

Colorado Potato Administrative Committee, Area II
Proposals for 2010-2011

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Potato Postharvest Physiology
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Title: Pressure bruise management, prediction and control.

Most relevant funding source: CPAC

Nature, scope, objectives of proposed research:

Pressure bruise is primarily caused by the weight of the pile but many physiological and genetic factors play a role in affecting the structure of tubers on the bottom portion of the bin. Pressure bruise limits the storage duration of potato and reduces grade the longer potatoes are stored. Pressure bruise can result in quality losses of 20 to 30% in long term storage potatoes, yet little is known about factors influencing this condition. Some cultivars are more prone to this condition. In addition to that there are a number of pre-harvest and post-harvest factors that can make this condition worse.

Pressure bruise is a complex process that involves physical damage to cells on the surface of the tuber and discoloration of internal tissues. These flattened areas of the potato exhibit crushed periderm and underlying cells when viewed with a microscope (Lulai et al., 1996). Turgor pressure is the counteractive force within the cells of potato tubers that helps to prevent the development of pressure bruise. Cells create turgor pressure by increasing water intake into the cell, thereby increasing outward force on the cell membranes and walls. Plants regulate turgor pressure during growth by increasing the osmotic potential within cells. Turgor pressure allows cell elongation leading to shoot and root expansion during plant growth. For example, turgor pressure in roots creates a penetration force of up to 1 MPa (145 psi). How that force corresponds to resistance to pressure bruise is unknown. Correspondingly, how turgor pressure, hydration level, and water potential of tuber tissue relate to resistance to pressure bruise is not known either. Tissues beneath pressure flattened areas turned black to gray within 5 days after removal from storage. The black coloration results from increased levels of melanin, a characteristic commonly associated with black-spot bruise. The delay in bruise formation has been hypothesized to be related to limited oxygen availability under the pressure-flattened areas.

Objectives:

1. Studying the correlation between early tuber weight loss and susceptibility of tubers to pressure bruise during long-term storage
2. Studying the cultivar differences in pressure bruise susceptibility
3. Role of DMN in pressure bruise susceptibility

Methods and facilities, including resource needs at the SLVRC:

- Samples of standard cultivars will be placed on top of the pile in the commercial storage bin. Shrink will be assessed every month for the first 5 weeks of storage, and then every other week over the next 40 weeks or until the storage is emptied. Shrink will be determined by weighing each sample prior to being placed in storage and after removal from storage. These data will then be correlated to pressure bruise incidence of cultivars. During the bin emptying, 180 tubers will be collected randomly and pressure bruises per tuber were recorded. We will also collect data from storage managers on the extent pressure bruise in those bins based on USDA inspector's reports and other data.
- Pressure bruise susceptibility of different cultivars grown in Colorado will be studied using crib experiments. These tubers will be subjected to 10 foot pile height pressure and samples will be analyzed after 3, 6 and 9 months of storage.
- How DMN plays a role in minimizing the pressure bruise is of immense interest. Number of growers in the valley is applying this compound once or twice during the storage season. Reports on benefits of using this product in potato storage are varying greatly. Experimentally proving the role of DMN in minimizing the pressure bruise in commercial storage conditions will be a challenging task considering the number of factors involved. Claims were made that DMN reduces respiration there by it reduces shrink and pressure bruise. Using recently developed crib experiment we can test the efficacy of DMN treatment on pressure bruise susceptibility.

Relationship of proposed research to overall problem for potato growers:

This is the number one problem faced by commercial storages in the valley. Understanding the mechanism of pressure bruise susceptibility will greatly help the industry in reducing the losses.

Potential for results to leverage additional outside funding:

This year USDA –ARS funded our pressure bruise project submitted in collaboration with University of Wisconsin.

I will continue to further explore the possibility getting money from chemical companies.

