

Effect of Boron and Putrescine on Russet Asian pear (*Pyrus spp. L.*) under subtropical condition of Jharkhand province of India.

Abstract:

A russet or brown spot in Asian pear is the most common phenomenon to the pear grower particularly when grown under subtropical to tropical climatic condition. **Aims:** Although one or two varieties of russeted Asian pear cultivar developed for local consumption in New Zealand still substantial production of russet free Asian pear is a global demand as it is crunchy and tasty. ICAR-RCER, Research centre Ranchi, Jharkhand soil is acidic where boron deficiency is common and *Pyrus prifolia* produces small russeted fruit. Hence, the objectives of the research work were non-cracking and russet free pear production by application of boron and production of quality fruit through the application of Putrescine. Several attempts have been made so far but browning and fruit cracking were unpreventable which losses maximum production. **Methods:** Eight combinations of boron and putrescine were sprayed separately in 24 trees with one selected branch each following Randomized Block Design having three replication each and control plant was sprayed with only water. **Results:** It has been found that T2 (Boron (0.2%) and Putrescine (0.1%)) resulted in less russetting along with bigger fruit (324.66g) and high TSS (14.0⁰B). Although, T₁ treatment was at par with T2 in respect fruit size but remains second best following other characters. Regarding russet control, treatment T2 and T3 were at par having less lenticels (5-6) per square inch and look wise attractive. **Conclusion:** From three years study in ICAR-RCER, research center Ranchi it concluded that T2 treatments (boron 0.2% and putrescine 0.1%) spraying before peanut stage is very effective to minimize russet in Asian pear.

Key words: Boron, Putrescine , Quality, Russet Free, Asian Pear.

Introduction

Asian pear (*Pyrus pyrifolia* L.) is one of the most important fruit crops which have immense potential to grow under subtropical sub-temperate climate prevailing different parts of India. Asian pear are generally low chill pear and very much response to dormancy breaking chemicals and bring forth flowering with easy maintenance. *Pyrus serotina* Rhed. and *Pyrus pashia* can also be grown under tropical condition. The only demerit is the development of the russet on the fruit skin which leads to loss in luster and good look of the produce. Even it earns low fetching prices as compared to russet free cultivars. Deficiency of boron also responsible for russetting and in internal cork in apple (Bharatdwaj, 2010). Among the minor element Boron (B) is an essential micronutrient for plant growth and development. Among all micronutrients used in plant, B is the second most widespread and economically important micronutrient which deficiency resulted in huge crop loss in dicot rather than monocots (Dear and Weir, 2004). Possible role of boron is in translocation of sugar and regulation of the intake of water into the cell. It tends to keep calcium in soluble form with in the plant and may act as regulators of potassium cat ions. Russet is prominent when fruit size was small owing to greater lenticels density on fruit skin. It reduces losses from internal and external corking, fruit cracking, pitting,

deformation and discoloration (Hanson (1991). It also leseen gum spots of stone fruit like Sweet Cherry. Dunlap and Thompson (1959) examined that boron reduces bitter pit in apple. Even internal cork symptom was observed in Granny Smith apple due to boron deficiency (Dart-2004). ~~In plants, Boron reaches roots mainly by mass flow and is absorbed as boric acid, which is uncharged. Most plant species exhibit very little control over B uptake. Passive uptake of B through plant membranes could be the good option.~~ In higher plant B accumulation is directly related to transpiration and soil B concentration. Narrow range of Boron contents in plants may shows deficient and toxic availability (Marschner, 2011). So, uniform B availability through soil applied fertilizer is critical to ensure optimum nutrition (Brown et al, 2002). ~~Phosphorus and potassium uptake is enhanced by boron.~~ Boron functions through functioning ATP- ase activity in dividing cells. By maintaining proper structure of root cell membranes, B has a positive influence on root uptake of P and K, particularly (Kakmak and Romheld, 1997). Boron also plays an important role in the colonization of mycorrhizal fungi in root zone, which helps in root uptake of P. B supply is essential for mitigation of aluminum toxicity in plants grown under soil having low pH. The chemical putrescence is known to be very effective chemical to increase the fruit size and quality of Asian pear (Franco-Mora, et al. 2006). Putrescine [$H_3N-(CH_2)_4-NH_3$] is a biogenic polyamine synthesized in small quantities by healthy living cells by reaction of Ornithine Decarboxylase (ODC). Putrescine can bind to the polyamine modulatory site of the NMDA (N-methyl D-aspartate) receptor and potentiate NMDA induced currents by electrostatic linkages. Putrescines are essential growth factors necessary for cell division. Due to its positive charge, can bind various cellular macromolecules, including DNA, RNA, chromatin and proteins. Because of these functions it has been implicated in myriad fundamental cellular processes including regulation of gene expression, translation, cell proliferation, and membrane stabilization (LIU et.al. 2006). So far, exogenously applied polyamine has been reported to be effective for increasing fruit set and yield of pear (Crisosto, C. H. et al. 1988 and 1992).

