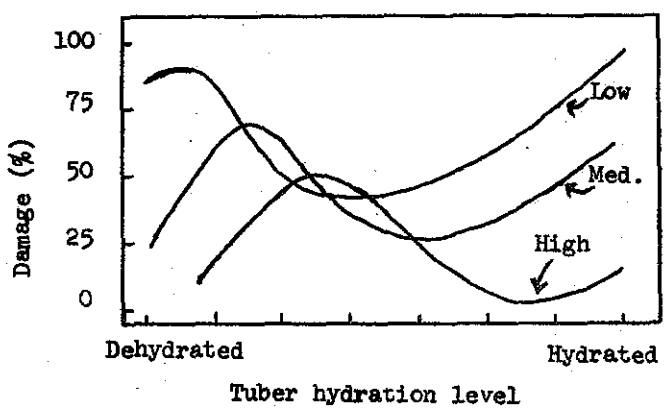


Figure 2. The effect of tuber temperature and hydration level on damage susceptibility (6).



Normally, most tubers are resistant to blackspot when flesh temperature is at 70°F. Some tubers are more resistant to blackspot at lower temperatures but may be more susceptible to shatter bruise if turgor level is high. When tuber flesh temperature is near 70°F, maximum turgor is desirable to minimize blackspot. A high turgor level increases the tendency of bruised tissue to heal even at relative humidities as low as 30 percent. When tuber flesh temperature is near 40°F the flesh tends to shatter if tubers are too crisp. Anomylous tubers are always found, however. Some tubers may be more susceptible to blackspot at low flesh temperatures than at high flesh temperature and some tubers are resistant to shattering when bruised at low flesh temperature.

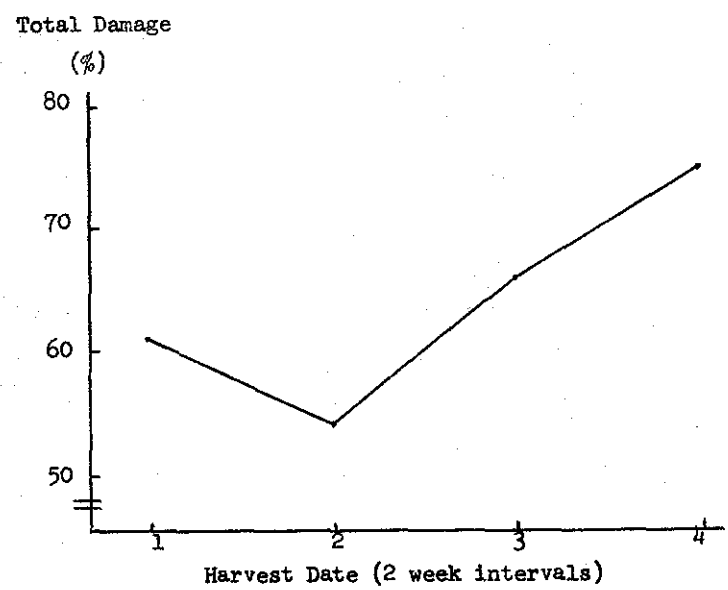
From the above discussion it is obvious that to minimize damage at harvest and during handling, the best tuber condition is a combination of the optimum tuber turgidity level and tuber flesh temperature. The many interactions and main effects of the different cultural practices will

hopefully identify these conditions. One interesting observation from the 1974 study is the change in total damage (blackspot plus shatter bruise) as harvest was delayed (Fig. 3). This observation agrees with other reports; however, there are other conflicting reports on amount of damage in relation to time of harvest. This question definitely merits further study and additional data for our conditions in the Columbia Basin.

Other preliminary data obtained in Dr. Iritani's lab indicates that reducing sugar accumulation in storage was higher in those tubers harvested at later dates. This observation will also require further study.

This discussion has attempted to illustrate some of the many variables involved in the concept of tuber condition, one of the factors determining amount of tuber damage at harvest, and to point out the experimental approach to measure effects of various practices influencing this problem. Reduction of potato tuber damage continues to be a concern in the production and harvest of high quality potatoes. Being able to determine the proper tuber condition for harvest will greatly assist this objective.

Figure 3. The total amount of damage (blackspot + shatter bruise) as related to time of harvest. Average for 1973 and 1974 data. Total damage is a measure of the experimental bruising of tubers at Pullman after harvest.



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