Table 2. DCPA and related compound residues[z] for preemergence weed control in 'Cherry Belle' radish roots 45 days after application.

Application rate (kg/ha)	Residues[y] (ppm)			
	DCPA	MTP	TPA	HCB
0 (control)	0.02	<0.01	<0.01	<0.001
	0.05	<0.01	<0.01	<0.001
4.48	0.03	<0.01	<0.01	------
	0.04	0.02	<0.01	------
	0.01	<0.01	<0.01	------
	0.05	0.04	0.02	------
	0.03	0.01	<0.01	------
8.97	0.04	0.01	0.01	<0.001
	0.02	0.06	<0.01	<0.001
	0.02	<0.01	0.03	<0.001
	0.01	<0.01	<0.01	<0.001
	0.03	<0.01	<0.01	<0.001
17.94	0.12	0.01	0.01	<0.001
	0.12	0.01	<0.01	0.001
	0.11	0.05	0.02	<0.001
	0.22	0.03	0.01	<0.001
	0.07	<0.01	<0.01	<0.001

[z]Method sensitivity for DCPA, MTP and TPA, 0.01 ppm; HCB, 0.001 ppm.

[y]Recovery studies for DCPA, 0.01 ppm (90.0%), 0.05 ppm (98.0%), 0.10 ppm (99.0%); MTP, 0.01 ppm (70.0%), 0.05 ppm (74.0%), 0.10 ppm (75.0%). TPA, 0.01 ppm (70.0%), 0.05 ppm (76.0%), 0.10 ppm (75.0%); HCB, 0.001 ppm (80.0%), 0.0025 ppm (88.0%), 0.005 ppm (80.0%).

The levels of DCPA residues in the radish roots ranged at the 4.48 kg/ha rate from 0.01 to 0.05 ppm, at the 8.97 kg/ha rate from 0.01 to 0.04 ppm, and the 17.94 kg/ha rate from 0.07 to 0.22 ppm. The controls had 0.02 to 0.05 ppm apparent residue which was determined by gas-liquid chromatography coupled to a mass spectrometer to be DCPA. The levels of MTP and TPA in the radish roots ranged from <0.01 to 0.04 and <0.01 to 0.02 ppm at the 4.48 kg/ha rate; <0.01 to 0.06 and <0.01 to 0.03 at the 8.97 kg/ha rate; and <0.01 to 0.05 and <0.01 to 0.02 at the 17.94 kg/ha rate (Table 2).

The levels of residues in the radish tops for DCPA ranged at the 4.48 kg/ha rate from 1.6 to 4.6 ppm; at the 8.97 kg/ha rate from 4.8 to 10.0 ppm; and the 17.94 kg/ha rate from 4.2 to 12.6 ppm. The controls had 0.30 to 0.41 ppm apparent residue which was determined by gas-liquid chromatography coupled to a mass spectrometer to be DCPA. The levels of MTP and TPA in the radish tops ranged from <0.01 to 0.06 and <0.01 to 0.03 ppm at the 4.48 kg/ha rate; 0.01 to 0.09 and <0.01 to 0.03 ppm at the 8.97 kg/ha rate; and 0.01 to 0.15 and <0.01 to 0.06 ppm at the 17.94 kg/ha rate (Table 1).

Residues of DCPA, MTP, TPA and HCB in radishes were detected in significant amounts in the tops, and only trace amounts were present in the roots under treatment conditions of this experiment.

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HortScience 15(2):147–148. 1980.

Glycoalkaloids of Hollow Heart and Blackheart Potato Tubers[1,2]

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Additional index words. Solanum tuberosum, physiological disorder

Abstract. **Tubers of potato (*Solanum tuberosum* L.) with the nonparasitic disorders of hollow heart and blackheart contained significantly more glycoalkaloids in the cortical region than normal tubers in 3 cultivars. The glycoalkaloid content of tuber tissue was related to the severity of the disorders.**

The glycoalkaloids naturally occurring in potato tubers have been associated with bitter taste, objectionable off-flavor, inhibition of cholinesterase, and poisoning in humans and animals. The level of glycoalkaloids in the tubers depends upon cultivar, state of development, and nature of storage or growth environment. Light and mechanical injury are the most well known factors which stimulate glycoalkaloid synthesis in the potato tubers (3, 7, 9, 13).

[1]Received for publication October 11, 1979. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper must therefore by hereby marked *advertisement* solely to indicate this fact.

[2]This research was supported by Grant FD-00683-03 from the Office of Research Grants, Food and Drug Administration.

Hollow heart and blackheart are very common nonparasitic disorders of potatoes grown anywhere in the world. The former has its inception in the field (1, 4, 5, 6) while the latter develops during shipment or storage (2, 11). The effect of these disorders on glycoalkaloid content has not been reported. This investigation was undertaken to determine the extent of the effect of these disorders on glycoalkaloids of potato tubers.