. Keeping this point in view , the present study was undertaken at ICAR-RCER, Research Center, Ranchi to produce quality Asian pear with the application of different concentrations of both the boron and putrescence on local and hardy cultivar 'Netrahat Selection' to come up with russet free crops under eastern plateau and hill region of India.

MATERIALS AND METHODS

The experiment was conducted at ICAR Research Complex for Eastern Region, Research Centre, and Ranchi during 2009 and 2010. This area is situated 620 m above mean sea level (msl) and at 23° 25' N latitude and 85° 20' East longitude experiencing an average annual rainfall of 110-140 cm. Soil is acidic and pH range from 5.0-6.5, which is ideal for pear cultivation. ~~Fruit cracking and fruit russetting are the mojar problems in this region.~~ The varieties under study was Netrahat Selection which was an hardy regular bearing Asian pear cultivar at Netrahat hill and adjoining area of Ranchi . Boron and putrescence dihydrochloride were given in eight combination to findout suitable treatment for this specific problems. The treatments were (T1) Borax (0.1 %) and Putrescine (0.1%) (T2) Boron (0.2%) and Putrescine (0.1%), (T3) Boron (0.3%) and Putrescine (0.1%) (T4) Boron (0.4%) and Putrescine (0.1%) (T5) Boron (0.1 %) and Putrescine (0.2%), [T6] Boron (0.2%) and Putrescence (0.2 %),[T7] Boron (0.3%) and Putrescence (0.2%), [T8] Boron (0.4%) and

Putrescence (0.2%) and [T9] control i.e. only water spray. ~~Spying~~ was done during petal fall stage and may be extended to 3rd week of March ,when fruits are in peanut stage,under Ranchi, India. Source of boron was the Boromax powder having 20% boron. Putrescence was taken from HiMedia product generally obtained in the form of Putrescence Di - hydrochloride. The experiment was laid out in Randomized Block Design with 3 replications. Total 27 trees were selected with downwards large branches for convenience in taking observation. Data were taken on fruit size, weight , TSS, acidity, reducing sugar and total sugar. TSS was recorded ATAGO digital refractometer. Acidity was measured by citric acid equivalent method and the both types sugar were measured by Lane and Eynon method(Ranganna,1996).

RESULTS

Data pertaining to Table -1 explained that fruit weight was the maximum in T2 treatments [Boron (0.2%) and Putrescine (0.1%)] gave the maximum fruit size followed by T6 treatments [(Boron (0.2%) and Putrescence (0.2 %)). In T6 treatments the boron content was increased into 0.2 % which produced at per result The maximum TSS of 14.03 ⁰B was observed in T2 treatment followed by T6 (12.26 ⁰B). However, total sugar and reducing sugar was non significant and their value varies between 4-5 % The difference between reducing sugar and total sugar was very les which clearly indicated that Asian pear is predominated with substantial amount of monosaccharide. From table-- 2 it was observed that T2 and T3 treatments had less lenticels /square inch skin i.e. 5 and 6 ,respectively. Control treatment had almost russeted fruit having17 lenticels/square inch of fruit surface . ~~Valero (2010) also described that both endogenous and exogenous, polyamines before ripening increased fruit size and quality.~~ Plate - 1 reflected the deficiency symptom at the transition vegetate and reproductive stage. Leaves are reduced floral parts are very short and thicken. Plate-2 reveals the boron deficiency fruit cracking at fruit maturity stage. Plate -3 was T2 treated fruits at Ranchi condition.

