International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 7, Issue 7, 2015, pp.-554-558.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

EFFECT OF FOLIAR SPRAY OF UREA AND GROWTH REGULATORS ON MARKETABLE YIELD AND QUALITY OF MANGO CV. "AMRAPALI"

MANDAL B.K., RANI R.* AND RAY R.N.

Department of Horticulture, Birsa Agricultural University, Kanke, Ranchi - 834 006, Jharkhand, India.
*Corresponding Author: Email- rrupa_bau@rediffmail.com

Received: June 20, 2015; Revised: August 25, 2015; Accepted: August 28, 2015

Abstract- To assess the impact of foliar spray of urea 2 (%), thio-urea (1000ppm), and PGRs (GA_3, 100ppm, NAA 40ppm, ethephon 200ppm, SA 100 and 200ppm and triadimefon 1000 and 2000ppm) alone and in combination with urea 2 percent on marketable yield and quality characters of Amrapali mango under agro-climatic condition of Ranchi were carried out at the Department of Horticulture, Birsa Agriculture University, Jharkhand during two fruiting season 2008-2010. Maximum duration of panicle emergence (37 days) and minimum days required for anthesis (19.33 days) were observed from ethephon 200ppm treated tree. However, minimum fruit drop (86.16%) and maximum fruit retention per panicle (5.41%) was observed with SA 100ppm in combination with urea spray over control (water spray). The highest yield per tree (16.21kg) was recorded under plant treated with SA 200ppm in combination with urea 2 percent. Highest total sugar (11.97%) as well as non reducing sugar (9.51%) in the fruits of the plant sprayed with triadimefon 200ppm. Similarly, the highest increase in ascorbic acid and β-carotene were measured highest from the fruits of the plants sprayed with triadimefon 2000ppm in combination with urea 2 percent. Beside salicylic acid 100ppm along with urea 2 percent recorded minimum spoilage (10.62%) over control.

Keywords- Plant Growth Regulators, Mango, Yield, Quality

Citation: Mandal B.K., et al (2015) Effect of Foliar Spray of Urea and Growth Regulators on Marketable Yield and Quality of Mango Cv. "Amrapali". International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 7, Issue 7, pp.-554-558.

Introduction

Despite the largest production base of mango in the world with respect to number of varieties grown and area under cultivation, the productivity of mango in India is low, which adversely affect the economic potentialities of its production. Among several reasons for low productivity, high incidence of fruit drop at initial stages of fruit development owing to assimilate limitation, improper source sink relationship and internal hormonal imbalance are of primary importance [1-3]. Several studies on different fruit crop have shown that plant growth regulations have potential to enhance productivity of fruits by bringing out a change in nutritional and hormonal status of the plant [4-6]. It is evident from the reports of [7-9] conducted on different fruit crops that bearing habit of mango fruit is brought to be triggered by GA_3, NAA and ethephon. The effect of salicylic acid has been known to be present in some plant tissues for quite some time, but has recently been recognized as potent plant growth regulators which play an important role in regulating a number of plant physiological processes [10]. Recently, among important triazole group, triadimefon (Bayleton) has been widely used for fungicidal properties which also exhibit plant growth regulating activities [11,12]. Plant nutrition, particularly the level of N has more influence on growth, yield and quality of fruits than any other single plant nutrient and has been shown to be integral part for routine orchard management [13-15]. The application of foliar nitrogen and plant growth regulator can provide significant economic advantages to mango growers when used in appropriate situation as they have proven to be effective in stimulating number of desired responses such as increase in bearing ability, reducing pre harvest fruit drop as well as increase in shelf life of fruit. Therefore, this study was initiated with the objective to study the impact and efficacy of foliar N applied through urea and thio- urea and PGRs alone or in combination with urea on fruit production along with quality and shelf life of 'Amrapali' mango.

