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Full Length Research Paper

Postharvest application of heats treatment and thiabendazole, sodium bicarbonate fungicides on decay control and characteristics quality and quantity in the "Valencia" orange

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The aim of this study was to assess the effect of heat treatments and fungicides on shelf life of Valencia orange. The research was conducted in a completely randomized design with 3 replications and 21 treatments at two levels of inoculation and no inoculation. Treatments were included: Thiabendazole (300, 600, 1500 and 2000 ppm), sodium bicarbonate (0.5, 1, 1.5 and 2%), hot water (45, 50, 55 and 60°C) with the duration (1, 2 and 3 min), control treatment. The fruits, after harvest were affected by fungicides and heat treatments were in 2 levels of inoculated and non inoculated form. Then, they were maintained and kept in plastic bags for 3 months at a temperature of 6°C with relative humidity of 85 to 90% at the end of the third month, the quantitative tests and experiments including decay percent, qualitative traits of vitamin C, percentage of Tss and acidity were done on the samples. The comparison of averages indicated that, in two groups of inoculated and non inoculated, thiabendazole treatments and sodium bicarbonate had a great and more significant effect on fruit decay. In non inoculated fruits, the hot water treatments and highest level of TSS in inoculated fruits with hot water treatment (60°C for 3 min) was observed. However, there was no significant difference with 50°C hot water treatment. In inoculated and non inoculated fruits, the highest level of TA was observed in hot water treatment. On the whole, to control the induced disease of Penicillium attacks, we can recommend the use of fungicides and hot water treatments.

Key words: Shelf life, heats treatment, vitamin C, fungicide, Valencia orange.

INTRODUCTION

Higher importance citrus fruits especially orange, as one of the most important products and export material of Iran, we must demolish and minimize the damages induced by pathogens, by using suitable methods and we should take better method to increase and enhance their resistance to many pathogens, fruits contamination by micro organisms between the time of consumption and the time it is usually accelerated in hot climates especially when the relative moisture is high. Also, the fruits and vegetables due to having high moisture and foodstuff, are suitable environment, for the growth of various micro organisms. Their attack especially the fungicides, the most important issue in post harvest (Aidoo, 1991). The most prevalent microorganisms, such as the green mould and blue mould, which are created by *Penicillium digitatum* and *Penicillium italicum*. These moulds are seen and observable in every citrus garden, and are the predominate factors of decaying. The most important damage causing factor in post harvest period is Penicillium that imposes billions of dollars damage (Pitt, 1981). The green mould decay usually turns into green in wounded areas but in decay caused by blue mould, the edges of the wound changes color. Thiabendazole with 2000 ppm and bating a floating treatment of fruits in 52°C hot water for 3 min, effectively controls the blue green moulds in Valencia orange (Alemzadeh and Feridon, 2007).

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The results indicated that the floating of oranges in 53°C hot water, controlled the green moulds in fruits which had been inoculated artificially and bicarbonate sodium 3 or 4% with floating time of 150 s, was detected as a suitable method and as it experimented, the decay of fruits decreased to 90% (Smilanick and Sorenson, 2001). The research results has shown that, thiabendazole fungicides had the most and greatest effect in controlling green mould decay (Alden, 1985). Thiabendazole with (0, 25, 50, 100 ppm) and bicarbonate sodium 3% in temperatures of 16, 27, 38 and 49°C was applied to thiabendazole with 100 ppm in 49°C temperature and the most prohibitive effect green mould activity (Smilanick et al., 2006). Alemzadeh and Feridon (2007) showed that, thiabendazole fungicides 2000 ppm and the fruits floating in hot water for 3 min in 52°C significantly decreased green mould weight loss. Also, it maintained the firmness and ascorbic acid content of the fruit. Bicarbonate sodium fungicide with 0.5, 1, 1.5%, and thiabendazole with 400, 600 ppm with heat treatments caused controlled green mould and prevented weight loss in fruits (Schirra et al., 2008). Bicarbonate sodium with concentration of 3% decreases citrus post harvest decay (Torres et al., 2007).

The study showed that curing the fruits in 36°C for 72 h and fruits floating in hot water with 52°C for 2 min and temperatures of 52, 56 and 60°C for 10 s greatly decreased fruit decay (Poart et al., 2000). Using potassium sorbate fungicides, thiabendazole, imazalill, in company with hot treatment, decreased the prevalence of green mould (Smilanick et al., 2008). The floating of fruits in hot water 55°C for 2, 3 min caused the control of green mould and improved the post harvest quality in tangerine (Smilanick et al., 2008). The heat treatments can be appropriately replaced in stowing Valencia oranges with artificial fungicides (Williams et al., 1999; Nanes et al., 2007). The aim of this study was to assess postharvest application of heat treatment and thiabendazole, sodium bicarbonate fungicides on decay control and their effects on "Valencia" oranges quality and quantity traits.