Discussion :A close perusal of Table -1 revealed that fruit weight was the maximum in T2 treatments [Boron (0.2%) and Putrescine (0.1%)] accounted for the maximum fruit size (324.66 g) and high TSS (14.0⁰B) followed by T6 treatments [(Boron (0.2%) and Putrescence (0.2)] In T6 treatments the boron content was increased into 0.2 % which produced similar type of results like increase in fruit size and total soluble solid content following T2 while other treatments containing more boron content did not account for significant result. It clearly implicated that apple and pear growing in acid soil need the narrow range of boron content . The maximum TSS of 14.03 ⁰B was observed in T2 treatment followed by T6 (12.26 ⁰B). Total sugar and reducing sugar was ranged from 4-5%. The difference between reducing sugar and total sugar was very lower than any other temperate fruits which clearly indicated that it content the maximum amount of monosaccharide. Less russet fruits was observed in T2 and T3 treatments and lenticels /square inch skin were 5 and 6, respectively. Control treatment was almost russeted fruit having17 lenticels/square inch of fruit surface not only that fruit size was also small. The result was inconformity with Hanson (1991) who described Russet as a greater lenticels density on fruit skin. It also reduces losses from internal and external corking, fruit cracking, pitting, deformation and discoloration. Waterlogged and very dry soils and dry acid soil can lead to boron deficiency, as roots are unable to take up nutrients (AGFACT-2004). Therefore judicious watering is very useful in pear production even in case of low organic

carbon content of soil. Valero (2010) also described that polyamines are naturally biological compounds involved in many growth and developmental processes with ubiquitous presence in all cells. Fruit in which comprehensive research has been developed to get a better understanding of the role of polyamines, both endogenous and exogenous, especially during the growth, ripening and senescence processes. LIU et al. (2005) also found that in peach concentrations of the free polyamines, putrescine (Put), spermidine (Spd) and spermine (Spm) in pre-harvest fruit peaked 16 days after full bloom i.e. petal fall stage and continues to fruit development before ripening. Hence, it may be concluded that the combine effect of boron and putrescine may reduce the fruit russet in Asian pear. It might be due to boron resist fruit cracking whereas putrescence di-hydrochloride increase the fruit size. The demand for boron is not constant across the growing season, but rather shows very clear peaks after flowering and fruit set. Boron is mobile in a few tree like apple and pear that produce polyols in which phloem mobility helps in its transport (Marschner, 2011) along with sugar. From the plate-1 and plate -2 it may be further concluded that from very beginning of flowering stage, boron and putrescine (T2) was very useful for fruit development until endogenous ethylene content increased during maturity. ~~Plate-3 was T2 treated fruits under subtropical sub humid region of Ranchi(Jharkhand) and this treatment was recommended for commercial cultivation~~

References:

1. AGFACTS . Australia. (2004). www.agric.nsw.gov.au ORDER NO. H4.AC.2 AGDEX 431/622
2. Bharadwaj, R.L. (2010). Role of Boron in Horticultural crops. IMMA news. Micofertilizers manufacturers association , Pune, India. April June, Vol.3 (1):4-7
3. Brown PH ,Bellaloui,N.,Wimmer,M.A.,Basi,E.S.,Ruiz,H.,Pfeffer,H. Danniell,F. and Romheld,V. (2002): Boron in Plant Biology. Plant Biology, 4:205-223.
4. Cakmak I and Römheld V. (1997): Boron deficiency-induced impairments of cellular functions in plants. Plant Soil, 193: 71-83.
5. Crisosto, C.H., P.B. Lombard, D. Sugar, and V.S. Polito. (1988). Putrescine influences ovule senescence, fertilization time, and fruit set in 'Comice' pear. Journal of the American Society for Horticultural Science 113(5): 708-712
6. Crisosto, C.H., P.B. Lombard, D.G. Richardson, and R. Tetley. (1992). Putrescine extends effective pollination period in 'Comice' pear (*Pyrus communis* L.) irrespective of post-anthesis ethylene levels. Scientia Horticulturae 49: 211-221.
7. Dart, Julie.(2004). Boron deficiency (cork) in pome fruits Agfact H4.AC.2, 2nd edition 2004 ,Tumut Internal cork symptoms in Granny Smith apple.
8. Dear BS and Weir RG. (2004): Boron deficiency in pastures and field crops. New South Wales Department of Agriculture AgFact, P1. AC1, 2nd Ed.
9. Dunlap, D.B., and A.H. Thompson. (1959). Effect of boron sprays on the development of bitter-pit in the York Imperial Apple, University of Maryland Agriculture Experiment Station. Bull. A-102