Materials and Methods

The study was conducted on 10 years old uniform and well managed 'Amrapali' mango plants which were spaced at about 5 x 5m growing at Horticulture garden Department of Horticulture, Birsa Agricultural University, Ranchi in two fruiting seasons from 2008 to 2010. Altogether, there were seventeen treatments with three replications using single plant as a treatment unit in Randomized Block Design (RBD). The treatments were T_1 = urea 2%, T_2 = thio-urea 1000 ppm; T_3 = GA_3 100 ppm; T_4 = NAA 40 ppm; T_5 = ethephon 200 ppm; T_6 = SA 100 ppm; T_7 = SA 200 ppm; T_8 = triadimefon 1000 ppm; T_9 = triadimefon 2000 ppm ; T_{10} = GA_3 100 pm urea 2 (%); T11 = NAA 40 ppm + urea 2 (%); T_{12} = ethephon 200 ppm + urea 2 (%); T_{13} = SA 100 ppm + urea 2 (%); T_{14} = SA 200 ppm + yrea 2 (%); T_{15} = Triadimefon 1000 ppm + urea 2 (%); T_{16} = Triadimefon 2000 ppm + urea 2 (%) and T_{17} = Control (water spray). Aqueous solution of all the treatments was prepared and sprayed on whole tree to run off. In order to give a clear understanding, the extent of flowering, fruit set and fruit retention 10 uniform shoot were

selected randomly in each treatment and tagged. Duration of panicle emergence as well as flowering, days to 50% flowering were calculated in days after spraying of chemicals and they were recorded by visual observation through regular visiting to orchard. Fruit drop percent as well as number of fruit retention per panicle on the tagged shoot initially and at the time of fruit maturity were counted. Samples of 30 representative fruits were collected randomly from all sides of each plant and average fruit weight (g) and fruit volume were calculated. Fruit yield were recorded at the time of harvesting from each plant individually and expressed as kilogram/plant. The fruit pulp quality analysis including ascorbic acid, total sugar as well as non reducing sugar, TSS/acid ratio and β- carotene were done following standard producers.

"Amrapali" mango fruits were harvested at commercial maturity from the orchard. Thereafter, fruits were transferred into bamboo baskets and kept at ambient condition (26-32 and 65-75% RH) for about 2 weeks in different lots. Fruits were assessed daily during shelf life evaluation for skin colour and firmness changes. Subjective visual skin colour ratings were; 1. 100% green; 2. 25% yellow; 3. 50% yellow; 4. 75% yellow and 5. 100% yellow [16]. Hand firmness rating were 1. Hand; 2. Firm; 3. Slightly soft; 4. Soft, and 5. Very soft [17].

Results and Discussion

All the experimental treatments significantly extended the duration of panicle emergence and shortened the days required for anthesis compared with control [Table-1]. Maximum duration of panicle emergence (37 days) was observed from ethephon 200 ppm treated tree, statistically similar to triadimefon 2000 ppm (36 days) followed by SA 200 ppm (35.5 days). Maximum duration of panicle emergence (24 days) was observed from control tree (water sprayed). Similarly, minimum day required for anthesis from ethephon 200 ppm treated tree (19.33 days) which was almost equally effective with treatment triadimefon 1000 ppm (19.83 days) whereas maximum days 29.50 was required from anthesis from tree treated with water only (control). The minimum days taken to 50% flowering (73.54) were recorded at 200 ppm ethephon. The next equally effective treatments with each other were ethephon 200 ppm + urea 2 percent (76.35 days) and triadimefon 1000 ppm + urea 2 percent (76.86 days). Applying triadimefon (2000 ppm) combined with urea 2 percent increased the intensity of flowering shoot (88.50%) in fruit plant which was almost equally effective with SA 100 ppm + urea 2 (%) sprayed fruit plant. Minimum intensity of flowering shoot (48.67%) was observed in water sprayed fruit tree (control). Early differentiation of buds and anthesis were probably due to suppression of vegetative growth. In mango exogenous application of ethephon inhibited vegetative growth of shoot and promoted floweirng has been reported by [18]. High intensity of flowering shoot in fruit plant treated with triadimefon may be due to its ability to reduce GA_3 biosynthesis in shoot meristem. There are evidences from different scientist work that GA_3 play an inhibitory role in mango flowering [19,20] while salicylic acid in floric activities and enhancement of flowering in fruit plant [21].