MATERIALS AND METHODS

The needed fruits for doing the experiment, were bought form a garden located in Jahrom city in Fars province in the country of Iran. The tree age was 8 years, the samples were surveyed, from different points of view and the sound fruits were separated from dirty ones. After washing with ethanol (10%), they were disinfected and released on wire net for 2 h to be dried. For inoculation, we used contaminated fruits green mould as the source of spore. Ferg spore was taken away by using a scalpel and after purification, it was put on PDA. After 4 days, by using the Haemocytometer of green mould fungi spore by 1×10^6 per ml was provided.

Treatments applied included: thiabendazole 300, 600, 1500 and 2000 ppm, bicarbonate sodium 0, 0.5, 1, 1.5, and 2%, floating hot water 45, 50, 55 and 60°C for 1, 2 and 3 min and control treatment in 2 levels of inoculated and non inoculated. Each treatment was in plastic bags with 3 replications and in each one replication, 5 fruits were used. At the end of the experiment the assessed factors including decay percent, TSS, vitamin C and TA of the fruits were assessed and studied. To determine the total percentage of TSS we used a manual Refrectometer, acidity by using titration and as a percentage of citric acid was expressed. The amount of vitamin C was determined by using titration with KI (4%), data obtained were analyzed by SPSS software in completely randomized design and the means comparison was calculated by Duncan test at 5% probability level.

RESULTS AND DISCUSSION

Comparison of treatment means

Rot (decay) percent

The various treatments had different effect on fruits decay. In inoculated fruits, there was a significant difference between control and other treatments (Table 2). In inoculated fruits, the highest rate of health fruits were related to thiabendazole treatments with 1500, 2000 ppm and bicarbonate sodium 1, 1.5 and 2% in the non inoculated group, all the treatments (Table 1) were significantly different in comparison with control treatment. However, the hot water treatment in the non inoculated groups worked effectively as fungicides treatments, while the hot water treatments 60°C, worked effectively with other treatments. Based on the obtained results, thiabendazole with 2000 ppm , sodium bicarbonate with 1, 1.5, 2% and thiabendazole with 1500, 2000 ppm, effectively controlled the green mould; the obtained results are completely similar to results obtained by Schirra et al. (2008), Smilanick et al. (2008) and Alemzadeh et al. (2007).

Vitamin C

In 2 groups of inoculated and non inoculated, the effect of different treatments on vitamin C showed significant difference at the 5% level. In the non inoculated fruits, the 50°C treatment for 3 min (59.52 mg) and 60°C treatment for 1 min (47.31 mg) had the highest and least rate of vitamin C respectively. On the whole, retaining and storing of the fruits in controlled conditions of the store house caused decrease of vitamin C. Vitamin C is unstable and gets decreased specially due to adverse conditions.

Total amount of solid solutes (TSS)

The various treatments had significant differences in both states, inoculated and non inoculated, on TSS of fruit juice (Tables 3 and 4). In inoculated fruits, the highest amount of soluble solid material in hot water treatment of 60°C for 3 min was observed, which did not have any significant difference with 50°C hot water treatment, according to existing results in Table 1, it seems that hot

Table 1. Mean comparison levels thiabendazole , bicarbonate sodium and hot water treatment on characteristics quality fruits (no inoculation).

TSS(%)	TA(%)	VIT C(mg/100 ml)	ROT(%)	Treatment (noinoculation)
10.5833abc	1.225ab	52.69ab	0a	TBZ 300
10.5833abc	1.2403ab	52.7567ab	0a	TBZ 600
10.3333a	1.2133 a	55.3367abc	0a	TBZ 1500
10.5ab	1.2507abc	54.76abc	0a	TBZ 2000
11abcd	1.256abcd	52.47ab	0a	SBC 0.5
10.75abc	1.3567abcd	54.19abc	0a	SBC 1
11.0833abcd	1.4077abcd	54.4133abc	0a	SBC 1.5
10.5ab	1.3277bcd	53.6167abc	0a	SBC2
11abcd	1.431abc	59.0633bcd	5.5533a	HW 45 C°T 1
10.6667abc	1.281 d	58.06bc	0a	HW 45 C°T 2
10.8333abcd	1.497abc	62.5033cde	0a	HW 45 C°T 3
11.5833 cd	1.25 a	67.5067 de	0a	HW 50 C°T 1
10.5833abc	1.2133ab	67.5067 de	0a	HW 50 C°T 2
10.6667abc	1.2403ab	69.5133 e	0a	HW 50 C°T 3
10.5833abc	1.225abc	62.9333cde	0a	HW 55 C°T 1
10.8333abcd	1.246abc	54.42abc	0a	HW 55 C°T 2
10.5ab	1.323abcd	60.2bcd	0a	HW 55 C°T 3
10.5ab	1.4157abc	47.31a	0a	HW 60 C°T 1
10.5ab	1.3587abcd	51.61ab	0a	HW 60 C°T 2
11.5bcd	1.4513 cd	52.1ab	0a	HW 60 C°T 3
11.75 d	1.319abcd	52.03ab	16.6633b	control

Different letters in columns show significant difference based on Duncans multiple test at P ≥ 0.05.

