International Journal of Agricultural Sciences
Volume 8 |Issue 1| January, 2012 | 161-164

RESEARCH PAPER

Prolongation of harvesting period in Kinnow mandarin

NIRMALJIT KAUR* AND P.K. MONGA
Regional Research Station (P.A.U.), ABOHAR (PUNJAB) INDIA
(Email : nirmal_physio@rediffmail.com)

Abstract **:** Foliar application of different chemicals, *viz*., gibberellic acid (50 ppm), 2,4- dichlorophenoxyacetic acid (20 ppm) and calcium nitrate (1.0 %) prolong the harvesting period of kinnow mandarin without affecting fruit yield and quality in the successive year. Fruit yield increased significantly with the application of different chemicals in comparison to control and maximum fruit yield was obtained with 2,4 – D (20 ppm) application. With the prolongation of harvesting period, fruit yield declined and minimum decline (16.25 %) was observed with 2,4-D (20 ppm). Fruit quality parameters, *viz*., fruit size, fruit weight, juice, TSS, acidity and vitamin C varied significantly with the prolongation of harvesting period and improved with the foliar application of 2,4-D (20 ppm).

Key Words **:** Tree storage, Kinnow, Gibberellic acid, 2,4 - D, Calcium nitrate

View Point Article **:** Kaur, Nirmaljit and Monga, P.K. (2012). Prolongation of harvesting period in Kinnow mandarin. *Internat. J. agric. Sci.*, **8**(1): 161-164.

Article History **: Received :** *09.06.2011;* **Revised :** *26.09.2011;* **Accepted :** *15.11.2011*

INTRODUCTION

Since citrus fruits are non climacteric, the commercial harvest of any particular variety can occur over a prolonged period in the same orchard. Delayed citrus fruit harvest has earlier been reported to influence fruit quality variables during a current season and affect the next years yield (Papadakis *et al*., 2008). After attaining the harvest maturity, Kinnow fruits have been found to lose their firmness within 2-4 weeks thereby reducing the marketability of the fruit to a greater extent (Sandhu, 1992). Loose skinned fruits such as Satsumas, Mandarin and Ponkan easily puff up and loose quality during storage at high humidity (Murata, 1981). However, growth regulators have been reported to delay maturity and prolong shelf life in citrus (Coggins, 1973). The present investigations were, therefore, carried out to study the effect of different chemicals in prolonging the harvesting period in Kinnow mandarin without affecting the fruit yield and quality.

MATERIALS AND METHODS

To study the effect of chemicals in prolongation of the harvesting period of Kinnow mandarin fruits, GA_3 (50 ppm), 2,4-D (20 ppm), and $CaNO_3$ (1.0 %) were sprayed during mid-October and mid-November on twelve year old Kinnow mandarin trees planted at spacing of 25' x 25', having uniform growth and vigour during the fruiting seasons 2004-07. Each treatment was replicated thrice with single tree unit per replication. The fruit samples were collected starting from mid January to end March at an interval of 15 days each and analyzed for their physico – chemical characteristics using standard methods (AOAC, 1990). The fruit yield was recorded at each date of sample collection.

RESULTS AND DISCUSSION

The data presented in Table 1 indicates that fruit size varied significantly with the foliar application of different chemicals at different intervals of harvesting period. Fruit length increased significantly in all the treatments over control and maximum mean fruit length (6.64 cm) was observed in the fruits harvested from trees treated with gibberellic acid (50 ppm). Inconsistent variations (increase / decrease) of fruit breadth observed at different intervals of harvesting period of fruits, but maximum mean fruit breadth (7.61 cm) was observed with 2,4 – D (20 ppm) treatment.

*** Author for correspondence.**

Fruit weight and juice content (Table 2) increased significantly in all the treatments over control at different intervals of harvesting period. Fruit weight (199.73 g) and juice (51.93 %) contents were found to be maximum in 2,4 – D (20 ppm) treatment which is in agreement with the findings of Rodrigues *et al.* (1963) in Coorg mandarin. However, increase in juice content and fruit weight in Kinnow mandarin (Sandhu, 1992) and Nagpur mandarin (Ladaniya, 1997) was observed with gibberellic acid.

TSS increased while acidity content decreased (Table 3) significantly with the foliar application of chemicals in comparison to control during different intervals of harvesting period. Maximum TSS (11.46 %) while minimum acidity (0.713 %) contents were observed with the foliar application of 2,4-D (20 ppm). The increase in TSS while decrease in acidity during the prolongation of harvesting period might be due to biochemical changes occurring during the period as reported by Bhullar (1983).