Timeline and expected short term (1 yr) and longer term (3-5 yrs) outcomes:

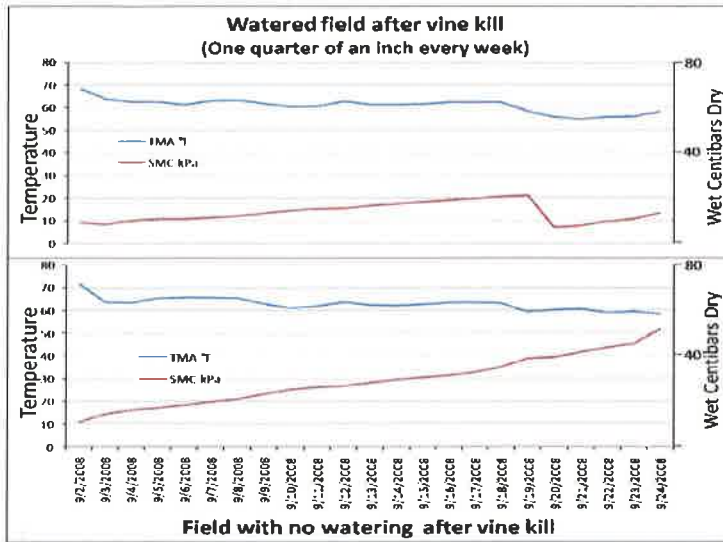
First Year: Commercial storage experiments on relation between initial weight loss and pressure bruise susceptibility was initiated. Lab based experiments on predicting pressure bruise in potato tubers will be conducted.

Long term (3-5 years): Lab based and commercial storage studies will help in understanding physiological and genetic basis for pressure bruise susceptibility. This understanding will enable us to devise specific strategies in potato pre and postharvest operations.

Title: Relationship between soil moisture and tuber quality after vine kill.

Nature, scope, objectives of proposed research

During potato crop growth, turgor pressure within tuber tissues is influenced by environmental conditions. For example, as soils become drier the water potential of tuber tissue decreases as transpiration exceeds the rate of water uptake. However, we do not know how well plants or



will be subjected to 10 foot pile height pressure and samples will be analyzed after 3, 6 and 9 months of storage.

Relationship of proposed research to overall problem for potato growers

This is the number one problem faced by commercial storages in the valley. Understanding the soil moisture and tuber hydration levels will greatly help in maintaining the quality in storage.

Potential for results to leverage additional outside funding

Preliminary results obtained with this grant money will greatly help in preparing proposals to get state and federal funding.

Title: Quality loss during storage, including quantification of cullage and shrink in the SLV.

Nature, scope, objectives of proposed research:

Huge losses are incurred by the potato industry due to diseases in the potato storage houses. These diseases are caused by both bacterial and fungal pathogens. The most devastating are soft rot (*Erwinia cartovora* ssp *carotovora*), black leg (*Erwinia cartovora* ssp *atroseptica*), dry rot (*Fusarium sambucinum*), ring rot (*Clavibacter michiganensis* ssp. *sepedonicus*), late blight (*Phytophthora infestans*), pink rot (*Phytophthora erythroseptica*), and leak (*Pythium ultimum*). Potentially, all the harvest operations involve some amount of bruising and wounding of the tubers which provides avenues for pathogen infection. Pathogens thrive in the storage with high humidity and other favorable conditions. Currently, visual inspection, bad odors and temperature sensors are the only means of detection for disease. Existing temperature and other sensors can detect problems only after symptoms appear and damage has been taken place.

Weather patterns during harvest time significantly affect the quality of tubers coming into storage. Early season frost and leaving little time for growers to harvest in ideal conditions are the main reasons for tuber bruising leading to infection and subsequent problems in storage.

Objectives:

Estimating losses due to disease and shrink during harvest, storage and pack out operations

Procedure:

Losses will be estimated in the grower cooperators fields and storages. Efforts will be made to document losses due to specific diseases and other reasons including equipment handling and transportation by visiting grower operations. A survey document will be sent to growers for their input. Federal and state inspectors will be requested for their evaluation during shipping.

Relationship of proposed research to overall problem for potato growers:

Estimating losses due to diseases and other storage disorders is necessary to measure importance of postharvest storage management. It will greatly help the industry in devising strategies to reduce losses.

Title: Storage guidelines for new cultivars

Nature, scope, objectives of proposed research:

Storage guidelines for new cultivars, Canela Russet, Rio Grande Russet, and Mesa Russet

Canela Russet and Rio Grande Russet are the popular cultivars grown in the valley. Management information on storage will further benefit growers and help increase their returns on these two cultivars. Both these cultivars come from Colorado Potato Breeding program. Each cultivar is unique and different cultivars require new management and storage practices.

Canela Russet gained popularity among growers for its size and shape and long dormancy period. But this cultivar is daunted by storage disorders and some negative characteristics such as lower stem number and longer dormancy. The objective of this research is to find ideal storage regime for Canela Russet.