Table 2. Mean Comparison levels thiabendazole , Bicarbonate sodium and hot water treatment on characteristics Quality fruits (inoculation).

TSS(%)	TA(%)	VITC(mg/100 ml)	ROT(%)	Treatment (inoculation)
10.75cd	1.316cdef	44.7467bc	11.1067a	TBZ 300
10.416cd	1.337def	49.1733bc	5.5533a	TBZ 600
10.6667cd	1.12bc	48.8833bc	0a	TBZ 1500
10.8333cd	1.12bcd	48.4533bc	0a	TBZ 2000
10.5cd	1.2667cdef	52.9833c	11.1067a	SBC 0.5
10.5833cd	1.429fgh	43.01bc	0a	SBC 1
11cd	1.4267fgh	53.6467c	0a	SBC 1.5
10.5cd	1.5563gh	52.18bc	0a	SBC2
10.5833cd	1.053b	47.2933bc	49.99de	HW 45 C°T 1
9b	1.2233bcde	46.74bc	66.6633e	HW 45 C°T 2
10c	1.5533gh	40.71b	49.99 de	HW 45 C°T 3
11.1677de	1.2333bcdef	47.4967bc	57.22 de	HW 50 C°T 1
10.5833cd	1.2767cdef	48.2433bc	44.4333cde	HW 50 C°T 2
10.75cd	1.3403def	45.6167bc	55.5467 de	HW 50 C°T 3
10.6667cd	1.222def	48.0333bc	38.8867bcd	HW 55 C°T 1
10.0833de	1.2647cdef	44.52bc	22.2167abc	HW 55 C°T 2
10.3333cd	1.411efgh	50.2bc	22.2167abc	HW 55 C°T 3
10.8333cd	1.609 h	45.48bc	22.2167abc	HW 60 C°T 1
11d	1.3863fg	45.3433bc	22.2167abc	HW 60 C°T 2
11.9167e	1.3123cdef	51.8bc	16.66ab	HW 60 C°T 3
0a	0a	0a	100f	Control

Different letters in columns show significant difference based on Duncans multiple test at P≥ 0/05.

Table 3. Analysis of variance thiabendazole, bicarbonate sodium and hot water treatment on characteristics Quality Fruits (no inoculation).

Mean square					Source
TSS	TA	VIT C	ROT	df	
17.091**	31.314**	357.975**	2235.167**	20	Treatment
0.250	1.230	35.604	161.253	42	Error

**Significant in the P ≥ 0.05, ns no significance.

Table 4. Analysis of variance thiabendazole, Bicarbonate sodium and hot water treatment on characteristics quality fruits (inoculation).

Mean square					Source
TSS	TA	VIT C	ROT	df	
0.459**	0.023**	108.311**	42.750**	20	Treatment
0.11	0.011	23.696	17.631	42	Error

**Significant in the P ≥ 0.05, ns no significance.

water treatments caused the increase of TSS, which is similar to the results of Nanes et al. (2007).

Total acid level

The treatment had significant effect on fruit acidity (Tables 1 and 2), so, that the highest rate of acidity in inoculated fruits was observable in hot water treatment 60°C for 1 min with 1.609 mg/ml (Table 2). In non inoculated groups, the highest rate of acidity was observed in 45°C hot water for 3 min which had no significant difference with 60°C treatment for 3 min and 45°C treatment for 1 min. On the whole, no significant difference was observed in the inoculation.

Conclusion

The most prevalent diseases in orange is penicillium, especially of green and blue moulds that control them. As such, we can get use of fungicides and heat treatment. In this research, the fungicides decreased the pollution of the fruits significantly but the heat treatment was not as effective as fungicides alone. The results according to combined probability of thiabendazole fungicides with hot water treatment, had higher and greater effect on green mould which is similar with the result of Smilanick et al. (2008). This result effect of these treatments was prevented by the initial propagation spore environs fruits.

Today, due to environment pollutions and fungicides dangers on fruits that threaten the health of consumers, it is highly recommended that hot water treatments are to be replaced with chemical materials. Floating fruits in hot water treatments through direct inhibition of pathogenic agent and promoting special defensive reactions have been known as methods to control post-harvest diseases. Part of the efficacy of hot water is due to its potential to remove spores from the wounds and also direct effect of high temperature on the pathogenic agent. No similar stimulating resistance in fruit cortex can play a role as well. During the past decades, benefit of most of the chemical treatments due to their efficacy, low cost and easy application has been documented. Recently, many factors have however, contributed to decreased dependence on chemical compounds.

One of the major reasons is the increased breed of resistant fungal strains due to inappropriate and continuous use of chemicals leading to their decreased efficacy. Therefore, new investigations are being conducted so that through employment of physical, chemical or biological agents like extracts of medicinal plants, resistance to pathogens can be increased. As a general conclusion in this research, the inoculated and non-inoculated fruits subjected to rot were investigated. This mild immunity might be directly related to lack of ability of treatments for perfect disinfection of wounds due to presence of pathogenic agents. However, the findings of this study corresponded with those of Smilanick et al. (1999).

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