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Research article

INFLUENCE OF FOLIAR SPRAYS ON FRUIT CRACKING IN LEMON

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ABSTRACT: Lemon is leading acid citrus fruit because of its very appealing colour, odour and flavour, however, the summer crop has been observed to be prone to severe fruit cracking. The present study showing influence of foliar application of growth regulator (NAA) and nutrients (K_2SO_4 and Borax) on fruit cracking in lemon (*Citrus limon* (L.) Burm.) cv. Baramasi" was conducted at "Punjab Government Progeny Orchard & Nursery, Attari, Amritsar" during the fruiting years 2005 and 2006 with a view to manage fruit cracking in lemon. An experiment comprising of seven treatments replicated four times, consisted of foliar sprays of NAA (40 ppm), K_2SO_4 (8%) and Borax (1%), singly and in combinations. The experiment was laid out in Randomized Block Design. The maximum decrease in fruit cracking viz. 59.43 per cent during 2005 and 63.48 per cent during 2006 was observed in treatment T_7. The application of growth regulator and nutrient sources collectively proved to be most effective for minimising this malady in Baramasi lemon under Punjab conditions.
Key words : Baramasi, Borax, cracking, K_2SO_4, Lemon, NAA.

INTRODUCTION

Lemon is quite popularly grown in the northern plains of India, mainly in the arid-irrigated regions and submontane zone. It has gained more importance as kitchen garden fruit. Lemon juice is widely used in the preparation of soft drinks and possesses special dietic and medicinal values, associated with its high vitamin C content. On the other hand, lemon is confronted with a very serious problem of fruit cracking. The disorder causes considerable losses of the marketable fruit which make it inconsumable leading to heavy losses to the growers. The conflicting reports quoted by various workers indicate that fruit splitting is a complex phenomenon which may be determined by a combination of factors. Garcia-Luis et al. [4] studied the anatomy of the fruit in relation to the propensity of citrus species to split. They studied the response of application of growth regulators to fruit cracking and found them relevant to splitting as this application markedly affected the rind structure, affecting both cell size and the thickness of the flavedo. Hoffmann [6] explained citrus fruit splitting as one of the most exasperating problems experienced by the citrus fruit growers. Splitting is usually observed when growing conditions become erratic such as imbalance in nutrients. The optimal growing conditions including reasonable cultural practices along with mineral nutrition can significantly reduce the malady of splitting. He advocated the use of foliage spray of trace elements at the most receptive time to replenish the nutrients. Simon [12] reviewed the rain induced fruit cracking of sweet cherries, its causes and the possibilities of prevention. According to this review, cracked fruits can be reduced in sufficiently effective way by using foliar sprays of minerals like calcium and boron. Singh et al. [14] added that the deficiencies of calcium, boron and potassium causes imbalance leading to fruit cracking. The selection of proper spraying schedule of nutrients and growth regulators before splitting helps to control cracking. On theoretical grounds, it may also be expected that an increase in peel thickness, increases the mechanical resistance of the peel and reduce splitting.

Although many studies have dealt with this complex phenomenon, the basic mechanism involved in fruit cracking remained unclear. Therefore, present investigation is helpful to ascertain the possible causes and to find out suitable control measures for this malady using spray of growth regulator and nutrient.

MATERIALS AND METHODS

The present studies were conducted at the Department of Agriculture, Khalsa College, Amritsar during 2005 and 2006. The plant material for investigation was selected from "Punjab Government Progeny Orchard & Nursery, Attari, Amritsar". In the trial, uniform and disease free eight year old lemon trees were selected on which the spray treatments were applied. The experiment was conducted in Randomized Block Design consisting of seven treatments that were replicated four times.. The experiment consisted of foliar sprays of NAA (40 ppm), K_2SO_4 (8%) and Borax (1%). On the basis of earlier work done by different workers, the best treatments were picked and applied alone and in combination.

Treatment details:

T_1 - Untreated (control)
T_2 - NAA (40 ppm)
T_3 - K_2SO_4 (8%)
T_4 - Borax (1%)
T_5 - NAA (40 ppm) + K_2SO_4 (8%)
T_6 - NAA (40 ppm) + Borax (1%)
T_7 - NAA (40 ppm) + K_2SO_4 (8%) + Borax (1%)

The whole plant spray was given with the help of knapsack sprayer during forenoon. Each year 2 sprays were given during May at an interval of 15 days. First spray was given on 10th May and second on 25th May. The total number of fruits present on the tree was counted on 11th June when first observation on fruit cracking was recorded. Cracked fruits were counted regularly at weekly interval. These were picked out and the dropped fruits were removed. The percentage of cracked fruits was calculated on the basis of total number of fruits initially present on the tree.

