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Storage Response of Potatoes after Pre-Harvest Application of Maleic Hydrazide.

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Foliar sprays of maleic hydrazide at 1,500 and 3,000 ppm on potato plants (cv 'Kufri Chandramukhi') 4 and 5 weeks before the harvest of tubers. profoundly influenced the sprouting behaviour, per cent cumulative physiological weight loss, changes in carbohydrate, ascorbic acid, and specific a-amylase activity were recorded. Pre-harvest treatment with MH effectively controlled the sprout growth, but failed to reduce rotting. Some reduction in weight loss and starch breakdown in potato were recorded in the tubers during storage.

Key Words - Amylase Ascorbic acid Carbohydrate Foliar-spray Sprout.

Sprouting is one of the major problems in potato storage that leads to deterioration of its quality. Singh & Verma (1979) reported that maleic hydrazide (MH), did not delay sprouting but inhibited sprout growth and induced rotting even at 3000 ppm. How best MH could be used to delay sprouting without increasing rotting? In this paper the sprouting behaviour, physiological weight loss, biochemical changes in starch, sugars, ascorbic acid and a-amylase activity in the pre-harvest MH-treated potatoes are reported.

MATERIALS & METHODS - Seed tubers of *Solanum tuberosum* cv 'Kufri Chandramukhi' were obtained from Central Potato Research Institute (CPRI), Modipuram, U.P. Potato tubers were sown in 12 experimental beds each of 1x3m in the University Botanical Garden in November, 1983 and were harvested in March, 1984. Plants of four such beds were sprayed with MH (1500 and 3000 ppm) at an interval of 4 and 5 weeks before harvesting.

The potatoes harvested from the treated and control plants were kept at room temperature (35-42 C) and used.

The per cent weight loss (CPWL) of tubers was calculated from the formula $[(x-y)/x] \times 100$ where x = initial weight of potato; y = weight of potato on the day up to which the % CPWL is to be calculated.

The soluble sugars and starch were determined according to the method of Hard & Fisher (1971) while the specific activity of a-amylase was determined by Bernfeld's (1951) method. Ascorbic acid was estimated in 0.04% oxalic acid and was titrated against a standardised 2,6 - DCPIP solution (Aberg, 1958).

RESULTS *Per cent Rottage and Sprouting-* After 5 months of storage at room temperature (35-42 C) rotting was 36% in untreated potatoes while it was 43-47% in the treated one (Table 1). Tubers collected from plants sprayed with MH, (1500 and 3000 ppm) 4 and 5 weeks before harvest did not show much difference in rotting.

However, sprout growth was greatly checked by pre-harvest MH application although sprouts initiated after 2months of harvest. After 5months of storage at 35-42 C, the sprout length in tubers of untreated plants was 3-5 cm while in the treated tubers it varied from 0.5 to 2.0 cm. Effectiveness of these concentrations at two different periods of application remained unchanged (Fig.1, Table I).

Per Cent Cumulative Physiological Weight loss (% CPWL): Both concentrations caused some difference in % CPWL value. After 21 days, the % CPWL value in the control 1500 and 3000 ppm MH-treated potatoes were 3.9, 3.5 and 3.5 respectively (Table 2).

Carbohydrates - Starch - Immediately after harvest, the starch content of the potatoes was 74 ad 71 in cortex and pith regions respectively, and after 2-1/2 month storage, about 14-19% decline was recorded in the control. The decline was slightly less in the treated potatoes compared to control, i.e., 11 to 14% in 1,500 ppm and 9 to 14% in 3,000 ppm treated ones (Table 3).

Sugars - From an initial value of 10.1% and 9.7% on dry weight basis in the cortex and pith regions respectively, total sugars increased more than two-fold in the control but in the treated potatoes, the sugars declined after 2-1/2 months (Table 3).