'Russet Burbank', 'Norgold Russet', and 'Pontiac' tubers were obtained from local potato growers who suspected hollow heart and blackheart disorders. Tubers of 250 ± 10 g were selected for screening and cut in half from basal to apical end. Halves with slight and severe hollow heart and blackheart symptoms were chosen by visual observation. Since the glycoalkaloid concentration is arranged in an ascending gradient from the inside outward, the potato halves were sampled by cutting longitudinal portions only 1 cm away from the periderm. A control sample was similarly prepared from normal tubers for comparison. Triplicate samples on each treatment were freeze-dehydrated for total glycoalkaloid determination and triplicate analyses were conducted on each sample amounting to 50 g. The Gull and Isenberg method (3) was followed for glycoalkaloid determination. It involved Soxhlet extraction, liquid ammonia precipitation, followed by color development and spectrophotometric quantitation. The procedure for color development required drop by drop addition of 5 ml of concentrated sulfuric acid to an aliquot of glycoalkaloids over a period of exactly 3 minutes, followed by like addition of 2.5 ml of 1% formaldehyde over a period of exactly 2 minutes. This was accomplished by using a constant volume burettes mounted on an automatic shaking device (14). Glycoalkaloid content was expressed as milligrams per 100 gram dry tissue. Analysis of variance was made and means were compared according to Tukey w-procedure (10).

Potato tubers with the nonparasitic disorders of hollow heart and blackheart contained significantly more glycoalkaloids than normal tubers. This phenomenon was consistently shown by 3 cultivars of potatoes tested (Table 1).

Table 1. Glycoalkaloid contents of cortical region of hollow heart and blackheart potato tubers.

Cultivar	Total glycoalkaloid (mg/100 g dry wt.)				
	Normal tubers	Slight hollow heart tubers	Severe hollow heart tubers	Slight black heart tubers	Severe black heart tubers
Russett Burbank	1.45	1.93**	2.25**	3.10**	4.35**
Norgold Russett	1.16	1.80**	2.14**	3.21**	3.41**
Pontiac	1.49	1.88**	2.10**	3.55**	3.62**

**Significantly different from normal tubers at 0.01 level.

The glycoalkaloid content of tuber tissue was relative to the severity of disorder. Tissues of blackheart tubers contained more glycoalkaloids than those of hollow heart. The first sign of hollow heart is revealed by the death of a small area of the pith cells after cell contents have disappeared (4). Perhaps the lack of certain micronutrients or redistribution of assimilates (5, 6) are responsible for the death of the pith cells. As the disease progresses the tuber grows with a series of large cracks producing hollow center. The cavities are usually lined with a pinkish and later light brown dead tissue. The disorder appears to be associated with conditions favoring excessively rapid tuber enlargement (1). Blackheart is an abnormal discoloration of the central regions of the potato, in which there is a series of successive color changes from normal to pink, brown, and black on exposure to the air. Sometimes the blackened tissue collapses, leaving hollow cavities with blackened walls. The cause of blackheart is attributed to deep piling, lack of ventillation or high temperature during transit or storage (2, 11). Necrotic cells of hollow heart and blackheart are comparable with those of bruise induced blackspot in respect to melanin discoloration (8). Many compounds are produced in potatoes as a result of physiological stress that may alter normal metabolic pathways or cause different pathways to be utilized (12). It is apparent that both hollow heart and blackheart disorders cause a certain degree of tissue injury of potato tubers and consequently the injury stimulates glycoalkaloid synthesis of the tissue. In comparison with other factors as light and mechanical injury, hollow heart and blackheart disorders seem to be much less potent factors in stimulating glycoalkaloid synthesis of potato tubers.

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HortScience 15(2):148–149. 1980.

Symptoms of Acetaldehyde Injury on Head Lettuce[1]

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Additional index words. fumigation, *Myzus persicae, Lactuca sativa*

Abstract. **Acetaldehyde (Aa), a volatile produced in small quantities by plants, is a potential fumigant for killing the green peach aphid, *Myzus periscae* (Sulzer), on harvested head lettuce, (*Lactuca sativa* L. var. *capitata*). Concentrations of 3.0 to 6.0% Aa killed 100% of the green peach aphids on harvested head lettuce, but induced dark-green, water-soaked, necrotic areas on the outer leaves of the heads and occasionally caused a type of injury, similar to russet spotting, which we call tan flecking. Concentrations of 1.5 to 2.0% Aa, which killed all of the aphids, did not injure the lettuce.**

Very little lettuce is shipped from the U.S. to countries, such as Japan, that have quarantine regulations against the green peach aphid, which is sometimes found on lettuce. Known fumigants, such as hydrocyanic acid (HCN) and methyl bromide (MB), kill the green peach aphid but seriously injure lettuce, and therefore are unsuitable as fumigants for this commodity (2). We found that acetaldehyde (As), a volatile produced in small quantities by plant organs, killed 100% of the green peach aphids on harvested head lettuce without injuring the commodity (1). We report here on the phytotoxicity symptoms of this potential fumigant for lettuce at excessive concentrations.

Freshly harvested heads of 'Calmar' and 'Salinas' lettuce were obtained from the Salinas Valley of California during 1978. Heads of lettuce of both cultivars were experimentally infested with aphids (50-100 in each of 2 heads per treatment) and then placed in air-tight, 20-liter, glass jars with 2 or 4 noninfested heads per jar. Precooled liquid Aa was introduced into the jars in amounts sufficient to provide gaseous concentrations of 1, 1.5, 2, 3, 4, 5 or 6% Aa (by volume). Fumigations at each concentration of Aa for 4 hr at 21°C were replicated 3 times, each time with a new lot of lettuce. Aphid mortality was determined after 2 days at 2.5°C and

[1]Received for publication September 10, 1979.
The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper must therefore be hereby marked *advertisement* solely to indicate this fact.
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