RESULTS AND DISCUSSION

The data presented in Table 1 divulged that maximum fruit cracking was accrued in control (untreated) trees to the tune of 34.12 per cent in 2005 and 31.88 per cent in 2006. The treatment T_7 viz. spray of NAA (40 ppm) + K_2SO_4 (8%) and Borax (1%) proved to be most effective for minimizing the fruit cracking in lemon in two consecutive years of research trial, where it was recorded to be 13.84 per cent in first year and 11.64 per cent in second year. It was followed by T_5 and T_6 treatments. Among the singly applied foliar sprays, minimum fruit cracking was observed when borax (1%) was sprayed followed by 8% K_2SO_4 and 40 ppm NAA. The data pertaining to the effect of NAA and nutrient sprays on the periodical incidence of fruit cracking as presented in Table 2 and 3 clearly indicate that the fruit cracking started from second week of June when some of the fruits showed initial symptoms of cracking which continued till harvest. The intensity of fruit cracking was found to be maximum (5.21%) in first week of July. The cracking recorded during this week was significantly higher than the other dates of observations. During the second year of experimentation, the fruit cracking was recorded to be initiated from 11th June and continued till last harvest on 16th July. The pace of cracking experienced significant upsurge with the advancement of summer season. It was highly severe to the tune of 4.77 per cent recorded on 2 nd July. All the treatments significantly reduced the incidence of fruit cracking during both the years of research study, however, it was minimum under T_7 viz. 40 ppm NAA combined with foliar spray of 8% K_2SO_4 and 1% Borax.

The growth regulator and nutrient sprays significantly reduced the fruit cracking as compared to control. Similar results with NAA have also been reported by various workers. Greenberg et al. [5] and Amiri et al. [1] reported that sprays of synthetic auxins decreased fruit splitting and increased rind thickness. Garcia-Luis et al. [4] described that the intensity of the stresses generated by the pressures, together with peel resistance and plasticity, determines the intensity of cracking and the location of the cracks. According to them, the elastic properties of the citrus rind have been suggested to be involved in resistance to puncture. Application of auxins causes enlargement of cells by increasing the elasticity of cell wall. Thus, peripheral tissues of fruit would keep pace in growth with that of cortex resulting in the control of fruit cracking, since one of the reasons for cracking of fruits is thought to be the differential growth rates of the peripheral and cortex tissues.

Low level of potassium was thought to be responsible for splitting of Washington Navel orange Rahman et al., [10]. Earlier findings of Bar-Akiva [2] in Valencia orange also lend support to present results, who further reported that reduction of splitting may be a potassium mediated effect, via strengthening of the fruit rind as seen from the increasing rind thickness of fruits in potassium treated trees.

With regard to citrus fruit splitting, imbalances in potassium (K) can contribute to thin or weak rind and can therefore, indirectly increase the likelihood of splitting Morgan et al., [9]. Reduction in fruit cracking with boron application has also been reported in Pant lemon-1 Lavania, et al., [8], Baramasi lemon Josan et al., [7] and bael Saini, et al., [11]. The decline in cracking of fruits due to boron treatments may be attributed to its physiological role in synthesis of pectin substances in cells. Boron is responsible for increasing the elasticity of cell membranes and prevents the breakdown of vegetative tissues. Boron also improved the translocation of sugar and synthesis of cell wall material. Thus, this decrease in fruit cracking might be the result of borate bridging with cell wall constituents, thus giving elastic response to it as advocated by Singh et al., [13].

Table 1: Effect of foliar spray of NAA, K_2SO_4 and Borax on the fruit cracking in lemon (*Citrus limon* (L.) Burm.) cv. Baramasi

Treatments	2005		2006	
	Per cent Fruit Cracking	Per cent decrease over control	Per cent Fruit Cracking	Per cent decrease over control
T_1	34.12 (35.70)*	--	31.88 (34.34)*	--
T_2	27.60 (31.65)	19.10	26.40 (30.87)	17.18
T_3	26.35 (30.85)	22.77	23.90 (29.24)	25.03
T_4	24.70 (29.74)	27.60	22.65 (28.33)	28.95
T_5	15.83 (23.40)	53.60	13.71 (21.66)	58.69
T_6	20.81 (27.04)	39.01	18.61 (25.53)	41.62
T_7	13.84 (21.80)	59.43	11.64 (19.93)	63.48
CD (p=0.05)	3.03	-	3.23	-
CV %	5.97	-	6.79	-
SEm±	1.39		1.50	

