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SHORT COMMUNICATION

RESPIRATION RATE OF STORED POTATO TUBERS : EFFECT OF CHEMICAL SPROUT INHIBITORS

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Effect of single and combined application of two chemical sprout inhibitors, maleic hydrazide (MH) and isopropyl 3-chlorophenylcarbamate (CIPC) on respiration rate of tubers stored at higher temperature (14-30ºC, 80-95% RH) was examined in four potato cultivars. All treatments significantly reduced the respiration rate and respiratory carbon loss in tubers during storage as compared to control. Respiration rate of tubers was found to be positively and significantly correlated with sprouting and sprout growth of tubers during storage.

***Key words*: Chemical sprout inhibitors, non refrigerated storage, potato tubers, respiration rate, sprouting, sprout weight.**

Respiration, the oxidative breakdown of complex substrates to simple molecules with the concurrent production of energy required to maintain the life processes in potato tuber (*Solanum tuberosum* L.), contributes to loss in weight during storage. Respiration rate of tubers is higher during storage at higher temperature and is influenced by a number of extrinsic factors among which chemical compounds are important ones (Burton *et al*. 1992). Chemical sprout inhibitors are expected to have an influence on the rate of respiration, if not during the dormant period, then at least after the termination of the formal rest period. Only a few authors have investigated the influence of commercial sprout inhibitors on respiration (Boe *et al*. 1974, Hunter 1986).

Single and combined applications of chemical sprout inhibitors maleic hydrazide (MH) and isopropyl 3-chlorophenylcarbamate (CIPC) effectively reduced physiological losses, sprouting and sprout growth in tubers stored for 14 weeks at higher temperatures (Mehta and Kaul 1991). But the information on the effect of sprout inhibitors on respiration rate and losses due to respiration in stored tubers is lacking. The present investigation was therefore, designed with four potato cultivars differing widely in dormancy period, to study the influence of these sprout inhibitors on respiration rate of tubers and also to correlate it with sprouting parameters during storage at higher temperatures in an evaporatively cooled store (ECS).

Healthy potato crops of four cultivars were raised in sandy loam soil at the farm of Central Potato Research Station, Jalandhar following recommended cultural practices. Cultivars, Kufri Lauvkar, Kufri Chandramukhi, Kufri Lalima and Kufri Dewa with dormancy periods 17, 18, 21 and 22 weeks, respectively were included in the study. The harvested tubers were kept in heaps for 20 days for curing of skin before selecting samples of undamaged tubers. Diethanolamine salt of MH (Desprout, Micro Chemicals, India, a.i. 30% MH) was sprayed on part of the crop 3 weeks before haulm cutting. The unsprayed plants provided tubers for non MH treatments and for control. Pure CIPC (Sigma Chemical Co.) diluted to 1% was applied as immediate post harvest dust treatment under air tight conditions for 48 hours. Details of the treatments used were as follows:

MH	Maleic hydrazide, a 0.3% solution sprayed at a rate equivalent in 25 kg maleic hydrazide per ha.
CIPC-I	1% dust applied at 2.5 g per kg immediately before storage.
CIPC-II	As CIPC-I but followed by a second application after 1 month in store.
MH + CIPC	Application and rates as for MH and CIPC-I.
Control	Untreated tubers.

Code letters/roman numbers in treatments are as used in the text and tables. The concentrations of inhibitors were equal to those found effective in a preliminary study (Mehta and Kaul 1991). The treated and control tubers in lots of 5 kg in jute bags with 4 replications per treatments were stored in ECS in the first week of March.

Respiration rate (fresh weight basis) was measured using the standardized method (Singh *et al*. 1995) by an infrared gas analyser (CD-301, CID, Inc., USA) at monthly intervals. Weight loss was recorded from 20 marked tubers. Weight of carbon loss (mg of C present in CO_2) during storage was calculated from rate of respiration (Picha 1986). The difference between weight loss and carbon loss was assumed to be transpiration loss even though the ultimate source of some water loss was probably generated during respiration. Weight loss was expressed in milligrams (C or total) lost per gram of tuber fresh weight. Sprouting and rotting was recorded in 4 replications of 100 tubers for 16 weeks. Tubers having at least one sprout 0.5 cm or more in length were recorded as sprouted. Tubers were desprouted and sprout weight (g per kg tuber weight) was recorded in undisturbed separate lots. Data was statistically analysed and correlations were worked out between respiration rate and sprouting parameters during storage (Gomez and Gomez 1984).

