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Micro-organisms Meet Their Match

Chlorine dioxide proves effective against pathogens

Profitability from potato crops primarily depends on the management of two factors: yield and storage. Although good storage practices are widely published and followed throughout the industry, the difference between losing and saving a bin of potatoes from spoilage could be a result of subtle difference in management of stored potatoes. A few bad tubers can spoil the whole bin.

Proper storage practices helps in providing profitable potatoes for store display.

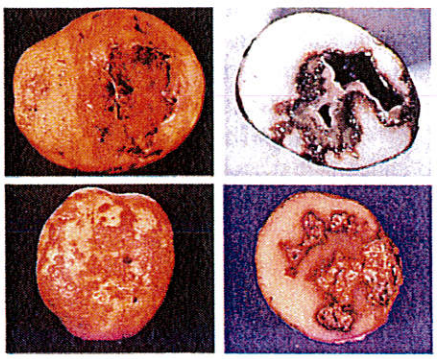
WOUNDING

A major cause for the generation of bad potatoes is wounding. Wounds are the results of breaks in the potato skin due to scratches, cuts, nicks and bruises from harvesting and handling equipment. While it is an attempt of every grower to minimize wounding, it is not completely avoidable.

Another synergistic disease-causing factor in potato storage is the available concentration of spoilage organisms (pathogen load) present inside the packing plants. A wounded potato allows route of entry to the pathogen which starts the rotting phenomenon. The interior of a potato, known as the periderm, has ample moisture and nutrients for the organism to flourish quickly and to increase the concentration of the organism multifold.

Table 1

TEST ORGANISMS	DISEASE	CONCENTRATION	CONTACT TIME (min)	REDUCTION
Erwinia carotovora subsp carotovora (4)	Soft Rot	50ppm	1	99.9999%
Helminthosporium solani (3)	Silver scurf	400ppm	10	98%
Fusarium spores (2)	Dry Rot	12ppm	NR	100%
Phytopphthora infestans Sporangia (3)	Late blight	7ppm	180	100%



Disinfecting is important in preventing diseases such as late blight, soft rot, silver scurf and dry rot.

Once the bugs destroy the polysaccharide matrix of the pulp, liquification of the potato results. The resulting juice provides an excellent vehicle for transmigration of pathogens into the entire bed. The location of this activity, namely the bottom of the pile versus the top, is immaterial since powerful air circulation in the packing plants makes microdroplets of the inoculum airborne and spreads the pathogen into the entire bin and potentially in adjoining bins.

To protect potatoes from infection by pathogens, the general practice in the industry is to treat them with disinfectants before and during storage. Treatments that are applied during storage vary from a continuous metering to frequent batching of disinfectant.

Before the potatoes are placed in storage, it is critical to clean and disinfect the bins for any residual pathogens from previous batches of potatoes.

It is ideal to use an approved disinfectant with residual activity to protect against pathogen spreading due to rubbing of potatoes with each other and with the handling equipment.

Chlorine dioxide has proven to be an effective tool for this application because of its strong effectiveness against a broad spectrum of microorganisms as well as the residual effect.

CHLORINE DIOXIDE

The antimicrobial efficacy of chlorine dioxide is not limited to the vegetative state of bacteria and fungi, but extends to hardy spores that are frequently the cause of spoilage problems. Chlorine dioxide is generated on the site of application from sodium chlorite precursor and an acid activator–commonly citric or phosphoric.

The activation reaction does not go to completion, which is an important beneficial feature of this technology.

The unused chlorite ion provides a bacteriostatic and fungistatic effect, thereby shielding the tuber from environmental infliction of a disease-causing organism.

The efficacy of chlorine dioxide on pathogens that cause late blight, soft rot, dry rot and silver scurf on tubers have been proven in many laboratory tests. Results are summarized in Tables 1 and 2.

The antimicrobial activity of chlorine dioxide is effective in a wide pH-range of 2 to 10.

Chlorine dioxide reacts with organic compound via oxidation, not chlorination.

Therefore, it does not generate harmful trihalomethanes (THMs) or other chlorinated byproducts. Soil and organic maters do not interfere with the antimicrobial effect of chlorine dioxide. It is safe and much less corrosive for equipments and environment as compared to chemicals such as hypochlorites.

A study conducted by the Department of Plant Pathology of North Dakota State University showed that chlorine dioxide effectively inhibited the growth of late blight pathogens Phytophthora infestans zoospores up to10 /ml that were sprayed on Russet Burbank tubers.

In another study, the potato tubers were inoculated with Erwinia carotovora, which causes soft rot disease on tubers. Results of these studies are summarized in Table 2.

Table 2

ClO2 concentration	% of tubers developed disease	
	Late Blight	Soft Rot
No treatment	28%	30%
5ppm	12%	NA
10ppm	6%	NA
50ppm	0%	NA
200ppm	NA	0%

LAB TESTING

Currently silver scurf is a big concern of growers in the Northwest. The disease is caused by the fungus Helminthosporium solani. Secor et al have demonstrated 100 percent inhibition of Helminthosporium solani spore with 50 ppm of chlorine dioxide. In another laboratory test, chlorine dioxide at 400 ppm reduced 98 percent of H.solani after 10 minutes of contact.

Another commercial fungicide which comprised of 2 percent peroxyacetic acid and 27 percent hydrogen peroxide was also tested. At a 1:1000 dilution rate a 27 percent reduction of H.solani was achieved in 10 minutes of contact time.

PRODUCTS

A commonly used chlorine dioxide product is distributed by by Bio-Cide International Inc., headquartered in Norman, Okla., under the brand name Purogene. This product is approved by the EPA for use on potatoes and other agriculture produces (EPA Reg. No. 9804-5). The antimicrobial efficacy of Purogene directly on potatoes has been well proven by tests that are reported in this article. Chlorine dioxide based products can also be used as disinfectant for packing plant and equipment. Brand names such as Oxine are registered for this application.

DIRECTIONS FOR USE

Purogene can be applied to seeds and tubers through dipping, spraying or misting. Purogene can also be distributed via the humidification system in the storage room. It is recommended to apply Purogene at 400 ppm as an initial shock treatment to the tubers or seeds, then follow-up with 200 ppm via periodically misting or 50 ppm continually via humidification system.

References

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