***are transformed values**

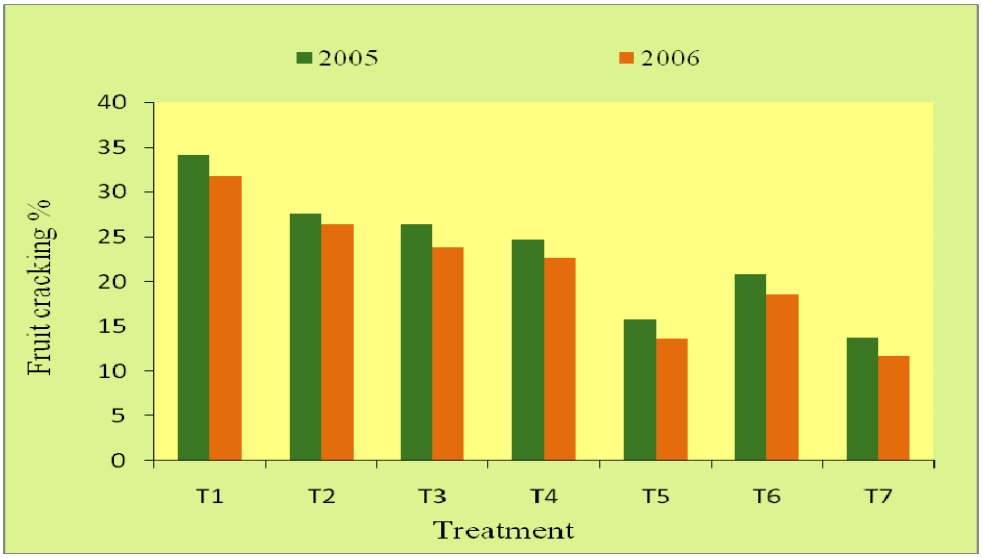

Fig.:1: Comparison of fruit cracking per cent during 2005 and 2006 under foliar spray of growth regulator and nutrients.

Zhang Lin Jing and Gui Ming Zhu [16] also reported that borax spray reduces fruit cracking to great extent. They further advocated that uncoordinated growth between the outer dermal tissue and the inner parenchyma caused cracking. The inner parenchyma grows faster during the rapid growth period, whereas the epidermis grows slowly or stops developing. It was stated that interspaces in the cutin serve as a break through point for cracking. A combination of internal turgor forces caused by the rapid inner growth acting on the fruit surface and the loss of skin elasticity caused fruit cracking. However, spray of borax maintained this coordination and water balance in the fruit resulting in decreased cracking.

Table 2: Effect of foliar spray of NAA, K_2SO_4 and Borax on time and duration of fruit cracking in lemon (*Citrus limon* (L.) Burm.) cv. Baramasi during 2005

Treatments	Fruit Cracking (%)						
	June				July		
	11	18	25		2	9	16
T_1	2.64	3.82	6.37		6.98	6.64	7.67
T_2	3.10	3.85	4.45		6.80	5.20	4.20
T_3	2.80	3.60	4.50		6.45	4.95	4.05
T_4	2.35	3.15	4.13		5.98	4.75	4.34
T_5	1.62	2.16	2.66		4.18	3.33	1.88
T_6	2.16	2.96	5.39		3.63	3.20	3.47
T_7	1.43	1.74	2.53		2.47	3.42	2.25
Mean	2.30	3.04	4.29		5.21	4.49	3.98

Table 3: Effect of foliar spray of NAA, K_2SO_4 and Borax on time and duration of fruit cracking in lemon (*Citrus limon* (L.) Burm.) cv. Baramasi during 2006

Treatments	Fruit Cracking (%)						
	June				July		
	11	18	25		2	9	16
T_1	2.98	3.59	5.08		8.06	7.02	5.15
T_2	3.05	2.85	5.75		5.32	4.98	4.45
T_3	2.23	2.75	4.10		6.35	5.08	3.39
T_4	1.96	2.65	4.15		5.11	5.78	3.00
T_5	1.56	2.15	2.49		2.44	2.81	2.26
T_6	2.22	2.84	3.27		4.32	3.92	2.04
T_7	1.20	2.24	2.41		1.82	2.44	1.53
Mean	2.17	2.72	3.89		4.77	4.57	3.11

