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Effect of pre-harvest sprays of growth regulators and chemicals on storage life of garlic (*Allium sativum* L.)[#]

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Abstract

The effect of pre-harvest treatments involving combinations of different chemicals and growth regulators *viz.*, maleic hydrazide (MH), MH + carbendazim, MH + dithane M-45, cycocel (CCC), CCC + carbendazim, CCC + dithane M- 45, borax, borax + carbendazim on storage life of garlic was studied. Among the treatments, minimum physiological loss in weight (30.67%) was recorded with the pre-harvest spray of MH (2500 ppm) + carbendazim (1000 ppm), three weeks prior to harvest followed by MH (2500 ppm) three weeks prior to harvest. Application of CCC (1000) ppm + dithane M- 45 (1000 ppm) showed maximum recovery of healthy cloves (41.04%) at the end of 180 days of storage.

Keywords: borax, carbendazim, cycocel, dithane M-45, maleic hydrazide, storage

Garlic (*Allium sativum* L.) is one of the second most important and widely consumed bulbous spice crops next to onion. Garlic is a seasonal crop and has comparatively low storability and bulbs are usually stored until the next planting season and significant losses in quantity and quality occur during storage. Storage of garlic bulbs has therefore become a serious problem in tropical countries like India, where post-harvest losses due to sprouting, rotting and physiological loss in weight pose great problems. Reports indicate that annual storage losses of more than 40% occur in garlic. Many at times, farmers find it difficult to sell the produce as the storage of crop would further enhance the losses due to weight loss, rotting etc. There are many instances when the bulbs needs to be stored till the next rabi season. This results in two to three times rise in the price when they are in short supply. The agronomic practices in vogue have lead to reduced storage life of garlic. Thus, during the seasonal glut, farmers are forced to sell the crop immediately. Keeping this in view, efforts are being made by garlic growing countries to overcome the post-harvest losses by reducing the rate of deterioration. Pre-harvest sprays have been widely applied to improve the keeping quality of garlic. Among the growth substances/ chemicals, maleic hydrazide (MH), cycocel (CCC), carbendazim, dithane M-45 and borax treatments as pre-harvest foliar applications

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have gained prominence. They have greatly facilitated in the maintenance of quality of garlic bulbs in storage with respect to inhibition of sprouting, rotting and reduction in the physiological loss in weight. Hence, the present study was taken up to study the effects of pre-harvest sprays of growth regulators and chemicals on storage life of garlic.

Field experiment was conducted at the Kittur Rani Channamma College of Horticulture, Arabhavi, Gokak Taluk, Belgaum district of Karnataka state during the rabi season of the year 2010-2011. This experiment was laid out in Randomized Block Design (RBD) with nine treatments and three replications. The size of the experimental plot was 3.0 m × 1.5 m with spacing of 15 cm × 7.5 cm. The cultivar of garlic used for the present study was 'Vannur Local'.

The treatment were: T_1- Maleic hydrazide (MH) 2500 @ ppm; T_2- MH 2500 @ ppm + carbendazim 1000 @ ppm; T_3- MH 2500 @ ppm + dithane M-45 1000 @ ppm; T_4- Cycocel (CCC) 1000 @ ppm; T_5- CCC 1000 @ ppm + carbendazim 1000 @ ppm; T_6- CCC 1000 @ ppm + dithane M- 45 1000 @ ppm; T_7- Borax 1000 @ ppm; T_8- Borax 1000 @ ppm + carbendazim 1000 @ ppm; T_9- Control (unsprayed).

The treatments were given three weeks before harvest by spraying uniformly with a hand sprayer to the foliage. The crop was harvested at maturity, i.e., 142 days after planting (DAP) when 50% of the plants showed drying and neck fall. The plants were uprooted from each plot separately, bundled and kept for curing on sand under shade for 15 days. The cured garlic bulbs were sorted out and 1.5 kg of healthy bulbs from each treatment was replicated thrice and kept in ambient conditions for storage studies. The observations were recorded on physiological loss in weight of cloves at 30, 60, 90, 120, 150 and 180 days after storage (DAS) and per cent recovery of marketable/ healthy cloves at 180 DAS. These parameters were calculated by using the formula:

$$PLW\ (\%) = [P0 - P_1 \text{ or } P_2 \text{ or } P_3 \text{ or } P_4 \text{ or } P_5 \text{ or } P_6] / [P_0] \times 100$$

Where, P_0=Initial weight; P_1=weight after 30 DAS; P_2=weight after 60 DAS; P_3=weight after 90 DAS; P_4=weight after 120 DAS; P_5=weight after 150 DAS; P_6=weight after 180 DAS

Recovery of marketable cloves (%) = [Weight of the healthy cloves obtained / Initial weight of bulbs stored] × 100

Physiological loss in weight (PLW)

Significant differences were observed among different treatments with respect to PLW at all the stages of storage except at 30 DAS (Table 1). At 180 DAS significantly least physiological loss in weight (30.67%) was recorded in T_2- MH (2500 ppm) + carbendazim (1000 ppm) and the highest physiological loss in weight (39.57%) was recorded in T_9- Control (unsprayed). It might be due to the fact that MH acts as an inhibiting substance in reducing the respiration of the bulbs, which in turn reduces the loss of moisture from the bulbs. It might also be attributed to the beneficial effect of MH, an antiauxin, which acts as mitotic inhibitor, chromosome breaking agent and growth suppressor. These results are in agreement with the findings of Kukanoor *et al*. (2007), Akhilesh *et al*. (2010), Gopalkrishnarao (1998) and Pandey *et al*. (1994).

