SUMMARY RESEARCH PROGRESS REPORT FOR 1997 AND RESEARCH PROPOSAL FOR 1998

Submitted to SLV Research Center Committee and the Colorado Potato Administrative Committee (Area II)

TITLE: **Characterizing and Overcoming Dormancy in Potato Minitubers**

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PROJECT JUSTIFICATION: This proposal is based upon a need to better understand mechanisms which impart postharvest dormancy in minitubers, and to develop well-defined methods to overcome dormancy. Minituber producers and their customers have encountered problems when prolonged dormancy results in sporadic and unpredictable emergence. Recent research with normal tubers has shown that dormancy is cultivar specific, it is prolonged by exposure to low temperature, and it can be defined quantitatively in terms of storage temperature and duration. We propose to apply similar principles to address dormancy problems with minitubers.

To the best of our knowledge, quantitative temperature requirements to maintain, or overcome, dormancy have not been reported for most modern potato cultivars and especially not for minitubers. Apparently, various chemical dormancy breaking agents have been tried on minitubers, but with little consistent success. This might be expected if there is a strong interaction with temperature and dormancy status. It would thus be essential to first characterize the role of temperature then optimize the potential use of growth regulating chemicals if temperature treatments alone are insufficient.

PROJECT STATUS: The Fourier Transform Identification research, funded in previous years, has been completed and is now being analyzed for manuscript submission. This proposal is for a new project. The following preliminary data on dormancy with field tubers is provided to support the objectives.

(a) Storage temperature and duration. Dormancy of six cultivars representing short (AC83064-6, CO85026-4), intermediate (Russet Norkotah, Russet Nugget), and long (Nooksack, Russet Burbank) dormancy characteristics was studied for five storage temperatures (4, 8, 12, 16, 20°C). Storage time required to produce 50% bud break, at 20°C, varied from 35 days for the early cultivars to 70 days for the long dormancy cultivars. At 8°C, dormancy ranged from 62 to more than 110 days depending on the cultivar.

(b) Alpha galactosidase, an enzyme known to become most active when seeds break down stored products during germination, may also be related to dormancy in potato tubers. In an effort to understand the nature of dormancy, a rapid and simple direct assay for detection of α-galactosidase enzyme activity in plant tissues, including potato buds has been developed. Preliminary evidence shows activity in potato buds, which is lower in dormant buds than in non-dormant buds and sprouting buds. Cultivars with short dormancy have higher ∝galactosidase activity at warm temperatures than cultivars with longer dormancy characteristics. Thus this assay should have potential to provide a rapid indicator of dormancy status in minitubers as well.

SIGNIFICANT ACCOMPLISHMENTS FOR 1997: Twenty eight new minituber entries were prepared and analyzed. Each entry was correctly identified when tested as an unknown against the entire minituber library. Spectra have been produced and documented for each entry. The results are consistent with previous years' work. Twelve peaks appear at constant wave numbers in all cultivars and are considered specific for potato, while an additional 10 to 12 peaks vary in position depending upon the cultivar. The latter are used to identify entries.

OBJECTIVES FOR 1998:

1. **To quantify storage temperatures required to break dormancy in selected cultivars of potato minitubers.**
2. **To determine if a rapid assay for α-galactosidase can be used to characterize dormancy in potato minitubers.**
3. **To test temperature manipulation as a means of breaking dormancy including: alternating daily high/low temperatures; sub-lethal heat shock; sub-lethal cold shock and constant high temperature regimes.**

1. **Dormancy.** Freshly harvested minitubers will be purchased from Colorado growers and stored at the following constant temperatures: 4C (39F), 8C (46F), 12C (53F), 16C (60F), 20C (68F)±1C. At weekly intervals minitubers from each storage temperature will be placed at 20C . Shoot emergence will be used to assess end of dormancy for each temperature x clone combination. Summation of storage temperature hours will be used to characterize each clone.

2. α-Galactosidase assay. The substrate for this newly developed assay consists of 3.0ml 0.8% agar containing 2.5mM p-nitrophenyl-∝-D-galactopyranoside (PNPG) prepared in colorimetric tubes. Bud sections (5mm x 2.5mm disks) are removed from clean tubers with a cork borer, weighed, dipped in 70% ethanol, and placed on the media. The action of ∝-galactosidase diffusing from the disk cleaves terminal galactose moieties from complex carbohydrates, leaving p-nitrophenylpyranoside (PNP) which absorbs at 400nm and can be read directly in each tube. This permits time course analysis with large sample numbers at specific controlled temperatures and desired frequency for data collection. Absorption data are normalized for sample weight. Enzyme activity will be compared to dormancy data to test validity of the hypothesis that this assay can be used as rapid screen for tuber bud dormancy.

3. Temperature manipulation as a means of breaking dormancy including: alternating daily high/low temperatures; sub-lethal heat shock; sub-lethal cold shock and constant high temperature regimes.

Dormancy in woody plant buds can sometimes be broken following exposure to a sub-lethal temperature stress (personal observation). We plan to first determine lethal temperatures for both cold and heat, then expose minitubers to extremes just below the lethal level and test for emergence from bud dormancy. If successful this would provide a quick and convenient method to break dormancy. Others have observed that alternating warm and cool conditions accelerate emergence from dormancy similar to emergence from seed dormancy, thus this method should also be tested.

FUNDING REQUEST:

1997 Allocation: $5,000

1998 Request:

1.	Purchase of minitubers	$ 500
2.	Consumable supplies, PNPG ($42./gm), agar, spectrophotometric tubes, ($44./doz.), GC, HPLC gases	1,200
3.	Travel, San Luis Valley and Fort Collins ($150/trip x 4)	600
4.	Student hourly	4,200
	Total	$6,500

Preliminary research referred to in this proposal has been conducted by Chang Yong Park, a new graduate student supported by the Korean government. He plans to complete his studies on dormancy of normal sized tubers and return in May 1999. Thus funds are requested for part-time student assistance to work on this project.