Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-7: 926-929

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-7 pp. 926-929**
Journal homepage: http://www.ijcmas.com

Original Research Article

Enhanced Shelf Life of Broccoli (*Brassica oleracea* var. *Italica*) at Ambient Condition Due to Foliar Application of Boron, Urea and GA_3

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A B S T R A C T

The experiment was conducted during rabi of two consecutive years i.e. 2013-14 and 2014-15 at horticultural farm of Birsa Agricultural University, Ranchi, Jharkhand, India. Sixteen treatments were used in a randomized block design with three replications. The treatments consisted of urea at three different concentrations of 0.5, 0.1 and 1.5%, GA_3 at three different concentrations of 25 ppm, 50 ppm and 75 ppm, B at three different concentrations of 1.0%, 1.5% and 2.0%. Different combinations of urea, Boron and GA3 were sprayed twice at 20 and 40 days after transplanting and a control was used with no spray. The data pertaining to self-life of curd at ambient condition was recorded to be maximum which is of 4.09 days at the treatment t_6 i.e. GA_3 @ 75ppm in both the years. Urea (0.5%) + GA_3 (75 ppm) + B as Borax (2%), when used in combination had significantly reduced the shelf life of curd in comparison to control i.e. 3.89 and 3.77 days in 2013-14 and 2014-15 respectively.

Keywords

Shelf life, ambient condition, Broccoli, foliar application, GA3, Urea and Boron

Introduction

Broccoli is an important vegetable among the Cole crops. The word *broccoli* comes from the Italian plural of broccolo, which means "the flowering crest of a cabbage", and is the diminutive form of brocco, meaning "small nail" or "sprout". Broccoli is a result of careful breeding of cultivated *Brassica* crops in the northern Mediterranean starting in about the 6th century BC. Since the time of the Romans broccoli has been considered a uniquely valuable food among Italians It is a rich source of vitamins and minerals. In fact, it contains more vitamin A than cabbage and cauliflower and the highest amount of proteins among the cole crops.

It also contains anti-cancerous compounds and antioxidants. For this reason, broccoli is a crop with increasing popularity. However, broccoli is a highly perishable product. The effect of different storage methods on shelf life of broccoli heads has been widely investigated (Izumi, Watada, & Douglas, 1996; Serrano, Martinez-Romero, Guillen, Castillo, & Valero, 2006; Vallejo, García-Viguera, & Tomás-Barberán, 2003). A timely harvest, cooling and controlled atmosphere are some of the tools used to extend the shelf life of broccoli. These practices reduce the rate of respiration and loss of quality of the vegetable directly, affecting the production and action of

ethylene, processes that are involved in the maturation and senescence of fruits and vegetables (Mattheis, Blankenship, Roberts, & Reed, 2000). Micronutrients enhance the shelf life of perishable vegetables by modulating several physiological and metabolic activities in the plant. They are useful in metabolic processes from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity, nitrogen fixation etc and influence the activities of many enzymes which are involved in maintenance of turgidity of cellular membrane and protein synthesis. Little investigations have been conducted to evaluate the response of combinations of Urea, Boron and GA3 on shelf life of sprouting broccoli at ambient temperature. Thus the present investigation is carried out to study their impact on the shelf life of this crop.

Materials and Methods

The experiment was conducted under filed conditions in the horticultural farm of Birsa Agricultural University, Ranchi, Jharkhand in the year of 2013-14 and 2014-15, on Broccoli variety Fiesta. The experimental site comes under the seventh Agro-Climatic region of country, i.e. Eastern plateau and hills which enjoys a sub-tropical climate with summer comparatively cool, heavy rainy season and moderate winters. The soil of the site is sandy loam with acidic pH which ranged between 5.4 to 5.7. Sixteen treatments were arranged in a randomized block design with three replications. The treatments consisted of urea at three different concentrations of 0.5, 0.1 and 1.5%, GA_3 at three different concentrations of 25 ppm, 50 ppm and 75 ppm, B at three different concentration of 1.0%, 1.5% and 2.0%. Different combinations of urea, Boron and GA3 were sprayed twice at 20 and 40 days after transplanting and a control was used with no spray. The randomly selected plants were tagged for observations. The curds of randomly selected and tagged plants were kept at ambient condition in clean hygienic environment. The shelf life of curd was carefully recorded and the average number of days was calculated and was then subjected to statistical analysis.