Table 1 : Effect of tree storage on fruit size of Kinnow fruits (Average of three years, 2004-2007)

Treatments	Fruit length (cm)						Mean fruit length (cm)	Fruit breadth (cm)						Mean fruit breadth (cm)
	Mid-Jan	End-Jan	Mid-Feb	End-Feb	Mid-Mar	End-Mar		Mid-Jan	End-Jan	Mid-Feb	End-Feb	Mid-Mar	End-Mar	
Gibberellic acid (50 ppm)	6.34	6.50	6.74	6.79	6.82	6.65	6.64	7.23	7.50	7.83	7.82	7.69	7.25	7.55
2,4-D(20 ppm)	6.36	6.53	6.69	6.69	6.86	6.53	6.61	7.33	7.65	7.86	7.79	7.91	7.09	7.61
Calcium nitrate (1.0 %)	6.37	6.49	6.67	6.63	6.68	6.47	6.55	7.53	7.46	7.79	7.60	7.39	7.37	7.02
Control	6.11	6.37	6.61	6.02	6.49	6.14	6.29	7.31	7.12	7.50	7.51	7.32	7.06	7.30
C.D. (P=0.05)	0.14	0.03	0.06	0.06	0.09	0.20	0.14	NS	NS	0.01	0.11	0.09	0.09	NS

NS=Non-significant

Table 2: Effect of tree storage on fruit weight and juice per cent of Kinnow fruits (Average of three years, 2004-07)

Treatments	Fruit wt (g)						Mean fruit weight (g)	Juice (%)						Mean juice (%)
	Mid-Jan	End-Jan	Mid-Feb	End-Feb	Mid-Mar	End-Mar		Mid-Jan	End-Jan	Mid-Feb	End-Feb	Mid-Mar	End-Mar	
Gibberellic acid (50 ppm)	182.2	178.4	189.4	193.0	196.4	205.7	190.85	51.57	50.65	50.46	51.89	50.67	48.99	50.70
2,4-D (20 ppm)	194.7	188.3	192.7	201.8	206.0	214.9	199.73	52.11	52.44	51.73	53.14	51.99	50.19	51.93
Calcium nitrate (1.0 %)	180.7	176.3	186.9	172.3	191.7	196.9	184.13	51.19	48.84	50.43	48.88	48.77	47.83	49.32
Control	176.7	165.1	183.8	168.7	182.3	192.7	178.22	49.91	47.97	49.55	47.18	48.97	49.06	48.77
C.D. (P=0.05)	6.92	8.67	NS	6.98	9.41	6.31	5.59	0.91	0.89	0.49	1.10	1.15	1.15	1.13

NS=Non-significant

Table 3: Effect of tree storage on total soluble solids and acidity per cent of Kinnow fruits (Av. of three years, 2004-07)

Treatments	TSS (%)						Mean TSS (%)	Acidity (%)						Mean acidity (%)
	Mid-Jan	End-Jan	Mid-Feb	End-Feb	Mid-Mar	End-Mar		Mid-Jan	End-Jan	Mid-Feb	End-Feb	Mid-Mar	End-Mar	
Gibberellic acid (50 ppm)	10.03	10.28	10.27	11.13	11.27	11.41	10.73	0.874	1.036	0.845	0.567	0.533	0.499	0.726
2,4-D (20 ppm)	10.18	10.98	10.94	12.10	12.20	12.34	11.46	0.857	1.067	0.832	0.529	0.520	0.473	0.713
Calcium nitrate (1.0 %)	9.80	9.88	9.51	11.34	11.20	11.53	10.54	0.956	1.040	0.837	0.580	0.524	0.496	0.738
Control	9.27	9.45	9.46	11.10	11.20	11.23	10.28	0.960	1.060	0.883	0.652	0.550	0.524	0.772
CD (P=0.05)	0.22	0.09	0.19	0.14	0.33	0.19	0.28	0.042	NS	NS	0.042	NS	NS	0.031

NS=Non-signifcant

The data presented in Table 4 reveals that reducing sugar and vitamin C content increased significantly in all the treatments over control at different intervals of harvest. Reducing sugar and vitamin C contents were found to be higher at different intervals of harvesting period in Kinnow mandarin with foliar application of 2,4-D (20 ppm) treatment.

The data (Table 5) reveal that the fruit yield (No. of fruits / tree) increased significantly with the application of different growth regulators over control and higher yield (1003 fruits / tree) obtained with foliar application of 2, 4 – D (20 ppm) treatment at the time of optimum maturity (up to 15th January). On prolongation of harvesting period till end March, the fruit

Table 4: Effect of tree storage on biochemical contents of Kinnow fruits (Average of three years, 2004 - 2007)

