

## EFFECT OF BIOAGENTS, OILS AND HERBAL EXTRACTS ON POST HARVEST DISEASES OF NAGPUR MANDARIN

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### ABSTRACT

An experiment was conducted to study the effect of microbial bioagents, oils and aqueous extracts on post harvest diseases during storage of Nagpur mandarin. The fruits treated with citronella oil (2%) resulted in minimum physiological loss in weight (2.48%), higher average juice content i.e. 96.38% g/fruit, higher per cent of acidity (0.55) and TSS (16.20 brix) followed by fruits treated with turmeric leaf oil (2%) at 45 days of storage. Spoilage was less (14.81%) in fruits treated with citronella oil (2%) followed by turmeric leaf oil (2%), which was 18.51%. The fruits treated with *T. viride* (104/ml retained higher amount of ascorbic acid (2%) and castor oil (2%). The fruits treated with citronella oil (2%) resulted in minimum physiological loss in weight (2.48%), higher juice content, acidity and TSS followed by fruits treated with turmeric leaf oil (2%). The ascorbic acid content was higher in *T. viride* at 45 days storage. Citronella, Carbendazim, turmeric leaf oil resulted in the minimum spoilage and mycoflora at 15, 30 and 45 days of storage.

**Key words:** bioagents, aqueous extracts, Nagpur mandarin, storage period

In India citrus is grown in 045 million hectares with a production of 3.79 million tones. The most important citrus cultivars in India are the mandarin (*Citrus reticulata* Blanco) followed by sweet orange (*Citrus sinensis* Obeck) and acid lime (*Citrus aurantifolia* Swingle) sharing 41, 23 and 23 per cent respectively in the country. Post harvest losses in citrus under Indian conditions are reported to be 15 to 20 per cent (Anonymous, 2001) which are evident as skin shriveling, weight loss, metabolic deterioration and rotting by pathogens. Generally blue and green mold rots, sour rots and stem end rots are the serious post harvest diseases found on mandarins. Therefore there is an emerging need to develop alternative means of decay control by treating Nagpur mandarins with some bio agents, oils and aqueous extracts. Despite their fundamental role in post harvest disease control, chemical treatments are confronted by several problems that threaten their future. These treatments which may leave a residue on fruits and in the environment are questionable in terms of public acceptance. This perception has resulted in trend to restrict or ban the use of synthetic fungicides already carefully and tightly regulated.

Loss of effectiveness of several fungicides attributed to the selections and proliferation of fungicides resistant to biotypes in pathogens population is an additional and ever increasing problem.

### MATERIALS AND METHODS

The well matured green color oranges with uniform size 65 - 70 mm diameter were procured from the orchard located near Akola. The fruits were thoroughly washed and cleaned and then these fruits were dipped in various suspension/emulsion/ solutions and various leaf extracts according to the treatments given in Table 1. In each treatments 45 fruits were used. The

experiment was laid out in randomized Block Design replicating thrice. Three oranges were taken for observation and analysis.

Periodical analysis was done at fortnightly interval for physiological weight loss (PWL %), average juice, TSS, acidity, ascorbic acid and per cent spoilage. The observations were recorded after fortnight. TSS was recorded with hand refractometer. The titrable acidity was determined by titrating the diluted fruit juice with N/10 NaOH using phenolphthalein as an indicator. The ascorbic acid was estimated by using methods as described in AOAC (1989). Spoilage in per cent was also recorded. The mycoflora was detected by Agar plate method.

### RESULTS AND DISCUSSION

An experiment was conducted at Post Harvest Technology Laboratory to study the effect of microbial bioagents, aqueous extracts on post harvest diseases during storage of Nagpur mandarin. The fruits treated with Palmorasa oil have been blackened immediately within three days. Hence the treatment was discarded for further analysis. The fruits treated with citronella oil recorded minimum weight loss i.e. 0.18, 1.77 and 2.48% at the end of 15, 30 and 45 days storage respectively followed by turmeric leaf oil (Table 1). The reduction in loss in weight with different oil treatment as compared to uninoculated control may be due to their effect on water loss and thereby retarded transpiration rate. Similar findings have been reported in acid lime by Jain (1999).

The juice content was increased in all the treatments significantly over uninoculated control. Maximum amount of juice content was found in citronella leaf oil treatment (101.06 g/fruit) followed by turmeric leaf oil (100.90 g/fruit) and castor oil (100.86 g/fruit) at 15 days storage. Similarly at the end of 45 days citronella oil (96.38

g/fruit) and turmeric leaf oil (96.01 g/fruit) observed superior in recording maximum average juice followed by castor oil (95.60 g/fruit). This was might be due to retentions of moisture losses resulted in maintaining higher juice recovery.