Respiration rates at any one storage time within a cultivar were similar during both the years of study and all treatments recorded a steady increase in respiration rate till 16 weeks of storage. Basal value of respiration rate in the four cultivars ranged between 3.21-5.04 mg CO_2 kg^{-1} h^{-1} at 0 day of storage which increased to 13.56-22.93 mg CO_2 kg^{-1} h^{-1} at 16 weeks of storage (Fig. 1). Mean respiration rates increased by only 5.8-

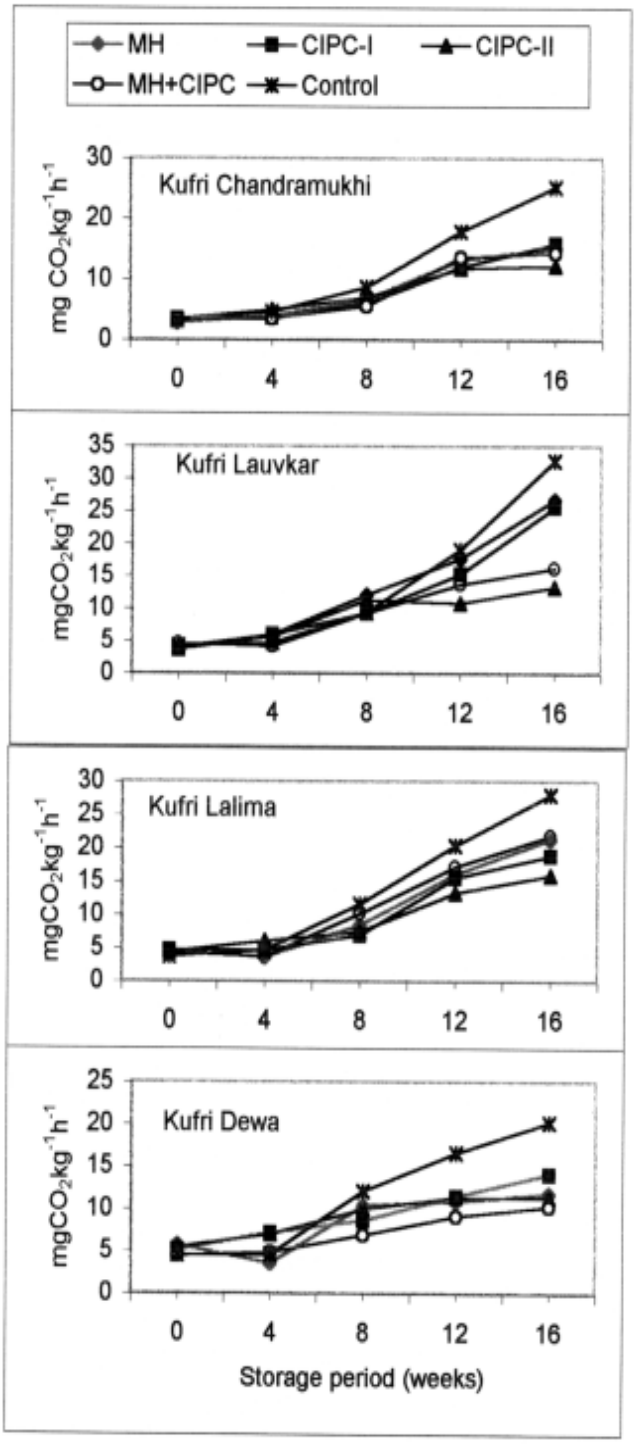

Fig. 1. Effect of sprout inhibitors on respiration rate of stored potato tubers. (CD at 5%: Cultivar: 0.28, 0.22, 0.42, 0.72 and 0.83: Treatment: NS, 0.25, 0.44, 0.80 and 0.91; Cv. x T: 0.63, 0.50, 0.91, 1.61 and 1.86 at 0, 4, 8, 12 and 16 weeks, respectively).