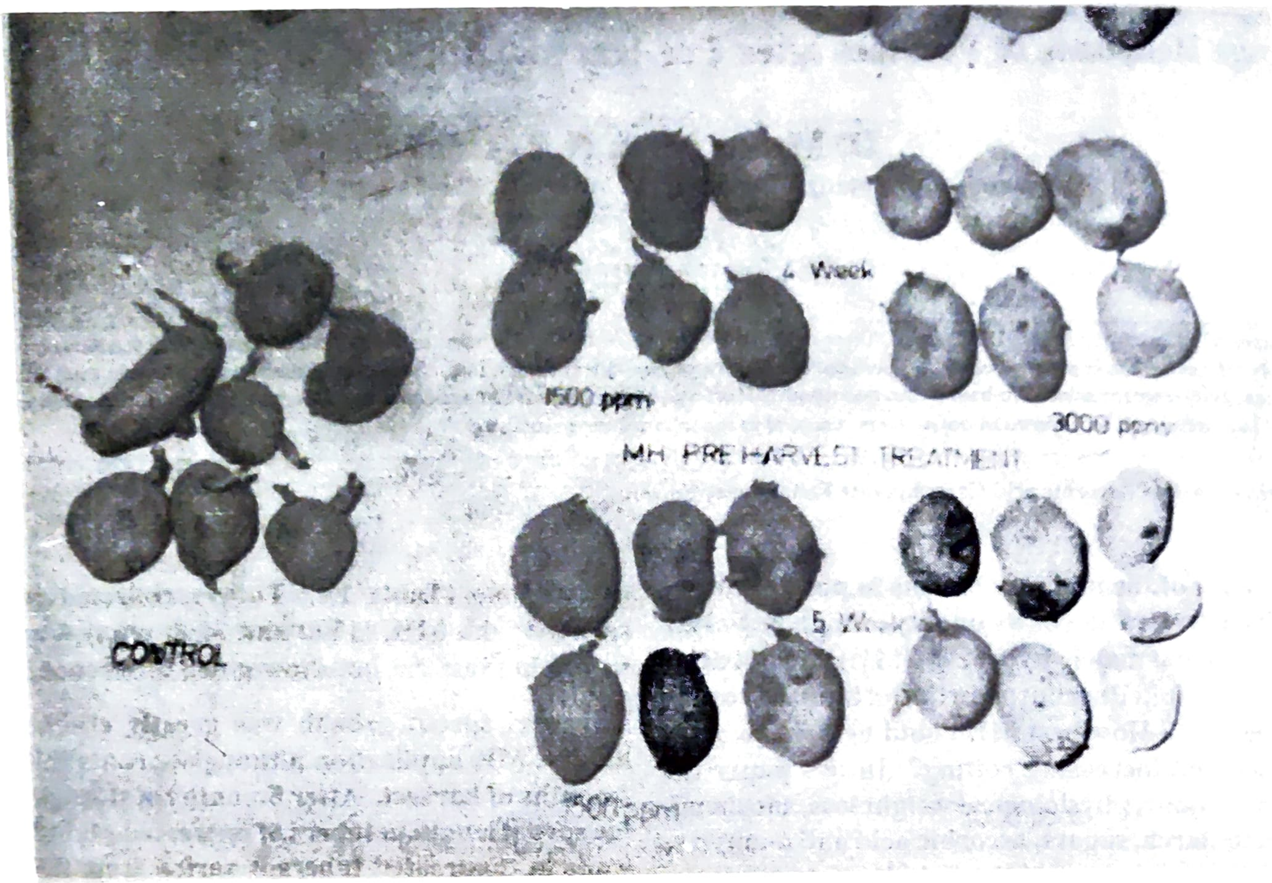

Fig 1. **Control and pre-harvest MH-treated potatoes (*Solanum tuberosum* cv. 'Kufri Chandrakukhi').**

Reducing sugars were lower than non-reducing sugars in the fresh tubers but after storage, the former exhibited markedly higher value than the latter (Table 3).

Specific Activity of a Amylase - The specific a-amylase activity increased two fold during the storage period in the cortex and pith regions (Table 3).

Ascorbic Acid - Initially, the amount of ascorbic acid was 107.2 and 115 mg/100 g dry weight. It declined by about 50% in the control as well as in the treated tubers after storage (Table 3).

The amounts of starch and sugars (reducing and non-reducing) were slightly higher in the cortex than in the pith in most of the samples whereas ascorbic acid content was always high in the pith.

DISCUSSION - The results clearly indicated the effectiveness of MH in checking the sprout growth of potatoes. However, rotting was higher in the treated tubers than in the control. Both concentrations as well as 4 and 5 weeks of pre-harvest MH treatments showed similar effects. MH is reported to control sprouting and increased rotting in potatoes (Rao & Wittwer, 1955), carrots (Wittwer *et al.*, 1950) and in onions (Wittwer & Sharma, 1950).

