2007 Proposal to the Colorado Potato Administrative Committee, Area II

Title: Controlling diseases in potato storage by exploiting induced resistance in different potato cultivars.

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Aim: The objectives of this project are to characterize potato cultivar differences in host defense gene expression and resistance to storage pathogens, with particular emphasis on *Phytophthora erythroseptica* and *Erwinia carotovara*. A combination of laboratory and field studies are proposed in this collaborative research to assess the efficacy of various treatments to up-regulate defense genes in various potato cultivars and provide a tool for farmers to suppress losses to disease during potato storage.

Summary of problem: Plants possess a variety of mechanisms that can allow them to successfully co-exist with the presence of pathogenic organisms. One such interaction is based on the recognition of specific cues from avirulent pathogen races (avr gene products), which are described in the gene for gene resistance theory (Boch et al., 1998; Yu et al., 1998). Alternatively, horizontal resistance is dependent upon multiple gene products and pathways that may be triggered by the invading organism or its release of an appropriate chemical cue. This general phenomenon is known as systemic acquired resistance (SAR). The general responses of SAR may vary with plant species but includes callose deposition for cell wall reinforcement (Vleeshowers et al., 2000), synthesis of phytoalexins (Kombrink et al., 1991), defense genes including the pathogenesis-related proteins (Van Loon and Van Strien, 1999) and the generation of reactive oxygen species such as hydrogen peroxide (Bolwell et al., 1999). Recent work has shown that pre-treatment of plants with various chemical compounds can induce some or all of these processes rendering the plant less susceptible to future pathogenic attack from a variety of organisms. For example, pre-treatment with a fungal derived elicitor can increase resistance to future bacterial infection, and vice versa.

There has been increasing consumer concern about chemical residues on potato tubers as well as the risk of exposure of farm staff to fungicides. Current fungicide treatments do not fully control the range of economically significant diseases such as silver scurf, black dot, soft rot, gangrene and dry rot and involve significant input cost; whereas, treatment the up-regulate host defenses may offer broad-spectrum resistance to the various diseases affecting potato during storage.

Potato is the number one vegetable crop in the U.S. with a farm gate value (value directly from the field, prior to value-added processing) of $2.7 billion in 2003. Commercial losses to potato diseases during storage are estimated at 20% annually; however, even with the availability of fungicides, losses to late blight alone are in excess of $210 million annually. The development of treatments that induce plant defense responses and broad-spectrum resistance are critical in reducing disease losses during potato storage.

Research objectives:

1) Evaluate the efficacy of various treatments to induce SAR in different potato cultivars currently being considered for release by the Southwest potato breeding and cultivar development program.
2) Evaluate the longevity of the SAR response.
3) Evaluate the efficacy of various SAR-inducing treatments to control pathogen losses during potato storage.

Research Plan:

Objective 1: The induction of SAR genes will be evaluated in tubers of at least 12 different potato varieties following treatment with elicitors (control, *P. erythroseptica* elicitin, methyl jasmonate, and β-aminobutyric acid). Measured SAR responses will include H_2O_2 production and PR gene (PR1, PR5, PR10, and NtPRp27) expression. Briefly, tuber pieces will be placed in a 5 mL vial and incubated with 2 mL dH_2O for 4 hr for pre-treatment (Conrath et al. 2003). Following pre-treatment, elicitors will be added to a final concentration of 2 mM. At the appropriate time interval, an aliquot of the bathing solution will be removed for H_2O_2 analysis and tubers will be frozen with liquid nitrogen for future RNA extraction and RT-PCR to determine defense gene expression.

Objective 2: A subset of samples from objective 1 (e.g., best elicitor treatment and four most responsive potato varieties) will be selected to determine the longevity of the SAR response. For example, after elicitor treatments, H_2O_2 and defense gene expression will be monitored 3, 7, 14, and 21 days after treatment.

Objective 3: Freshly harvested potatoes with or without fungicide treatments along with controls will be sprayed with elicitors at different concentrations during curing process. After treatment with elicitors, potatoes will be sprayed or inoculated with the fungal pathogen, *Phytophthora erythroseptica,* or common bacterial pathogen, *Erwinia carotovara*, to evaluate induced resistance and disease development. Sprayed and inoculated potatoes will be kept in containers supplied with constant humid compressed air, stored at different temperatures. Potatoes will be scored based on the severity of symptoms during 3, 6 and 12 weeks storage period.

Total Budget:

ARS		
Manter	**$18,000**	SAR gene expression and H_2O_2 production
CSU (cooperative agreement)		
Jayanty	**$15,000**	Storage chamber set-up and sampling
Davidson	**$7,500**	Inoculation and disease assessments
Total	**$40,500**	

References

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