The combination of PGRs and mineral nutrients proved successful in reducing the severity of citrus fruit splitting (Greenberg et al., [5] and Stander, [15]. The findings of various workers are in agreement with the results obtained in the present studies where sprays of growth regulators and nutrients reduced fruit cracking. Reduction in fruit cracking may be attributed to increase in peel thickness with various growth regulators and nutrient sprays. Decicco et al. [3] Observed that a small increase of rind thickness leads to greater resistance to splitting in Navelina orange. The application of the synthetic auxin results in thin and/or smooth rinds, leading to an increase in thickness and rind coarseness which has subsequently been shown to reduce fruit splitting García-Luis et al., [4].

REFERENCES

[1] Amiri, N.A., Kangarshahi, A.A. and Arzani, K. 2012. Reducing of citrus losses by spraying of synthetic auxins. Intl J. Agri. Crop. Sci. 4 (22): 1720-1724.

[2] Bar-Akiva, A. 1975. Effect of potassium nutrition on fruit splitting in Valencia orange. J. Hort. Sci. 50 (1): 85-89.

[3] Decicco, V., F. Intrigliolo, A. Ippolito, S. Vanidia and A. Guiffrida 1988. Factors in Navelina orange splitting. Proceedings of the Sixth International Citrus Congress. Middle East. pp 535-540. Tel Aviv, Israel.

[4] Garcia-Luis, A., Duarte, A.M.M., Kanduser, M. and Guardiola, J.L. 2001. The anatomy of the fruit in relation to the propensity of citrus species to split. Scientia Hort. 87:33-52.

[5] Greenberg, J., Kaplan, I., Fainzack, M., Egozi, Y. and Giladi, B. 2006. Effects of auxins sprays on yield, fruit size, fruit splitting and the incidence of creasing of Nova mandarin. Acta Horticulturae, 727.

[6] Hoffmann, H. 2007. Citrus fruit loss in the home garden. Department of Agriculture, Western Australia, Gardennote 38.

[7] Josan, J.S., Sandhu, A.S., Singh, R. and Dhillon, D.S. 1995. Effect of plant growth regulators and nutrients on fruit cracking in lemon. Indian J. Hort. 52 (2): 121-124.

[8] Lavania, M.L., Misra, K.K. and Ratna Babu, G.H.V. 1986. A note on the control of fruit cracking in lemon (Citrus limon). Maharasthra J. Hort. 3 (1): 52-54.

[9] Morgan, K.T., Rouse, R.E., Roka, F.M., Futich, S.H. and Zekri, M. 2005. Leaf and fruit mineral content and peel thickness of 'Hamlin' Orange. Proc. Fla. State Hort. Soc. 118:19–21.

[10] Rahman, A.E., Hoda, G.F., Mohamed, M. and Tayh, E.A.T. 2012. Effect of GA3 and Potassium Nitrate in Different Dates on Fruit Set, Yield and Splitting of Washington Navel Orange. Nature and Science, 10(1), 148-157.

[11] Saini, R.S., Singh, S. and Deswal, R.P.S. 2004. Effect of micro-nutrients, plant growth regulators and soil amendments on fruit drop, cracking and yield and quality of bael (Aegle marmelos Correa) under rainfed conditions. Indian J. of Hort. 61 (2): 175-176.

[12] Simon, G. 2006. Review on rain induced fruit cracking of sweet cherries (Prunus avium L.), its causes and the possibilities of prevention. Int. J. Hort. Sci. 12 (3): 27-35.

[13] Singh, A.K., Sharma, P., Sharma, R.M. and Tiku, A.K. 2005. Effect of plant bioregulators and micronutrients on tree productivity, fruit cracking and aril proportion of litchi (Litchi Chinesis Sonn.) cv. Dehradun. Haryana J. Hortic. Sci : 34 (3-4): 220-221.

[14] Singh, D.B., Kingsly, A.R.P. and Jain, R.K. 2006. Controlling fruit cracking in pomegranate. Indian Hort. 51(1): 14, 32.

[15] Stander, O.P.J. 2013. Fruit split and fruit size studies on Citrus. M.Sc thesis submitted to Faculty of Agri Sciences, Stellenbosch University.

[16] Zhang-Lin Jing and Gui Ming Zhu 2006. Cracking mechanism of Prunus Salicina and related preventions. Acta Horticultural Sinica. 33 (4): 699-704.