The minimum fruit drop (86.16%) was observed in fruit tree sprayed with SA 100 ppm combined with urea 2 percent which was almost equally comparable with SA 200 ppm + urea 2% as well as triadimefon 2000 ppm alone [Table-2]. The maximum fruit drop (94.39%) was obtained in control. The mean maximum fruit retention per panicle (5.41%) was recorded at SA 100 ppm in combination with urea spray as compared to mean minimum in control i.e. fruit retention of 1.42 percent. Whereas next effective treatments were SA 200 ppm + urea 2% and triadimefon 2000 ppm which exhibited statistically at par with each others. The developing fruits need auxin in higher quantity and fruit drop occurs when auxin levels goes down. SA plays on important role in regulating number of physiological process including synthesis of auxin and/or cytokinin. Furthermore, nitrogen in the form of urea also triggered the synthesis of tryptophan, a precursor of auxin synthesis that inihibit fruit drop thus increasing fruit retention. The results were in line with [22,23].

Table 1- Effect of chemicals on flowering characters of Amrapali mango

Treatments		Duration of panicle emergence	Duration of flowering (Days)	Days to 50% flowering	Percentage of flowering shoot
		Pooled	Pooled	Pooled	Pooled
T_1	Urea-2%	30.5	27	84.15	55.05 (48.08)
T_2	Thiourea-1000ppm	32.5	23.83	81.02	61.44 (51.91)
T_3	GA_3-100ppm	28	24.5	81.59	58.25 (50.00)
T_4	NAA-40ppm	29.5	26	83.8	72.79 (58.66)
T_5	Ethephon 200ppm	37	19.33	73.54	82.82 (65.49)
T_6	Salicylic Acid-100ppm	34.5	23.34	78.17	84.85 (67.15)
T_7	Salicylic Acid-200ppm	35.5	21.67	77.28	86.17 (68.19)
T_8	Triadimefon- 1000ppm	32	19.83	80.2	85.07 (67.81)
T_9	Triadimefon- 2000ppm	36	22.17	77.11	88.21 (73.47)
T_{10}	$GA_3$100 $GA_3$10ppm + Urea-2%	30	27.17	83.19	68.50 (56.01)
T_{11}	NAA40ppm + Urea-2%	28.5	25.17	84.94	72.27 (58.45)
T_{12}	Ethephon 200ppm + Urea-2%	33.5	23.17	76.35	82.03 (64.98)
T_{13}	SA 100 ppm + Urea-2%	34	21.84	78	88.50 (70.23)
T_{14}	SA 200 ppm + Urea-2%	33.5	20.67	77.09	84.80 (70.60)
T_{15}	Tri 1000 ppm + Urea-2%	33.5	22.17	76.86	88.50 (66.26)
T_{16}	Tri 2000 ppm + Urea-2%	31.5	24.5	81.83	88.50 (66.55)
T_{17}	Control (Water spray)	24	29.5	89.57	48.67 (38.12)
	SEm (±)	0.88	0.941	2.13	3.13
	CD (5%)	2.49	2.66	6.03	9.47
	CV (%)	7.34	10.93	6.07	7.22

The data presented in [Table-2] indicates that the highest fruit weight (252.73) as well as fruit volume (231.12 cc) was obtained from tree treated with ethephon 200 ppm combined with urea 2 percent, statistically similar to 100 ppm GA_3 treatment followed by mixture (GA_3 100 ppm + urea 2 percent) treatments. The possible reason behind increasing the fruit weight and volume might be due to the rapid cell division and cell enlargement and also due to hormone mediated direct transportation, accumulation and ensure balanced partitioning of photosynthetic assimilates to developing fruit (Sink). Further, this increase in weight and volume may be due to the less number of fruit per tree in these treatments as smaller number of fruit may get more metabolites and plant food reserves. The corroborative results of fruit weight and volume was reported by [24] in Sutlug plum with ethephon.