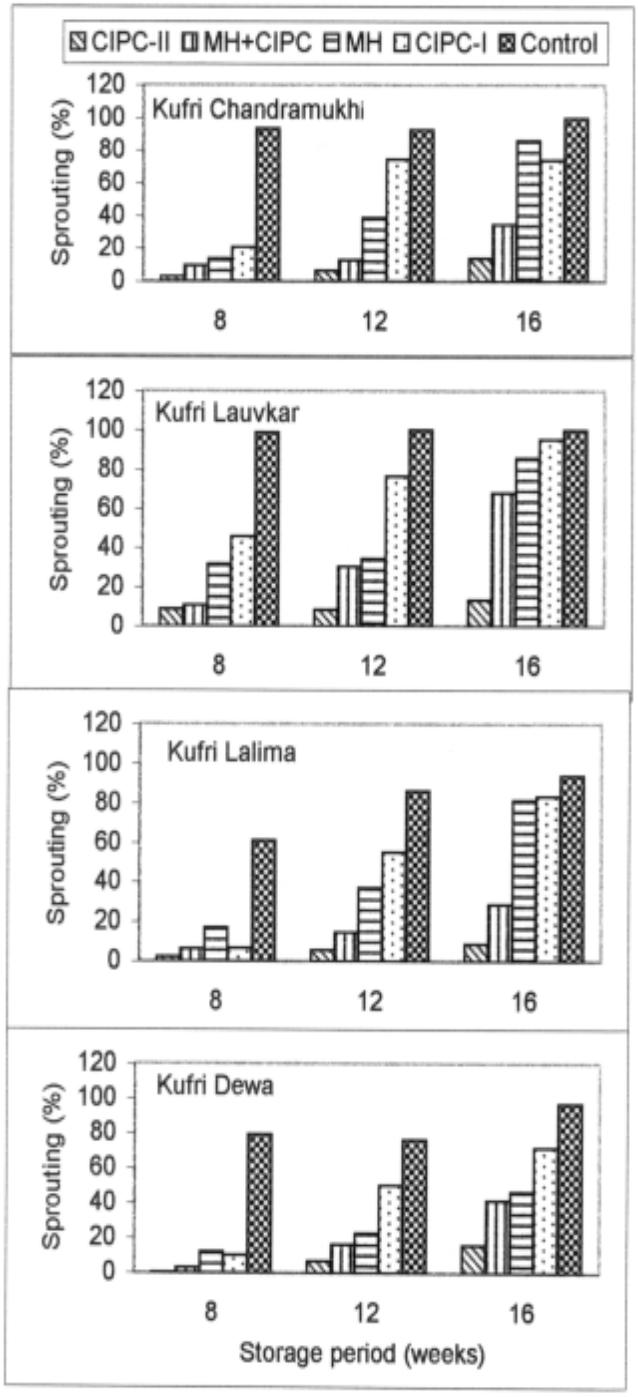

Fig. 2. Effect of sprout inhibitors on sprouting of potato tubers (CD at 5%: Cultivar: 2.97, 3.82 and 4.30: Treatment: 3.33, 4.30 and 4.79; Cv. x T: 6.65, 8.56 and 9.62 at 8, 12 and 16 weeks, respectively).