10. Franco-Mora,O.,Tanabe,K.,Tamura, F. and Itai,A. (2006) The influence of putrescine on fruit set , size in Housi Japanese Pear. *Acta Hort* 774: 102-105
11. Hanson, E.J. (1991). Sour cherry trees respond to foliar boron applications. *HortScience* 26 (9): 1142 – 1145.
12. Jihong Liu, Kazuyoshi Nada, Xiaoming Pang, Chikako Honda, Hiroyasu Kitashiba and Takaya Moriguchi. Role of polyamines in peach fruit development and storage. *Tree Physiology.* 26(6): Pp. 791-798
13. Ji-Hong LIU, Chikako HONDA and Takaya MORIGUCHI (2006). Involvement of Polyamine in Floral and Fruit Development. *JARQ* 40 (1), 51 – 58.
14. Marschner, P. (2011): Marschner's Mineral Nutrition of Higher Plants, 3rd Ed. Academic Press
15. Ranganna,S.(1996). Proximate constituents. In :Handbook of analysis and quality control for fruits and vegetable products.Tata MacGraw Hill Publishing compny LTD. Second Edition , New Dehi ,pp1-31
16. Valero, D. (2010.) . The role of polyamines on peach fruit ripenining and quality during storage . *Acta Horticulturae(ISHS)* 884: XI International Symposium on Plant Bioregulators in Fruit Production. Pp62-66



Plate-1, Boron deficiency in pear foliage,

Plate-2, Boron deficiency in fruits

Table:1 Effect of Boron and putrescence on physic-co- chemical property of Asian pear

Treatments	Fruit weight	Fruit volume	TSS	Acidity	Reducing sugar	Total Sugar
Boron (0.1 %) and Putrescence (0.1%)	227.33	223.33	10.63	0.201	4.31	4.57
Boron (0.2%) and Putrescence (0.1%)	324.66	209.33	14.03	0.184	3.77	4.2
Boron(0.3%) and Putrescence (0.1%)	232.66	222.00	10.93	0.173	4.38	4.51

Boron (0.4%) and Putrescence (0.1%)	242.33	235.33	11.36	0.179	4.14	4.42
Boron(0.1 %) and Putrescence (0.2%)	233.33	220.66	10.83	0.179	4.22	4.58
Boron (0.2%) and Putrescence (0.2 %)	279.00	232.33	12.26	0.206	4.03	4.19
Boron(0.3%) and Putrescence (0.2%)	262.00	251.66	11.00	0.168	4.09	4.37
Boron (0.4%) and Putrescence (0.2%)	241.33	242.66	10.63	0.157	4.03	4.25
No spray (Control)	190.33	203.33	10.56	0.049	4.19	4.46
CD at 0.5%	2.54	NS	0.825	0.073	NS	NS

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164 **Table: 1. Visual appearance of the fruits as affected by Boron and Putrescence spraying**

Treatments	Visual appearance	Lenticels/square cm
Boron (0.1 %) and Putrescence (0.1%)	Moderate	11
Boron(0.2%) and Putrescence (0.1%)	Less	6
Boron (0.3%) and Putrescence (0.1%)	Less	5
Boron(0.4%) and Putrescence (0.1%)	Moderate	10
Boron (0.1 %) and Putrescence (0.2%)	Moderate	11
Boron (0.2%) and Putrescence (0.2 %)	Moderate	12
Boron (0.3%) and Putrescence (0.2%)	Less severe	15
Boron (0.4%) and Putrescence (0.2%)	moderate	11
No spray (Control) water spray	severe	17



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166 **Plate-3 Cultivar Netrahat Selection at harvesting stage at Ranchi India (T2 treatment)**