Recovery of healthy cloves

All the pre-harvest sprays of growth regulators and chemicals were found to be significantly superior in reducing the PLW and enhancing the recovery of healthy cloves. Significantly higher recovery of healthy cloves (41.04%) was recorded in T_6- CCC (1000 ppm) + dithane M-45 (1000 ppm) and lowest recovery of healthy cloves (24.41%) was recorded in T_9- Control (unsprayed) at 180 DAS. This may be due to reduction in the moisture loss because pre-harvest sprays of growth regulators and chemicals are known to reduce the cell division after harvest and retain cell structural integrity in the epical region. These results support the earlier findings of Masters *et al*. (1985), Sidhu & Chadha (1986), Kukanoor *et al*. (2007) and Vijayakumar *et al*. (1989).

Table 1. Effect of pre-harvest sprays of growth regulators and chemicals on cumulative physiological loss in weight (PLW %) and recovery of healthy cloves of garlic cv. 'Vannur Local' in storage life

Treatment*		Cumulative physiological loss in weight (%)						Recovery of healthy cloves at the end of storage life (%)
		30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	
T_1	Maleic hydrazide (MH) 2500 @ ppm	3.77	6.40	13.23	16.97	23.17	31.97	35.35
T_2	MH 2500 @ ppm + carbendazim 1000 @ ppm	4.31	7.13	12.77	17.93	23.83	30.67	39.64
T_3	MH 2500 @ ppm + dithane M-45 1000 @ ppm	4.44	8.97	12.70	19.10	27.53	34.93	33.27
T_4	Cycocel (CCC) 1000 @ ppm	3.63	8.17	12.63	17.93	24.87	33.33	39.48
T_5	CCC 1000 @ ppm + carbendazim 1000 @ ppm	3.60	7.53	11.35	17.33	25.53	34.07	35.82
T_6	CCC 1000 @ ppm + dithane M- 45 1000 @ ppm	4.66	7.20	11.93	17.33	24.17	33.10	41.04
T_7	Borax 1000 @ ppm	3.22	8.07	13.47	18.30	25.60	34.80	32.46
T_8	Borax 1000 @ ppm + carbendazim 1000 @ ppm	4.51	8.33	14.00	19.43	27.27	34.43	34.67
T_9	Control (Unsprayed)	4.13	10.73	17.47	23.84	29.83	39.57	24.41
	Mean	4.03	8.06	13.28	18.69	25.76	34.10	35.24
	S.Em ±	0.62	0.76	1.06	1.17	1.15	1.49	2.91
	CD (P<0.05)	NS	2.29	3.18	3.50	3.44	4.47	8.71
	CV (%)	26.80	16.40	13.81	10.82	7.71	7.57	14.30

*Sprays were given as per treatments three weeks before harvest; DAS=Days after storage; MH=Maleic hydrazide; CCC=Cycocel; NS=Non-significant

Table 2. Initial vigour of garlic cv. 'Vannur Local' after storage period of 180 days during rabi season of 2011-2012

Treatment*		30 Days after sowing (DAS)				
		Plant height (cm)	No. of leaves plant^{-1}	Leaf length (cm)	Leaf breadth (cm)	Collar diameter (mm)
T_1	Maleic hydrazide (MH) 2500 @ ppm	22.39	4.53	11.58	0.45	3.29
T_2	MH 2500 @ ppm + carbendazim 1000 @ ppm	22.73	4.27	12.05	0.47	3.36
T_3	MH 2500 @ ppm + dithane M-45 1000 @ ppm	19.28	4.35	10.30	0.42	3.52
T_4	Cycocel (CCC) 1000 @ ppm	21.19	4.27	10.63	0.38	3.20
T_5	CCC 1000 @ ppm + carbendazim 1000 @ ppm	21.93	4.60	11.73	0.39	3.31
T_6	CCC 1000 @ ppm + dithane M- 45 1000 @ ppm	22.63	4.47	11.88	0.39	3.53
T_7	Borax 1000 @ ppm	22.03	4.60	10.96	0.42	3.12
T_8	Borax 1000 @ ppm + carbendazim 1000 @ ppm	22.14	4.13	10.68	0.39	3.19
T_9	Control (Unsprayed)	18.16	4.20	10.72	0.38	3.46
	Mean	21.39	4.05	11.17	0.41	3.33
	S.Em ±	0.95	0.16	0.84	0.04	0.19
	CD (P<0.05)	2.85	NS	NS	NS	NS
	CV (%)	7.69	6.22	13.02	15.61	9.80

*Sprays were given as per treatments three weeks before harvest during previous season; NS=Non-significant; DAS=Days after sowing; MH=Maleic hydrazide; CCC=Cycocel

Vigour of stored garlic cloves

Vigour of stored garlic tested after 180 DAS and at 30 DAP indicated that except plant height, other parameters like number of leaves plant^{-1}, leaf length and breadth and collar diameter were not affected significantly after storage (Table 2). Significantly highest plant height (22.73 cm) was recorded in cloves obtained from the treatment T_2- MH (2500 ppm) + carbendazim (1000 ppm) and the least plant height (18.16 cm) was recorded in cloves obtained from control (unsprayed). This may be due to reduced PLW in storage in treatments involving pre-harvest sprays of growth regulators and chemicals.

It may be concluded that pre-harvest sprays of growth regulators and chemicals significantly reduced the cumulative PLW compared to unsprayed control over a period of six months which resulted in higher recovery of healthy cloves. The changes from endodormancy to ecodormancy and subsequent sprouting of the bulbs undergo changes, the mechanism of which is not fully understood. In this regard the studies of Chope *et al*. (2012) are important, who reported significant changes during curing of onions and concluded that ratio of monosaccharides to disaccharides and concentration of zeatin riboside are important factors in discriminating between sprouting and presprouting of bulbs.

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