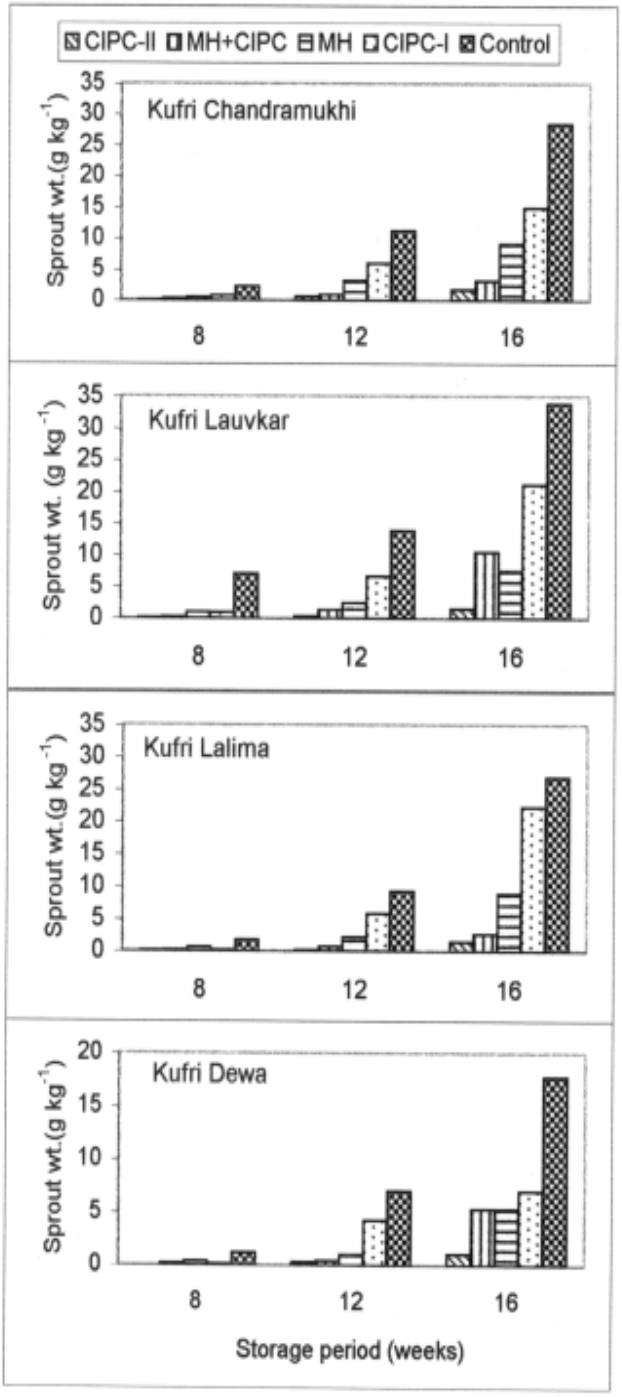

Fig. 3. Effect of sprout inhibitors on sprout weight of potato tubers (CD at 5%: Cultivar: 0.17, 0.58 and 1.27: Treatment: 0.19, 0.64 and 1.41; Cv. x T: 0.36, 1.27 and 2.83 at 8, 12 and 16 weeks, respectively).

27.7 % between 0 and 4 weeks of storage, but a steep increase (64.1-95.6%) was observed between 4 and 8 weeks of storage when the tubers start sprouting. Increase in respiration rate after 8 weeks of storage continued with increasing sprout growth and three to five fold increase was recorded at 16 weeks of storage (Fig. 1, 3). Steep increase in respiration rate was concurrent with higher sprout weight of tubers.

Significant differences in respiration rates were observed between cultivars at all dates of observation (Fig. 1). Mean initial respiration rates in a short dormant cv. Kufri Lauvkar (4.09 mg CO_2 kg^{-1} h^{-1}) and a long dormant cv. Kufri Lalima (4.31 mg CO_2 kg^{-1} h^{-1}) were not much different (Fig. 1). A cultivar with initial higher respiration rate did not always had the higher respiration rate during storage. Kufri Dewa, a long dormant cultivar with initial higher mean respiration rate (5.04 mg CO_2 kg^{-1} h^{-1}), recorded the lowest respiration rate (13.56 mg CO_2 kg^{-1} h^{-1}) after 16 weeks of storage which seemed to be affected by the stage of sprouting and sprout growth.

All treatments significantly decreased the mean respiration rate of tubers as compared to control after 8 weeks of storage (Fig. 1). On 16 weeks of storage the reduction was maximum (43.3-59.6%) in CIPC-II treatment with maximum reduction observed in Kufri Lauvkar, a short dormant cultivar recording maximum respiration rate in control tubers. Interaction between cultivar and treatment was significant at all observation dates during storage.

Physiological weight loss in the four cultivars increased progressively during storage. Since the interaction between cultivar and treatment was not significant during storage, the data on mean of four cultivars has been given in Table 1. Mean total weight loss and respiratory carbon loss was 11.1 mg g^{-1} and 0.96 mg g^{-1} tuber weight at 4 weeks which increased to 130.5 mg g^{-1} and 3.64 mg g^{-1} tuber weight, respectively after 16 weeks of storage. The contribution of respiratory carbon loss to total weight loss was little (2.8-8.6%) during storage at higher temperature which supports an earlier report (Mehta and Kaul 1997).

