Potato Sprout Suppression from Clove Oil

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One of the newcomers to the potato sprout control sector of the industry is clove oil. The potato industry is already dominated by the highly effective sprout inhibitor, chlorpropham or CIPC, but availability of effective alternatives is needed. CIPC is a mitotic inhibitor which means it hinders sprout development by interfering with cell division. The mode of action of clove oil is completely different from CIPC by physically damaging the sensitive sprouting tissue (Figure 1). Since only the exposed sprout is damaged, new sprout development will not be inhibited. If long-term sprout control is desired, repeated applications will be required. Unlike potatoes treated with CIPC, judicious monitoring of sprout development is required when relying upon clove oil for sprout suppression.

Clove oil is distilled directly from the evergreen plant *Syzygium aromaticum* (L.). The plant is native to Indonesia but is now grown in several other countries such as Madagascar and Brazil. The active ingredient of clove oil is eugenol and other eugenol-based components in the distillate product. The products used in the potato industry are 100% naturally derived clove oil and are approved for organic use. Due to the chemistry and volatility of clove oil it can be applied with a thermal applicator and distributed throughout the storage similar to applications of CIPC. University of Idaho evaluated clove oil (Biox™ formulations) for sprout suppression for four years at the Kimberly Potato Storage Research Facility. A tremendous amount of data was generated, but the two most common questions we receive regarding the use of clove oil are (a) how effective is the sprout control, and (b) does it alter the taste of the potato or processed product? The first question has a complex answer dependent upon clove oil application rate, timing and method of application, frequency of applications, cultivar and storage management.

Applications of clove oil should be made when sprouts are peeping and preferably no longer than ½ inch in length. Depending upon cultivar, not all eyes on a potato sprout at the same time so carefully watch the sprouting behavior and time the application accordingly. One benefit of using clove oil for sprout control in storage is the ability to capitalize on the inherent dormancy of the cultivar. Applications are not made until the potato actually begins to sprout which is dependent upon cultivar, storage temperature, and growing season. For example, Russet Burbank stored at 42°F typically won't break dormancy for approximately 175 days compared to 130 days at 48°F.

Research results indicate clove oil rates between 30 to 90 ppm applied when sprout development occurs, or approximately at three to six week intervals, will provide adequate sprout control. This rate recommendation will vary with stage of sprout growth, cultivar and storage facility, and first consult the label of the clove oil product you are using prior to application. Delay in subsequent applications after initial treatment may result in greater sprout growth than if no product was applied. By properly and frequently applying clove oil, short and long-term sprout suppression can be achieved with different cultivars and storage temperatures (Table 1, Figure 2). Caution: it may be difficult to attain 100% sprout control and realize some sprout development may occur.

To answer the second most common question, professional taste test trials were conducted on baked potatoes either previously treated in storage with clove oil or CIPC. Potatoes were exposed to clove oil six times at rates ranging from 30 to 90 ppm prior to the taste test. No differences in baked potato color, texture, flavor or overall taste were detected between the CIPC treated and clove oil treated potatoes (Table 2). Even after multiple applications at high rates, these preliminary tests indicate treating potatoes with clove oil did not affect the potato taste of Russet Burbank potatoes.

Clove oil can be used effectively for potato sprout suppression but additional applications when sprout regrowth occurs will be required for long-term sprout suppression. Applications methods and rates need to be fine-tuned for individual growers, storage facilities, and cultivars. Cultivars need to be assessed on an individual basis for proper timing and frequency of application and, of course, that will also be dependent upon storage environment. Clove oil does not have the efficacy or mode of action as CIPC, but it does have ideal sprout suppressant properties for organic potatoes, potatoes destined into non-CIPC allowed markets, or to temporarily remove or blacken sprouts just prior to marketing.

Figure 1. Physically damaged (blackened) sprouts after a clove oil application.

Table 1. Sprout weight (g/tuber) for two cultivars after seven thermal aerosol applications of clove oil and six months of storage at 45°F. Values in the same column followed by the same letters are not significantly different (α=0.05).

	Russet Norkotah	**Chipeta**
Clove oil	9.9 A	2.8 A
Untreated	18.7 B	4.1 B

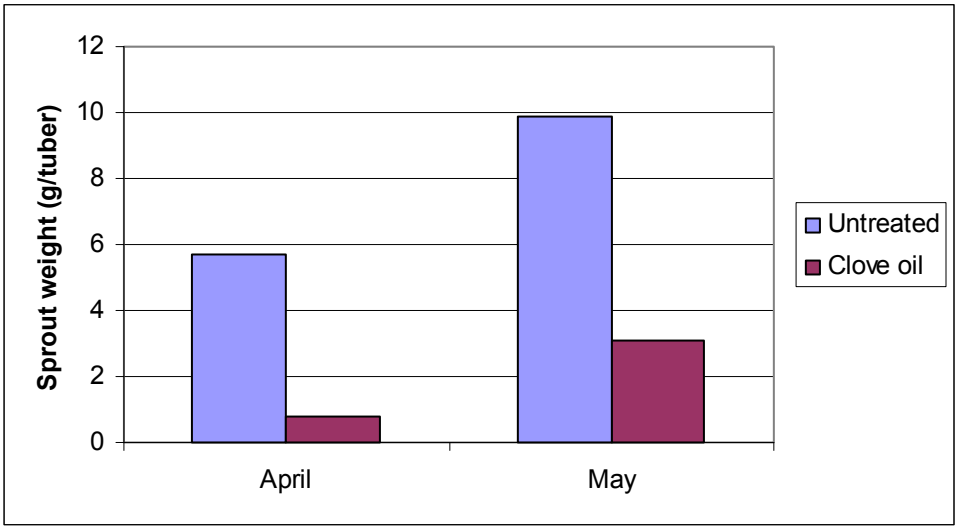

Figure 2. Compare sprout growth of untreated Russet Burbank potatoes and potatoes treated with multiple applications of clove oil—at 3-week intervals: 8 applications were made by the April sampling date and 9 applications by the May date. Initial clove oil rate was 67 ppm; subsequent rates were 23 ppm.

Table 2. Taste test comparing clove oil and CIPC treated Russet Burbank baked potatoes Values in the same column followed by the same letters are not significantly different (α=0.05)**.**

Treatment	***Color***	***Texture***	***Flavor***	***General***
Clove oil	6.9 A	6.3 A	6.2 A	6.1 A
CIPC	6.9 A	6.2 A	6.3 A	6.2 A