As regard acidity the data presented in Table 1 revealed significant differences due to various treatments over uninoculated control. At 15 days interval citronella oil had maximum acidity. It was observed that as the storage period increased the acidity decreased in all the treatments. At 45 days citronella oil treatment had retained acidity up to ( 0.55 %), which was highest as compared to other treatments followed by turmeric or leaf oil ( 0.54%). Similar results were obtained by Singhrot *et al.* ( 1987) in Baramasi lemon.

The ascorbic acid decreased significantly and regularly with storage period ( Table 2 ) and it was found that the losses in treated fruits were comparatively low as compared to untreated control. At 15 days interval the treatment of turmeric leaf oil, citronella oil and *T viride* had maximum amount of ascorbic acid content (28.66 mg/ 100ml) and found significantly superior over other treatments. At 30 days *T viride* had maximum ascorbic acid content (38.19 mg/100ml) followed by citronella oil ( 27.14 mg/100 ml). Similarly at 45 days of storage *T viride* had maximum ascorbic acid content ( 27.08 mg/ 100 ml) followed by turmeric leaf oil, citronella oil and castor oil which was at par with different oil and waxol shows maximum retention of ascorbic acid as compared to uninoculated control.

The TSS content increased up to 45 days in all treatment. It was revealed from the Table 2 that there was significant differences on TSS at 15,30 and 45 days of storage period. At 15th days the highest TSS ( 15.83%) was recorded by citronella oil and was superior over all the treatments. Uninoculated control had maximum TSS. This was due to moisture loss in these treatments. Among the treated fruits maximum TSS ( 16. 93° brix) was recorded in citronella oil ( 15.93° brix) followed by turmeric leaf oil. Similar results are quoted by Jain ( 1999) and, Jain and Chauhan (1994).

It was revealed from the Table 2 that there was a difference on spoilage at all the intervals due to various treatments. Citronella oil, turmeric leaf oil and carbendazim recorded minimum spoilage percentage at 15 and 30 days intervals viz. ( 4.44%) and ( 10.81 %) respectively. However at 45 days interval\_ the minimum spoilage was noticed in citronella oil (14. 81%) followed by turmeric leaf oil ( 18.51%). In general the spoilage was found to be increasing from 15 days to 45 days of storage period. It revealed from the Table 3 that during 45 days storage of Nagpur mandarin under ambient condition the minimum average mycoflora (6.65%) was observed in carbendazim followed by thiram (8.65%) indicating that the treatments were superior over uninoculated control followed by oil treatments ( 14-16 %). Among the oil citronella and turmeric leaf oil showed 14.06% and 15.91 % mycoflora respectively. Among the bio agents *T viride* was found effective ( 18.85 %) for controlling mycoflora of Nagpur mandarin as compared *P.flourescens* (21.79%).

**Table 1. Effect of bioagents, aqueous extracts and oil emulsion on physiological weight loss average juice content and acidity at various intervals.**

Treatment	Concentration %	Physiological wt loss			Av. Juice (g/fruits)			Acidity (%)		
		15 days	30 days	45 days	15 days	30 days	45 days	15 days	30 days	45 days
<i>Trichoderma viride</i>	1	0.66	2.89	3.65	99.72	96.05	88.13	0.60	0.57	0.53
(Culture filtrate)										
<i>Pseudomonas fluorescence</i>	2	0.33	2.16	3.02	100.34	97.34	94.64	0.57	0.54	0.51
(Culture filtrate)										
Turmeric leaf oil	2	0.21	1.83	2.59	100.90	97.70	96.01	0.60	0.58	0.54
Citronella oil	2	0.18	1.77	2.48	101.06	98.26	96.38	0.61	0.58	0.55
Eucalyptus oil	2	0.27	1.98	2.83	100.86	97.48	95.10	0.51	0.48	0.46
Castor oil	2	0.22	1.90	2.68	100.86	97.40	95.60	0.58	0.56	0.52
Kalmegh leaf extract	10	1.31	2.64	4.38	99.24	94.61	84.52	0.51	0.46	0.45
Thiram	0.05	0.92	2.94	3.79	99.42	94.64	85.43	0.56	0.53	0.48
Gokami extract	10	1.27	2.79	4.15	99.16	94.62	84.52	0.55	0.49	0.47
Adulasa leaf extract	10	1.20	2.99	3.96	99.61	94.70	86.47	0.49	0.46	0.44
Carbendazim	0.05	0.43	2.42	3.65	100.00	96.84	92.05	0.51	0.47	0.45
Albendazim	0.05	0.63	2.44	3.56	99.89	96.39	89.76	0.57	0.55	0.49
Uninoculated control		2.43	3.18	5.09	100.66	81.37	65.10	0.48	0.43	0.41
C.D p = 0.01		0.45	3.08	1.57	0.33	2.07	8.25	0.012	0.028	0.15