The dormancy period of Rio Grande Russet is shorter than Russet Norkotah and Russet Nugget. It is around 85 days when stored at 45 °F. The objective of this project is to find optimum harvest conditions to lengthen dormancy without any storage disorders. Optimum storage conditions will be studied by manipulating storage temperature and humidity. Rio Grande shows sensitivity to storage temperature. Reports indicate when stored at low temperatures Rio Grande tubers showed discoloration (blackening). This may be due to expression of polyphenol oxidase enzyme expression. Temperature sensitivity to this phenomenon will be explored.

Methods and facilities, including resource needs at the SLVRC:

Canela Russet and Rio Grande Russet will be harvested at different days after planting to get different levels of maturity (early, optimum, and late). These tubers will be tested for their storability and dormancy at different temperature and humidity conditions (38 -41°F). Tubers will be also evaluated for storage disorders periodically during storage. Tubers, after five months of storage, will be regularly evaluated for sprouting. Seed will be planted and tested for emergence, stem number, tuber size and yield. Canela Russet will be treated with different chemicals to increase stem numbers.

Relationship of proposed research to overall problem for potato growers

In the event of disease issues associated with Norkotah cultivars, both Rio Grande and Canela Russet cultivars are the main russets showed increase in acreage. Information on storage practices of Rio Grande and Canela Russet cultivars will enhance profitability of the potato industry in the valley.

Timeline and expected short term (1 yr) and longer term (3-5 yrs) outcomes

First year: Rio Grande and Canela Russet tubers will be harvested from Research station farm and placed at different temperature conditions, to test blackening in case of Rio Grande Russet. Similarly tubers from both cultivars will be tested for bruise and physiological disorders with respect to different management profiles.

2 & 3 years: Any significant outcomes of first year study will be expanded further.

Title: *An Integrated Approach to Improving Colorado Russet Potato Quality by Understanding and Reducing Skin Netting Loss from Russet Potatoes.*

Nature, scope, objectives of proposed research

Russet potatoes sold on the fresh market have an established image in the minds of consumers as having a uniform oblong shape and uniform brown external color. During the current harvest season some San Luis Valley potato growers have experienced poor russet netting development or the development of russeting that is easily and unevenly removed during routine harvest and shipping operations. Poor development of the russet skin netting of potatoes can lead to appearance and quality problems resulting in potatoes that appear white with brown patches, or appear as lower quality white or yellow potatoes. This defect results in lower returns to growers, shippers, and retailers who may have loads rejected or be paid lower prices for the crop. Loss of russet netting can lead to quality problems from increased moisture loss and increased visual appearance of defects such as external bruises, small cracks, or minor harvest damage. Prolonged appearance and quality problems may create a negative reputation for Colorado grown russet potatoes compared to other growing areas.

Causes of russet netting loss are not well understood. Previous research has examined soil temperature, soil moisture, and soil chemistry issues such as acidity or salinity as potential causes for poor development of russeting. Colorado grown potatoes may be losing russet netting in response to other factors as well that may result from local growing practices. It is the goal of the project to understand local causes of netting loss and develop economically viable strategies to reduce the occurrence and severity of the problem.

Relationship of proposed research to overall problem for potato growers

Through improvement in the appearance and quality of russet potatoes, growers and distributors of fresh market potatoes will be able to offer better quality to their customers and receive better prices for their crop. The improved appearance and quality of the potatoes can maintain or improve the reputation of Colorado grown potatoes as viewed by large retailers and consumers.

The overall goals of the project are to 1.) to improve our understanding of factors related to poor development or loss of russet skin netting, and 2.) develop economically viable strategies to reduce the occurrence or severity of russet netting loss. The goals will be measured by evaluating whether there have been significant gains in the understanding of the problem and if potential solutions can be proven to reduce the losses caused by the defect. Success will also be determined by effective presentation of this information to the Colorado potato industry.

Potential for results to leverage additional outside funding

Preliminary results obtained with this grant money will greatly help in preparing proposals to get state and federal funding mainly national potato council –ARS grants.

Detailed annual budget (personnel, materials and supplies, travel, equipment, services) and a budget justification.

Requested funding for 2010:	\$44,500.00
Research Associate (50%):	\$20,000.00
Temporary Labor:	\$2,500.00
Equipment and laboratory supplies:	\$10,000.00
Chemicals Supplies and Services:	\$10,000.00
Travel:	\$2,000.00