Results and Discussion

Shelf life of the curd is an important factor. The data pertaining to self-life of curd at ambient condition have been summarized in Table 1. Maximum value recorded was of 4.09 days at the treatment t_6 i.e. GA_3 @ 75ppm, in the year 2013-14. The treatment, T5 and T15 were recorded at par with T_6. The minimum shelf life of the curd that is 2.20 days was recorded with T_3 i.e. Urea.

The treatment T_{16}, control had recorded the value of 3.34 days. In the year 2014-15, the treatment T_6 i.e. GA_3 @ 75ppm had again recorded the maximum value of 3.90 days. T_5, T_{14} and T_{15} were recorded at par with T_6. The minimum shelf life of the curd at ambient temperature was recorded with T_3 i.e. Urea @ 1.5%. The treatment T_6, control had recorded the value of 3.31 days.

Urea and B when used individually had reduced the Shelf life of curd, GA_3 however was proved successful in enhancing the shelf life of curd at ambient temperature. Urea and GA_3, when used in combination had reduced the shelf life of curd in comparison to control. Urea @ 0.5%, with GA_3 and B had also positive effect upon the shelf life of the curd. Urea on the one hand increases the phenol content, however is reducing the shelf life of the curd. The results are in agreement with Mareczek and Leja (2005). Thus it could be concluded that the increasing phenol content had a negative impact upon the shelf life of the curd.

Table.1 Effect of foliar application of urea, boron and GA3 on the shelf life of broccoli (*Brassica oleracea* var. *Italica*) at ambient condition in the year 2013-14 and 2014-15

Treatments		Shelf life of curd at ambient condition	
		2013-14	2014-15
T_1	Urea (0.5%)	3.05	2.95
T_2	Urea (1.0%)	3.02	2.90
T_3	Urea (1.5%)	2.20	2.84
T_4	GA_3 (25 ppm)	3.50	3.10
T_5	GA_3 (50 ppm)	4.02	3.70
T_6	GA_3 (75 ppm)	4.09	3.90
T_7	B as Borax (1.0%)	3.41	3.11
T_8	B as Borax (1.5%)	3.20	3.11
T_9	B as Borax (2.0%)	3.20	3.00
T_{10}	Urea (0.5%) + GA_3 (25 ppm)	3.17	3.00
T_{11}	Urea (1.0%) + GA_3 (50 ppm)	3.20	3.10
T_{12}	Urea (1.5%) + GA_3 (75 ppm)	3.36	3.01
T_{13}	Urea (0.5%) + GA_3 (25 ppm) + B as Borax (1%)	3.62	3.12
T_{14}	Urea (0.5%) + GA_3 (50 ppm) + B as Borax (1.5%)	3.68	3.87
T_{15}	Urea (0.5%) + GA_3 (75 ppm) + B as Borax (2%)	3.89	3.77
T_{16}	Control	3.34	3.31
	S.E. (m) ±	0.13	0.15
	C.D. at 5%	0.39	0.43
	C.V. %	6.92	7.91

The enhanced shelf life of Broccoli, due to application of GA_3 may be attributed to the sound physiological and metabolic activities in the plant. The results are in agreement with Arora *et al.*, (2000).

It was observed that urea on the one hand is reducing the shelf life of the curd, while GA_3 on the other is increasing it. A combination of both, at different concentrations, enhanced the shelf life of curd which might be due to the positive effect of GA3.

Similarly, the treatments having the combinations of Urea, GA_3 and B at different concentrations had further enhanced the shelf life of the curd, which may be mainly attributed to the positive effect of GA_3 mainly.

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