Treatments	Reducing sugars (%)						Mean reducing sugars (%)	Vitamin C (mg/100 ml juice)						Mean vitamin C (mg/100 ml juice)
	Mid-Jan	End-Jan	Mid-Feb	End-Feb	Mid-Mar	End-Mar		Mid-Jan	End-Jan	Mid-Feb	End-Feb	Mid-Mar	End-Mar	
Gibberellic acid (50 ppm)	2.15	2.97	2.70	2.85	2.50	3.45	2.77	27.55	25.45	23.53	22.59	22.14	28.14	24.90
2,4-D (20 ppm)	2.31	3.48	2.91	3.48	2.61	3.53	3.05	30.82	29.34	27.20	26.06	22.11	29.11	27.44
Calcium nitrate (1.0 %)	2.12	3.33	2.63	2.78	2.50	3.33	2.78	25.55	24.52	23.61	25.89	21.44	27.67	24.79
Control	1.95	2.91	2.56	2.65	2.45	3.12	2.61	23.61	22.68	22.38	25.29	19.31	26.69	23.32
C.D. (P=0.05)	0.07	0.15	0.13	0.14	0.09	0.18	0.10	1.01	0.35	1.44	0.45	0.41	0.48	1.71

Table 5: Effect of tree storage on fruit yield (No. of fruits/tree) of Kinnow fruits

Harvesting dates		Fruit yield (No. of fruits/tree)				C.D. (P=0.05)
		GA_3(50ppm)	2,4-D(20 ppm)	$CaNO_3$ (1.0 %)	Control	
Mid-	04-05	860	975	780	665	
Jan	05-06	890	1035	734	702	
	06-07	815	1000	766	685	
	Mean	855(25.00)	1003(46.64)	760(11.11)	684	58.54
End-	04-05	790	925	700	655	
Jan	05-06	826	987	740	690	
	06-07	808	960	715	683	
	Mean	808(19.53)	957(41.57)	718(6.21)	676	14.78
Mid-	04-05	745	885	690	615	
Feb	05-06	792	927	723	675	
	06-07	788	903	666	690	
	Mean	775(17.42)	905(37.12)	693(5.00)	660	43.32
End-	04-05	760	835	670	615	
Feb	05-06	725	880	700	640	
	06-07	741	850	657	600	
	Mean	742(20.06)	855(38.35)	676(9.39)	618	38.54
Mid-	04-05	680	871	640	600	
March	05-06	675	837	682	575	
	06-07	711	833	658	600	
	Mean	689(16.38)	847(43.07)	660(11.48)	592	43.13
End-	04-05	725	860	620	545	
March	05-06	700	835	594	537	
	06-07	700	826	631	528	
	Mean	708(31.84)	840(56.42)	615(14.52)	537	24.92
Mean of stages		763(21.49)	901(43.47)	687(9.39)	628	22.37
Per cent decrease in stage VI over stage I		17.19	16.25	19.08	21.49	--

yield declined and minimum decline (16.25 %) was observed in 2,4- D (20 ppm) treatment as compared to other treatments. Higher fruit yield (56.42 %) over control was observed during end March might be due to check in fruit drop by 2,4-D (20 ppm) as earlier reported in Kinnow (Kaur *et al*., 2007) and Coorg mandarin (Ladaniya, 1997).

The prolongation of harvesting period in Kinnow mandarin can be done successfully without affecting its yield and fruit quality adversely. Maximum fruit yield and good quality fruits could be attained with foliar application of 2,4-D (20 ppm) uptil end March.

REFERENCES

AOAC (1990). *Official methods of Analysis*. Association of Official Agricultural Chemists. 15th Ed., Washington DC.

Bhullar, J.S. (1983). Storage behavior of Kagzi lime fruits. *Haryana J. Hort. Sci*., **12** : 52-53.

Coggins, H.Ch.W. (1973). Use of growth regulators to delay maturity and prolong shelf life of citrus. *Acta Hort*., **34** : 469-472.

Kaur, N., Monga, P.K., Thatai, S.K. and Vij, V.K. (2007). Physiological fruit drop check in *Kinnow mandarin. Environ. & Ecol*., **25S**(4A):1297-1299.

Ladaniya, M.S. (1997). Response of Nagpur mandarin to pre harvest sprays of gibberellic acid and carbendazim. *Indian J. Hort.,* **54**(3) : 205-212.

Murata, T. (1981). Physiological disorders of citrus fruits in Japan. *Proc. Int. Soc. Citriculture*, **2** : 776-778.

Papadakis, I.F., Protopapadakis, E.E. and Therios, I.N. (2008). Yield and fruit quality of two late maturing Valencia orange tree varieties as affected by harvest date. *Fruits*, **63**(6) : 327-334.

Rodrigues, J., Dalal, V.B., Subramanyam, H., Aiyappa, K.M. and Srivastava, H.C. (1963). Effect of pre harvest sprays of plant growth regulators on Coorg mandarin and their storage studies with and without wax coating. *Food Sci., Mysore*, **12** : 336-340.

Sandhu, S.S. (1992). Effect of preharvest sprays of GA, vipul, $CaCl_2$ and bavistin on the tree storage of Kinnow fruits. *Acta Hort*., **321** : 366-371.

*_*_*_*_*_*