All treatments significantly decreased the respiratory carbon loss as compared to control after 12 weeks of storage. Whereas, in case of total weight loss significant reduction was observed in case of only CIPC-II treatment which recorded the maximum sprout suppression (Table 1). Indeed the loss following CIPC-I was greater than that of control and both MH and CIPC-I performed poorly, perhaps because the efficiency of CIPC and MH are temperature dependent, decreasing as the temperature increases (Rama and Narasimham 1987). Even though the contribution of respiration towards total weight loss during storage was very low, the chemical sprout inhibitors reported to reduce the total physiological losses during storage at higher temperatures (Mehta and Kaul 1991) act via reducing the evaporative as well as the respiratory losses.

Untreated tubers of short dormant cultivars, Kufri Lauvkar and Kufri Chandramukhi started sprouting after

Table 1. Effect of sprout inhibitors on total weight loss (T) and respiratory carbon loss (C) during storage.

Treatment	Storage period (weeks)							
	4		8		12		16	
	*T	*C	T	C	T	C	T	C
MH	13.9	0.85	35.0	1.84	71.0	2.84	131.2	3.64
CIPC-I	9.0	1.05	34.5	1.51	78.3	2.66	150.9	3.66
CIPC-II	10.6	1.15	29.8	1.75	56.0	2.32	86.3	2.59
MH+CIPC	11.1	0.82	35.1	1.57	70.8	2.63	142.2	3.08
Control	11.0	0.92	32.0	2.05	64.2	3.63	142.1	5.23
Mean	11.1	0.96	33.3	1.74	68.1	2.82	130.5	3.64
SE m±	1.9	0.08	2.3	0.14	2.8	0.14	7.1	0.29
CD (0.05)	NS	NS	NS	NS	8.6	0.43	21.9	0.89

*mg g^{-1} tuber weight

Table 2. Correlation matrix between respiration rate and storage parameters.

Parameters	Storage period (weeks)			
	4	8	12	16
Respiration rate and sprouting per cent	-	0.379NS	0.643**	0.695**
Respiration rate and sprout weight	-	0.178NS	0.679**	0.772**
Respiratory C loss and total weight loss	0.049NS	0.055NS	0.357NS	0.706**

**Significant at 1%

2 and 4 weeks of storage, respectively. Whereas in long dormant cultivars, Kufri Lalima and Kufri Dewa sprouting started after 5-6 weeks of storage (Data not included). Significant differences between different cultivars in per cent sprouted tubers were observed with mean maximum sprouting in cv. Kufri Lauvkar and minimum sprouting in Kufri Dewa on all observation dates (Fig. 2).

All treatments significantly decreased the mean percentage of sprouted tubers during storage in the four cultivars (Fig. 2). On 16 weeks of storage the reduction was maximum (83.6-90.4%) in CIPC-II treatments with maximum reduction observed in a long dormant cultivar Kufri Lalima. Similar was the trend of sprout weight (Fig. 3). Maximum reduction (93.4-95.5%) was observed in CIPC-II and minimum reduction (17.5-60.4%) in CIPC-I treatment up to 16 weeks of storage. Interaction between cultivar and treatment was significant up to 16 weeks of storage. Data revealed that the treatments effectively suppressed sprouting and sprout growth during storage under non refrigerated conditions in all the four potato cultivars differing widely in dormancy periods.

A highly significant coefficient of correlation was established between respiration rate and sprouting and respiration rate and sprout weight after 12 weeks of storage (Table 2). Correlation between respiratory carbon loss and total weight loss remained non significant up to 12 weeks of storage because respiration contributes very little to the total weight loss and a relationship between the two can not be expected. It however, became significant at 16 weeks of storage probably because the rates of both the physiological processes, respiration and evaporation contributing to total weight loss are increased manifold with the advanced sprout growth during later stages of storage at higher temperatures.

Based on above results, it can be concluded that basal value of respiration rate of tubers increase manifold with the onest of sprouting and advanced sprout growth during storage under non refrigerated conditions. The respiration rate was found to be positively and significantly correlated with sprouting and sprout growth of tubers during storage. Chemical sprout inhibitors significantly decreased the respiratory as well as the evaporative losses in tubers during storage as compared to control.

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