The significant control over % CPWL could not be achieved with MH. The decline in the value may be attributed to the reduced rate of respiration. Indeed Boe *et al.* (1974) indicated sprout suppressors reduced the respiration.

Biochemical analyses clearly showed that starch breakdown occurred during the storage period at room temperature. a-Amylase activity was almost double during this period. The hydrolysis of starch resulted in the accumulation of sugars. Potatoes were dormant in this period, hence the loss in sugars was low and accumulated. Clearly

Table 1, Response of Potato Tubers to MH Treatment (Weight Category 50-70 g) After 5-months Storage at Room Temperature (35-42° C) *

	Rotting (%)	Sprout length
Control	36	3-5 cm
MH-Treated (4-week before harvest)		
1500 ppm	45	0.5-2.0 cm
3000 ppm	47	0.5-1.5 cm
MH-Treated (5-week before harvest)		
1500 ppm	43	0.5-2.0 cm
3000 ppm	46	0.5-2.0 cm

* Data of each treatment are based on at least 40 potatoes (Weight category 50-70g)
Observations were made after 5 months storage at 35-42 °C

Table 2 Effect of MH Treatment on Cumulative Physiological Weight loss in Pre-Harvest Treatment.

	Days after				
	0-7	0-14	0-21	7-14	14-21
	% Physiological Weight Loss				
Control	0.98 ± 0.09	2.67 ± 0.22	3.86 ± 0.25	1.72 ± 0.15	1.23 ± 0.24
MH-Treated					
1500 ppm	0.90 ± 0.06	2.23 ± 0.14	3.45 ± 0.06	1.30 ± 0.12	1.24 ± 0.13
3000 ppm	0.91 ± 0.05	2.31 ± 0.23	3.50 ± 0.17	1.38 ± 0.07	1.09 ± 0.02

Tubers (weight category 50-70 g) were stored for 2-1/2 months at 35-42°C

MH treatment could bring down the starch loss. Ascorbic acid was lost by about 50%. About 50-80% loss in ascorbic acid occurred during storage showed that Bring & Raab (1964), Bring (1966), Shekhar *et al.* (1978) Mondy & Chandra (1979). Trautner & Somogyi (1964) indicated that biosynthesis of vitamin C was closely related to carbohydrate metabolism. Since storage temperatures alter carbohydrate metabolism which is related to ascorbic acid biosynthesis, it is not surprising to note reduced ascorbic acid content with storage (Shekhar *et al.*, 1978).

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Table 3 Physiological Effects Induced by MH Treatment on Potato Tubers

		Initial (after harvest) control	2.5 month after harvest		
			Control	Maleic hydrazide 1500 ppm	Maleic hydrazide 3000 ppm
Starch	Cortex	74.6 ± 4.2	63.3 ± 3.0	66.4 ± 3.6	68.1 ± 2.3
	Pith	71.9 ± 4.2	55.5 ± 2.5	61.0 ± 2.8	62.7 ± 3.2
Total Sugars	Cortex	10.1 ± 0.9	22.4 ± 1.8	20.5 ± 0.6	19.6 ± 1.8
	Pith	9.7 ± 0.9	21.2 ± 2.6	18.2 ± 2.3	17.6 ± 2.0
Reducing Sugars	Cortex	3.8 ± 0.3	14.8 ± 0.4	14.2 ± 0.1	14.1 ± 1.5
	Pith	4.7 ± 0.2	13.4 ± 1.0	12.4 ± 0.3	13.5 ± 0.5
Non-reducing Sugars	Cortex	6.4	7.6	6.3	5.5
	Pith	5.0	7.9	5.8	4.5
Ascorbic Acid	Cortex	107.2 ± 6.3	55.3 ± 2.4	59.6 ± 0.7	57.5 ± 1.2
	Pith	115.0 ± 7.7	65.0 ± 2.1	66.7 ± 1.0	65.8 ± 1.5
Specific Activiity of α amylase	Cortex	0.2	0.4	0.6	0.4
	Pith	0.3	0.5	0.5	0.5

Starch and sugar expressed as mg/100 mg dry wt; ascorbic acid in mg/100 g;
α amylase activity expressed as mg protein.

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