The [Table-2] and [Fig-1] shows that the highest yield in terms of kilogramme per tree (16.21) was obtained with plant treated with SA 200 ppm in combination with urea 2 percent, statistically similar to the treatment (SA 100 ppm + urea 2%) followed by triadimefon 2000 ppm (14.59 kg/plant). The results are in agreement with findings of [25] in mango and [26] in ber with triadimefon. Improvement in yield due to combination of SA with urea might be the result of enhanced assimilating power of leaves to synthesize more organic metabolites [27]. Further, increased fruit retention per panicle was resulting in more fruit per tree which in turn was favourable in enhancing the fruit yield per tree.

Table 2- Effect of chemicals on fruiting characters of Amrapali mango

Treatments		Fruit drops (%)	Fruit retention per panicle (number)	Fruit weight (g)	Fruit volume (cc)	Yield (kg/tree)	Percentage increase
		Pooled	Pooled	Pooled	Pooled	Pooled	
T_1	Urea-2%	92.77 (74.22)	2.11	205.56	198.08	7.4	12.12
T_2	Thiourea-1000ppm	92.20 (73.79)	2.59	218.75	193.88	9.48	43.63
T_3	GA_3-100ppm	91.77 (73.36)	2.59	250.47	226.09	9.52	44.24
T_4	NAA-40ppm	93.05 (74.71)	2.25	206.1	188.06	8.83	33.78
T_5	Ethephon 200ppm	91.23 (72.77)	3.36	230.71	213.66	11.62	76.06
T_6	Salicylic Acid-100ppm	89.32 (70.92)	4.2	213.77	194.56	14.47	119.24
T_7	Salicylic Acid-200ppm	89.61 (71.16)	4.43	196.31	184.71	14.55	120.45
T_8	Triadimefon- 1000ppm	90.31 (71.58)	4.01	205.87	186.73	14.3	116.66
T_9	Triadimefon- 2000ppm	88.81 (71.03)	4.83	198.97	175.33	14.59	119.96
T_{10}	($GA_3$10 $GA_3$10 ppm + Urea-2%	91.60 (73.21)	2.58	235.58	219.9	9.71	47.12
T_{11}	NAA40ppm + Urea-2%	92.88 (73.94)	2.6	216.97	199.73	9.73	46.51
T_{12}	Ethephon 200ppm + Urea-2%	90.87 (72.34)	3.13	252.73	231.12	11.03	66.51
T_{13}	SA 100 ppm + Urea-2%	88.16 (69.85)	5.41	187.6	176.21	16.06	143.33
T_{14}	SA 200 ppm + Urea-2%	88.62 (68.71)	4.64	191.6	178.63	16.21	145.6
T_{15}	Tri 1000 ppm + Urea-2%	90.19 (71.75)	4.06	188.2	175.46	13.53	104.09
T_{16}	Tri 2000 ppm + Urea-2%	89.93 (70.43)	3.85	189.14	175.8	13.46	103.93
T_{17}	Control Water spray	94.39 (75.29)	1.42	166.24	161.4	6.6	
	SEm (±)	0.75	0.16	7.48	5.96	0.7	
	CD (5%)	2.29	0.47	21.12	16.84	1.99	
	CV (%)	1.48	14.16	9.51	6.82	13.41	

