

## ALTERNATIVE SPROUT INHIBITORS TO BE USED ALONE OR IN COMBINATION WITH CIPC

by

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### Introduction:

Several naturally occurring compounds have shown activity for sprout inhibition or suppression when applied to potatoes in storage. Many of these compounds have not been tested or utilized in full-scale storage evaluations, and information on their efficacy may be limited. Registration for use or labeling of these compounds as potato sprout suppressants is either not available or pending. However, interest in some of these alternative methods of sprout control in storage has increased in part due to pending federal regulations implied in the Food Quality Protection Act of 1996. Today, the U.S. potato industry has only a few options for post-harvest control of sprouting in stored potatoes. These options include the use of registered chemical suppressants (CIPC or chlorpropham and dimethylnaphthalene) or by using cold temperature storage.

### *Currently Registered Sprout Inhibitors*

Chlorpropham, or CIPC, is by far the most widely used sprout inhibitor in use today. It has been used successfully in the potato industry for over 40 years. A re-registration eligibility decision (RED) was recently issued (October 1996) by EPA for the use of chlorpropham on stored potatoes. This decision allows the continued use of CIPC as a post-harvest treatment for potatoes to control sprouting in storage. The registrants for CIPC spent over \$6,000,000 in the re-registration of this product.

Dimethylnaphthalene, DMN, has also received a registration for application to potatoes. This sprout suppressant may also be applied to stored potatoes with methods similar to those used for CIPC. DMN may require several applications to achieve the desired results. This product is more volatile than CIPC and consequently dissipates within the storage more rapidly. When the DMN residue on potato tubers becomes too low, normal sprout development will occur, thus requiring repeated applications to maintain sprout free conditions.

Maleic Hydrazide, or MH, is also registered for sprout control in storage but is not a post-harvest applied material. Maleic hydrazide is a cell division inhibitor that is applied to plants during the growing season. The growth regulator activity of MH is translocated to the developing tubers and suppresses sprout growth by limiting cell division in or near the eyes.

Carvone is a naturally occurring oil found in caraway seed. This oil fraction is applied to potatoes as an aerosol fog or as a volatile in the head space around stored potatoes.

Although this material is a post-harvest sprout suppressant, it is not registered for use in the United States. Use of carvone in Europe as an alternative to CIPC is increasing. This material is volatile, and multiple applications may be necessary for long term storage.

#### ***Other Potential Sprout Suppressants***

There are other materials that have sprout suppressant activity. The USDA-ARS potato lab in East Grand Forks, Minnesota, has identified methyl jasmonate or jasmonic acid as potential alternatives for sprout suppression in storage. Previous work at this lab had identified aromatic aldehydes and alcohols as potential sprout suppressants, and they recently patented the use of some aromatic acids as potential sprout inhibitors. Another U.S. patent allows the use of methylesters of rape oil for sprout suppression of potatoes in storage. Most of these materials can be applied as post-harvest chemicals to stored potatoes and achieve some degree of sprout control.

Jasmonates can be extracted from flowers of the jasmine family and in fact are fragrances used in various industries. As sprout inhibitors or suppressants they are unique in that at low residue concentrations they inhibit sprouting, yet at higher concentrations may actually stimulate sprout growth. Timing of application and concentrations of these materials that are effective in the commercial potato storages have not been totally determined. Continued research effort is needed to identify application techniques before these materials would have some interest to the potato industry.

Aromatic aldehydes and alcohols, including compounds such as thymol, benzaldehyde, salicylaldehyde, and cinnamaldehyde, have varying degrees of sprout suppression activity. Because these materials are highly volatile, the sprout suppression activity is usually related to the time and amount of the chemical that remains on the surface of the tubers or in the space surrounding the tubers. As volatilization reduces the concentration of these chemicals surrounding the tuber, they lose their ability to control sprouting. All of these compounds are naturally occurring and are present in cosmetics, flavorings, or in other commercial uses today. Theoretically, these types of sprout suppressants should be easier to register for use on stored tubers because they are generally regarded as safe (GRAS).

Diisopropylnaphthalene, or DIPN, is another naphthalene derivative that has received a patented use as a sprout suppressant for stored potatoes. Like DMN, DIPN can be applied to stored tubers as a thermal aerosol in a post-harvest treatment. Both of these naphthalene compounds were evaluated extensively at the Potato Storage Research facility in Kimberly, Idaho. Using commercially available products containing mixtures of isomers of these two compounds, potato sprout suppression for several months was achieved. DIPN appeared to be the better of the two naphthalenes for sprout suppression under conditions of that research evaluation. As indicated above for DMN, DIPN was more effective if applied twice during the storage season.

Essential oils, such as spearmint oil, peppermint oil or oils from seeds like carvone and canola oil, have potential uses for sprout suppression of potato tubers in storage. Several attempts to use these products for maintaining tubers sprout free in storage have been successful. Research at Kimberly has examined both spearmint and peppermint oil for post-harvest sprout control. Each of these oils when applied as an aerosol to sprouting potatoes stopped sprout development and caused some tip burning to existing sprouts. The suppression was maintained until the oils had dissipated or volatilized. Additional applications could be used to maintain the sprout free condition.

Some essential oils also have biosuppressant activity against some potato pathogens. In vitro studies where various concentrations of these oils were put into the growth medium in petri dishes containing actively growing microorganisms, suppression of growth or death of the pathogens occurred. At concentrations of 600 ppm peppermint oil in the media, growth of the potato pathogens *Erwinia caratovera* (soft rot), *Fusarium sambucinum* (dry rot), and *Helminthosporium solani* (silver scurf) were reduced or completely controlled. Of those sprout inhibitors evaluated at Kimberly, both essential oils, two naphthalene products, and several aromatic aldehydes expressed some antagonism to potato pathogens in culture. Suppression of inoculum levels on tuber surfaces would be expected from these results.

### **Application of Alternative Sprout Suppressants with CIPC**

Most alternative sprout inhibitors or suppressants were evaluated as individual treatments without using combinations of different materials. Experimental evaluations of these inhibitors in combinations with other treatments, such as CIPC, have only been partially studied. Usually, CIPC would be used as a "fall back" material should sprout suppression with alternatives not meet the needs of the storage manager. Remember, currently in the U.S. there are only two registered materials for post-harvest application to stored potatoes for sprout control, CIPC and DMN. As of January 1998, a label or use registration for DIPN in combination with CIPC had not yet been issued. The February 1995 DMN label does not allow for the use of CIPC on potatoes treated with DMN. The use of carvone for potato sprout suppression in storage is not available in the U.S.

### **Supporting Literature**

Vaughn, S. F. and G. F. Spencer. 1992. Aromatic aldehydes and alcohols as potato tuber sprout inhibitors. U.S. Patent # 5,129,951.

Vaughn, S. F. and G. F. Spencer. 1992. Inhibition of potato sprouting using volatile monoterpenes. U.S. Patent # 5,139,962.

Winklemann, H. H., G. Robl, and D. Henning. 1996. Sprout inhibition for potatoes (rape oil methylesters). U.S. Patent # 5,580,596.

Riggle, B. D. and R. K. Schafer. 1997. Sprout inhibition compositions comprising chlorpropham and substituted naphthalenes and methods of using same. U.S. Patent # 5,622,912.

D-1-4, Inc. February 1995. Label: 1,4SIGHT Potato Sprout Inhibitor. U.S. Environmental Protection Agency Registration No. 67727-1.