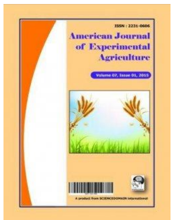

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Effect of Boron and Putrescene on Russet Asian pear (*Pyrus spp.* L.) under Subtropical Condition of Jharkhand Province of India

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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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. Although one or two varieties of russet 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 where soil is acidic and boron deficiency is common and *Pryrus prifolia* produces small russet pear fruit. Hence, the objectives of the research work were non-cracking and ruseet free pear production by application of boron and production of quality fruit through the application of putrescence. Several attempts have been made so far but browning and fruit cracking were unpreventable which losses maximum production. Eight combinations of boron and putrescene were sprayed separately in 24 trees with one selected branch of each as replications. The experiment is laid out Randomized Block Design having three replications in each treatments and control plant was sprayed with only water. It has been found that T2 (T=treatment) Boron (0.2%) and Putrescene (0.1%) resulted in less russetting along with bigger fruit (324.66 g) and high TSS (14.0°B). Although, T6 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.

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Studying in ICAR-RCER, research center Ranchi, India, we concluded that T2 treatments (boron 0.2% and putrescence (0.1%) spraying before peanut stage is very effective to minimize russet in Asian pear.

Keywords: Boron; putrescene; quality; russet free; Asian pear.

1. 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 pears are often called apple pear due to its hardy and crunchy texture and large sizes. It is eaten as raw and suitable for canning and fruit salad and world over it is cultivated as commercial crop. It has immense medicinal value like; controlling and lowering cholesterol, blood pressure and stoke as well as preventing cancer and osteoporosis. It provides fair amount of Bo, Ca, Mg and Vitamin C and pectin. In ancient age Greek poet Homer cited pear as God's Fruit. 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 resetting and in internal cork in apple [1]. 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 [2]. 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 [3]. It also lessens gum spots of stone fruit like Sweet Cherry. Dunlap and Thompson [4] examined that boron reduces bitter pit in apple. Even internal cork symptom was observed in Granny Smith apple due to boron deficiency [5]. 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 [6]. So, uniform B availability through soil applied fertilizer is critical to ensure nutrition [7]. 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 [8]. Boron also plays an important role in the colonization of mycorrhizal fungi in root zone, which helps in root uptake of Phosphorus. 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 [9]. Putrescene [H3N–(CH2)4–NH] is a biogenic polyamine synthesized in small quantities by healthy living cells by reaction of Ornithine Decarboxylase (ODC). Putrescene can bind to the polyamine modulatory site of the NMDA (N-methyl D-aspartate) receptor and potentiate NMDA induced currents by electrostatic linkages. Putrescene is essentially a growth factors necessary for cell division. Due to its positive charge, can bind various cellular macro-molecules, 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 [10]. So far, exogenously applied polyamine has been reported to be effective for increasing fruit set and yield of pear [11,12]. Active growth is often more sensitive boron deprivation than vegetative growth as suggested by Dell and Hang [13]. Typical symptom of boron deficiency to reproductive stage are drop of buds, flowers and fruits, stunted growth and alternation of fruit quality, lower viability of seed [14]. 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.

2. 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. 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 dihydrocloride were given in eight combinations to find out suitable treatment for this specific problem. The treatments were (T1) Boron (0.1%) and Putrescene (0.1%), (T2) Boron (0.2%) and Putrescene (0.1%), (T3) Boron (0.3%) and Putrescene (0.1%), (T4) Boron (0.4%) and Putrescene (0.1%), (T5) Boron (0.1%) and Putrescene (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. Spraying 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 a 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 [15].

3. RESULTS

Data pertaining to Table 1 explained that fruit weight was the maximum in T2 treatments [Boron (0.2%) and Putrescene (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°B was observed in T2 treatment followed by T6 (12.26°B). However, total sugar and reducing sugar were almost same i.e. 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 lenticel / square inch skin i.e. 5 and 6, respectively. Control treatment had almost russeted fruit having 17 lenticels/square inch of fruit surface. 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.

Plate- 1. Boron deficiency in pear foliage

4. DISCUSSION

A close perusal of Table 1 revealed that fruit weight was the maximum in T2 treatments [Boron (0.2%) and Putrescene (0.1%)] accounted for the maximum fruit size of (324.66 g) and high TSS (14.0°B) followed by T6 treatments [(Boron (0.2%) and Putrescence (0.2)]. In case of 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°B was observed in T2 treatment followed by T6 (12.26°B). 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 were observed in T2 and T3 treatments and lenticels / square inch skin were 5 and 6, respectively. Control treatment was almost russeted fruit having 17 lenticels / square inch of fruit surface not only that fruit size was also small. The result was inconformity with Hanson [3], who described Russet as a greater lenticels density

Plate- 2. Boron deficiency in fruits

Plate- 3. Cultivar netrahat selection at havesting stage at Ranchi India (T2 treatment)

Table 1. Effect of boron and putrescence on physi-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

Table 2. 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

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 [16]. Therefore judicious watering is very useful in pear production even in case of low organic carbon content of soil. Valero [17] also described that polyamines are naturally biological compounds involved in many growth and developmental processes with ubiquitous presence in all cells. Fruit in which compre-hensive 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. [10] also found that in peach concentrations of the free polyamines, putrescene (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 putrescene may reduce the fruit russet in Asian pear. It might be due to boron resist fruit cracking whereas putrescence di-hydrochloride increases 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. Dart [5] explained pericarp russeting at external cork though roughness, even pigmentation and cracking is due to boron deficiency in earlier stage of crop growth. Boron is mobile in a few trees like apple and pear that produce polyols in which phloem mobility helps in its transport [6] along with sugar. From the Plates- 1 and 2 it may be further concluded that from very beginning of flowering stage, boron and putescene (T2) was very useful for fruit development until endogenous ethylene content increased during maturity. Boron and nitrogen are known to increase fruit set and quality could increase after putrescene application [18,19]. Regulation of plant cell wall enzyme like methyl esterase by polyamines interact with metal ions and gave strength to cell wall and thereby increasing fruit size [20]. Even low boron can induce strong cellular bridges within cell wall structure as genes for skin of Tobacco was influenced [21]. Liu et al. [22] also stated that polyamines propel fruit growth and development significantly in peach fruits. Hence, boron (0.2% and putrescene (0.1%) may reduce the russet significantly in Asian pear.

5. CONCLUSION

From the present investigation, it is evident that russet of Asian pear although a genetical character, but markedly influenced by minerals and nutrition and soil on which it is grown. In acid soil of Ranchi in India it has been observed that boron and putrescine minimizes russet of Asian pear by improving cell wall quality of epidermis and increasing fruit quality through lowering lenticels number/square inch fruit surface and increasing fruit sizes.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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