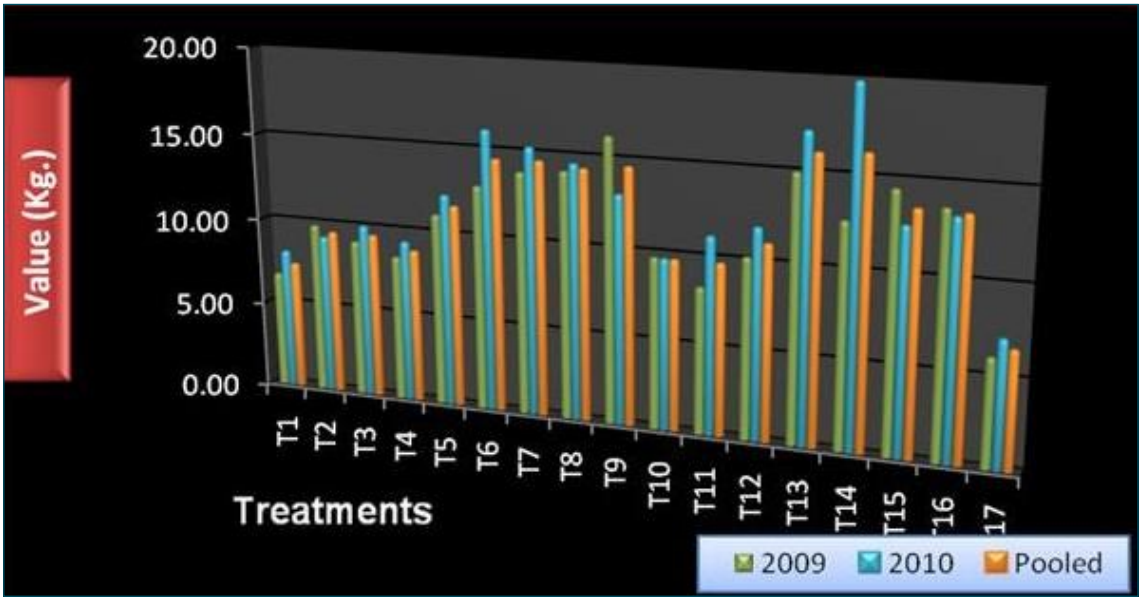

Fig. 1- Effect of chemicals on fruit yield Mango

The mean data in [Table-3] clearly indicates that highest total sugar (11.97%) as well as non reducing sugar (9.51%) in the fruits of the plant sprayed with triadimefon 200 ppm followed by NAA 40 ppm (10.50% and 7.53% respectively). Total sugar and non reducing sugar content were recorded lowest in the fruit from the plants treated with thio-urea 1000 ppm (7.51 % and 4.65% respectively). Increase in total sugar with triadimefon treatment was reported [12] in Ber and [6] in straw berry. The increase in total sugar may be because of transformation of organic acids into sugars. The ascorbic acid and b-carotene were measured highest (57.81 ml/100 ml and 12656.56 I.U) from the fruits of the plants sprayed with triadimefon 2000 ppm in combination with urea 2 percent. Lowest ascorbic acid of 35.87 mg/100 ml was measured in fruit treated with water (control) whereas lowest b-carotene recorded in triadimefon 2000 ppm (12067.67 I.U). The higher ascorbic acid content may probably be due to the catalytic influence of triadminefon on the biosynthesis of ascorbic acid from sugar. b-carotene content in triadimefom treated fruit is highly correlated with anti-oxidant activity and anti-oxidant enzyme as reported by [27]. The spoilage loss percent as adjudged from [Table-3] and [Fig-2] revealed that the treatment SA 100 ppm with urea 2 percent recorded minimum spoilage (10.62%) on 15th day, statistically at par with triadimefon 1000 ppm in combination with urea 2 percent (11.28%) and salicylic acid 100 ppm (11.44%).