**Table 2. Effect of bioagents, aqueous extracts and oil emulsion on ascorbic acid, TSS and spoilage at various intervals.**

Treatment	Ascorbic acid (mg/100 ml)			TSS (%)			Spoilage (%)		
	15 days	30 days	45 days	15 days	30 days	45 days	15 days	30 days	45 days
<i>Trichoderma viride</i>	28.66	28.19	27.08	15.26	15.60	15.76	6.66	13.88	24.00
<i>Pseudomonas fluorescens</i>	26.53	26.10	25.00	15.63	15.76	15.83	6.66	13.88	24.00
Turmeric leaf oil	28.66	26.10	26.04	15.80	15.86	15.93	4.44	10.81	18.51
Citronella oil	28.66	27.14	26.04	15.83	15.86	16.20	4.44	10.81	14.81
Eucalyptus oil	25.47	24.01	22.91	15.76	15.83	15.86	6.66	13.88	24.00
Castor oil	27.59	26.10	26.04	15.26	15.63	15.76	6.66	13.88	24.00
Kalmegh leaf extract	23.25	22.96	20.83	15.40	15.70	15.63	8.88	17.14	26.08
Thiram	26.51	25.06	23.95	15.06	15.56	15.93	6.66	13.88	20.00
Gokarni leaf extract	25.47	25.06	22.91	15.60	15.76	15.80	8.88	17.14	30.43
Adulasa extract	22.29	21.06	18.75	15.46	15.76	15.76	11.11	17.64	31.81
Carbendazim	24.41	24.01	21.87	15.66	15.70	15.83	4.44	13.51	19.23
Albendazim	26.53	26.10	25.00	15.33	15.60	15.86	6.66	13.88	20.00
U ninoculated control	27.59	26.10	25.00	15.33	16.06	16.80	11.11	20.58	42.85
CD p=0.01	3.19	3.30	3.45	0.362	0.190	0.218			

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Table 3. Effect of microbial bioagents, aqueous extracts and oil on mycoflora (%) of Nagpur mandarin during storage at various interval

Treatment	15 Days					30 Days					45 Days					Av.			
	C.g	Alt.sp	A.spp	F.sp	C.o	Total	C.g	Alt.sp	A.spp	F.sp	C.o	Total	C.g	Alt.sp	A.spp		F.sp	C.o	Total
<i>T. viride</i>	3.33	6.66			6.66	16.65	6.66	6.66			6.66	19.92	9.99	6.66			3.33	19.98	18.85
<i>P. fluorescens</i>	3.33	17.7			3.33	24.36	6.66	7.77		6.66	21.02			16.66		3.33		19.99	21.79
Turmeric leaf oil			6.66	9.99		16.65				6.66	14.43			3.33	3.33	9.99		16.65	15.91
Citronella oil			9.99			9.99			7.77	7.77	15.54			6.66		9.99		16.65	14.06
Eucalyptus oil	6.66	9.99	3.33	3.33	7.77	19.98	7.77	7.77	9.99	9.99	25.53	3.33	6.66	6.66	9.99	9.99		19.98	21.83
Castor oil	6.66	16.66	3.33	3.33	6.66	26.65	6.66	13.33	3.33	3.33	23.32	16.66	6.66	6.66	9.99	9.99		33.31	27.76
Kalmegh leaf extract	3.33	25.55	38.88			86.65	16.16	23.33	16.66		56.65	9.99	23.33	16.66				33.31	64.42
Thiram			9.99			12.66			6.66	3.33	9.99	3.33	3.33	9.99	3.33	6.66		13.32	8.65
Gokarni leaf extract	23.33	3.33	6.66			33.32	20.00	20.00	6.66	6.66	36.65	16.66	9.99	9.99	16.66			43.31	37.76
Adulsa leaf extract	3.33	25.55	9.99			38.87	20.00	20.00	3.33	3.33	48.88	23.33	9.99	9.99	17.77			51.09	46.28
Carbendazim			6.66			9.99			3.33	3.33	6.63						3.33	3.33	6.65
Thiabendazole	6.66	9.99	3.33			19.98	9.99	6.66		3.33	19.98	6.66	3.33	3.33	6.66	3.33		16.65	18.87
Un inoculated control	7.77	20.00	16.00	44.44		88.80	6.66	23.23	16.66	9.99	73.33	20.00	9.99	9.99	31.11	20.00	6.66	87.76	83.28

C.g - *Colletotrichum gloeosporioides*, Alt.sp. - *Alternaria spp*, A.spp.- *Aspergillus spp*, F.spp.- *Fusarium spp.*, C.o. - *Cladosporium oxysporum*.