Table 3- Effect of chemicals on physico-chemical characters of Amrapali mango

Treatments		Total sugar (%)	Non - reducing sugar (%)	Ascorbic acid (mg/100ml)	TSS/Acid	β- Carotene (I.U.)	Spoilage (%)	Average Return/plant (Rs)
		Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	
T_1	Urea-2%	8.99	5.89	39.39	70.56	12285.43	13.15 (21.18)	205.25
T_2	Thiourea-1000ppm	7.51	4.65	48.21	62.1	12404.2	12.01 (20.23)	259.75
T_3	GA_3-100ppm	8.49	5.16	51.33	98.99	12325.02	13.21 (21.26)	263
T_4	NAA-40ppm	10.5	7.53	49.61	107.32	12310.17	12.90 (21.02)	240
T_5	Ethephon 200ppm	7.62	4.83	35.25	83.35	12305.22	12.26 (20.44)	320.87
T_6	Salicylic Acid-100ppm	8.22	6.09	35.95	107.17	12329.97	11.44 (19.75)	401.17
T_7	Salicylic Acid-200ppm	8.47	6.42	44.86	108.65	12369.56	11.51 (19.82)	401.77
T_8	Triadimefon- 1000ppm	8.03	5.63	42.28	89.14	11993.44	11.79 (19.99)	393.82
T_9	Triadimefon- 2000ppm	11.97	9.52	39.15	74.48	12067.68	12.57 (20.71)	397.32
T_{10}	$GA_3$100 $GA_3$10ppm + Urea-2%	9.26	6.34	48.44	63.32	12518.02	14.50 (22.36)	267
T_{11}	NAA40ppm + Urea-2%	8	6.12	38.06	58.78	12621.95	13.16 (21.19)	271.15
T_{12}	Ethephon 200ppm + Urea-2%	7.95	4.85	55.78	83.04	12621.95	13.12 (21.19)	305.27
T_{13}	SA 100 ppm + Urea-2%	9.29	6.68	40.06	78.13	12612.05	10.62 (18.98)	444.27
T_{14}	SA 200 ppm + Urea-2%	8.02	5.34	48.68	103.91	12587.31	13.09 (21.20)	454.7
T_{15}	Tri 1000 ppm + Urea-2%	7.75	5.04	45.32	69.81	12626.9	11.28 (19.59)	369.62
T_{16}	Tri 2000 ppm + Urea-2%	10.03	6.7	57.81	71.62	12656.59	13.38 (21.37)	369.65
T_{17}	Control Water spray	7.57	5.23	35.87	112.5	12537.82	19.77 (26.37)	182.45
	SEm (±)	0.25	0.298	1.746	7.28	168.48	1.08	
	CD (5%)	0.7	0.902	4.93	20.56	475.67	NS	
	CV (%)	8.32	7.034	12.23	23.07	0.48	7.3	

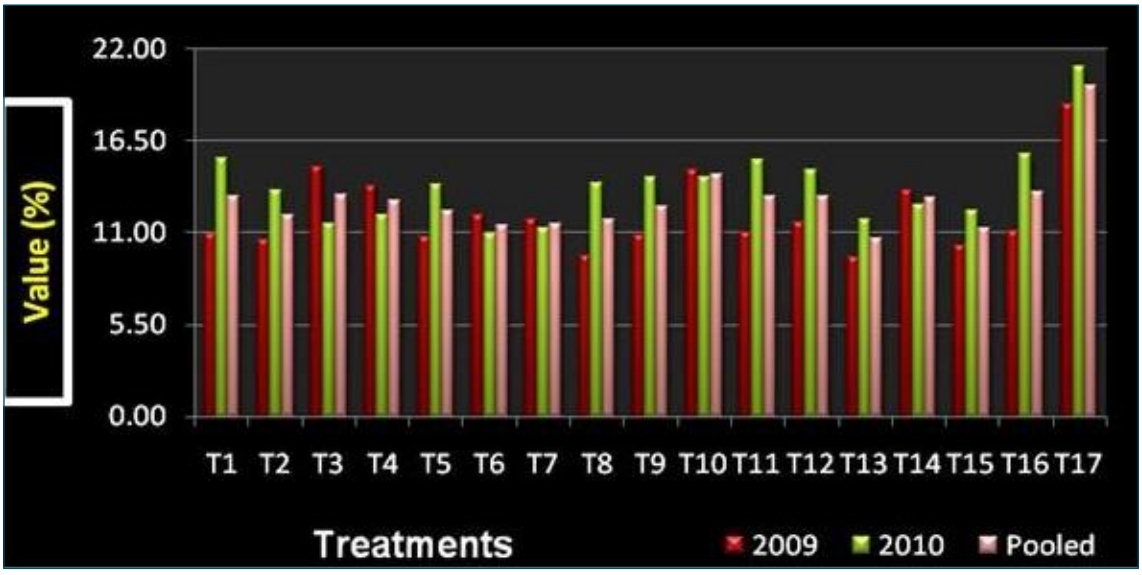

Fig. 2- Effect of chemicals on spoilage per cent

Conclusions

From the investigation it can be concluded that Salicylic acid in combination with urea 2% performed better in enhancing the fruit yield and minimising fruit drop as well as reduces the fruit spoilage per cent. It has also increased the return per plant and marketable yield. Tridimefon 2000 ppm alone and in combination with urea 2% resulted in enhanced quality of mango in respect of ascorbic acid, sugar and β- Carotene content.

Conflicts of Interests: None declared.

References

[1] Chacko E.K., Reddy Y.T.N. & Ananthanarayanan T.V. (1982) *Journal of Horticultural Science (UK)*, 45, 371.

[2] Khan N.A., Ansari H.R., Khan M. & Samiullah S. (2002) *Ind. J. Plant Physiol.,* 7, 75.

[3] Murti G.S.R. & Upreti K.K. (1999) *J. Plant. Biot.,* 26, 1.

[4] Duarte A.M., García-Luis A., Molina R.V., Monerri C., Navarro V., Nebauer S.G., ... & Guardiola J.L. (2006) *Journal of the American Society for Horticultural Science*, 131(5), 586-592.

[5] Singh N.K., Prasad J. & Singh H.K. (2007) *Ind. J. Hort.,* 64(2), 216.

[6] Tripathi V.K. & Shukla P.K. (2006) *J. Asian Hort.,* 2(4), 260.

[7] Aly M.A., Bacha M.A.A., Al-Queeb R.S. & Abdul-Rahman A.O. (2000) *J. King Saud univ. Agril. Scie.*, 12(2), 1420.

[8] Baghel B.S., Sharma R.K. & Nain P.K.K. (1987) *Prog. Hort.,* 19 (3-4), 200.

[9] Bhati B.S. & Yadav P.K. (2003) *J. Hort. Sci.,* 32 (1&2), 32.

[10] Amal M., Shraiy E. & Hegazi A.M. (2009) *Australian J. Basic and Applied Scie.,* 3(4), 3514.

[11] Davis T.D., Steffens G.L. & Sankhla N. (1988) *Hort. Rev.,* 10, 63.

[12] Thind S.K. & Kaur N. (2006) *Indian J. Hort.,* 63(3), 267.

[13] Klein I. (2002) *Acta Horticulture*, 594, 131.

[14] Nestby R. & Tagliavini M. (2005) *J. Hort. Sci. Biotech.*, 80(2), 272.

[15] Thompson T.L., White S.A., Walworth J. & Stower G. (2002) *Development of best management practices for fertigation of young citrus trees, 2002 report. Citrus and Deciduous fruit and Nut research report*, the Univ. of Arizona College of Agriculture and Life Sciences.

[16] Macnish A.J., Joyce D.C., Hetherington S.E. (1997) *Australian J. Experiment of Agril.*, 37, 463.

[17] Joyce D.C. & Shorter A.S. (1995) *Partial pressure calcium in-fileteration of mango did not delay repening*. Proceedings of the Australalasian Post harvest conference, Melbourne, Australia, 261.

[18] Chacko E.R., Kohli R.R. & Randhawa G.S. (1972) *Indian J. Hort*., 29, 1.

[19] Kachru R.B., Singh R.N. & Chacko E.K. (1971) *Hort. Sci.,* 6, 140.

[20] Tomer E. (1984) *Scientica Hort*., 24, 299.

[21] Metwally A., Finkemeier I., Georgi M. & Dietz K.J. (2003) *Plant Physiology*, 132(1), 272-281.

[22] Chauhan K.S. & Gupta A.K. (1985) *Haryana J. Hort. Sci.,* 14 (1&2), 9.

[23] Yadav G., Rana S. & Bhatia S.K. (2004) *Haryan. J. Hort Sci.,* 33 (3&4), 181-182.

[24] Gupta M. & Kaur H. (2007) *Indian J. Hort.,* 64(3), 278.

[25] Singh V.K., Saini J.P. & Mishra A.K. (2001) *Ind. J. Hort*., 58(3), 196.

[26] Seagel C.F., Guihong B., Fuchigami L.H. & Regan R.P. (2008) *Hort. Sci.,* 43(5), 1569.

[27] Sujatha B.M., Gopi R., Rajan S.N. & Karikalan L. (1999) *Ind. J. Plant. Physiol.*, 4(4), 307.