RESEARCH PROGRAMME

RESPONSE OF ZINC AND BORON SPRAY ON YIELD, GROWTH AND QUALITY OF PAPAYA (*Carica papaya* L.) cv. RED LADY

DISSERTATION REPORT - 1

Submitted to the
LOVELY PROFESSIONAL UNIVERSITY,
PHAGWARA, PUNJAB, INDIA

in partial fulfillment of the requirements for the award of degree of

MASTER OF SCIENCE
IN
(HORTICULTURE)
BY

Ravi Dahiya
Registration Number:
11719006
Under the supervision of
Dr. ANIS AHMAD MIRZA

Department of Horticulture, School of Agriculture,
Lovely Professional University, Phagwara, India.
MAY, 2018

CERTIFICATE I

I hereby declare that the Synopsis entitled **"RESPONSE OF ZINC AND BORON SPRAY ON YIELD, GROWTH AND QUALITY OF PAPAYA (*Carica papaya* L.) cv. RED LADY**is an authentic record of my work and will be carried out at Lovely Professional University as requirement for the degree of **Master of Science** in the discipline of **Horticulture**, under the guidance of Dr. Anis Ahmad Mirza, Assistant Professor, Department of Horticulture, School of Agriculture and no part of this synopsis has been submitted for any other degree and diploma.

Ravi Dahiya
(Registration No.11719006)
MSc Horticulture

CERTIFICATE II

This is to certify that synopsis titled **"RESPONSE OF ZINC AND BORON SPRAY ON YIELD, GROWTH AND QUALITY OF PAPAYA (*Carica papaya* L.) cv. RED LADY"** submitted in partial fulfilment of the requirement for the award of degree of **Master of Science** in the discipline of **Horticulture,** is a research work and will be carried out by **Ravi Dahiya(Registration No. 11719006)** under my supervision and that no part of this synopsis has been submitted for any other degree or diploma.

(**Signature of Supervisor**)

Dr. Anis Ahmad Mirza

Assistant Professor (Horticulture)

1. INTRODUCTION

Papaya (*Carica papaya L*.) is an important fruit of subtropical and tropical areas of the world belonging to the genus *Carica* of the family Caricaceae, with 48 species. It is the most cultivated species and commonly called as papaw or pawpaw (Australia), mamao (Brazil) and tree melon (China). Its origin is of Tropical America and was make known to India in the sixteenth century by Malacca (Kumar and Abraham, 1942).Papaya which has been remained as a backyard crop now has become an important commercial fruit crop over the centuries for its pharmaceutical and nutritional values, besides its continuous and quick yielding habit has given early earnings to the growers. The ripe fruit of papaya is eaten as such throughout the tropics. Ripe fruits are also used for several preparations like soft drinks, jam, ice-cream flavors and crystallized fruit, while green fruits are frequently used in salads and pickled or cooked as a vegetable.

Papain, a proteolitic enzyme existing in the latex of green fruits in milky form, the dried latex powder is having great demand in international market particularly in UK and U.S.A. The papain has various uses in the beverages, food and pharmaceutical industries, *viz.,* manufacturer of chewing gum, meat tendering and cosmetics, also used as drug for intestinal aliments, in the tanning industry, in silk as a de-gumming material and to provide shrink resistance to wool (Chan and Tang, 1978). Papaya leaves have medicinal value. Stem and bark is used for making ropes. Roots can be used to cure the piles and yaws. The other usages include extraction of oil, which is a source of protein and medicine to reduce thirst and as a vermifuge. Hence papaya is called as "Common man's fruit".

Papaya fruit has obtained a special place in human diet because of its phenomenal nutritional and medicinal values. It is a nutritious fruit containing proteins, carbohydrates and minerals primarily calcium, iron and phosphorus. It is rich in Vitamin „A" containing 2020 I.U./100g of fruit and a some source of Vitamin-C. Its delightful fruits are not only pleasant, nutritious and digestive but also behave as a slight laxative. National Commission on Agriculture have emphasized that in the present Indian dietary context, there is an crucial need for massive production of **"**Short duration, less expensive but nutritive fruits**"** (National Commission on Agriculture Report. 1976). Papaya exactly fits in this requirement and become an important fruit crop. In India papaya is cultivated in area of about 1.33 lakh hectares with total yield production of 56.99 million tonnes (NHB 2016-17).

PROBLEM BACKGROUND

Micronutrients can enormously improve crop yield and increase value and post-harvest life of product. They play an significant role in disease resistance, as they act as enzyme activators and also show a role in biosynthesis of lignin (Edward Raja, 2009). The fall in accessibility of organic manures is due to bigger use of inorganic fertilizer has made micronutrient supply dangerous. Hence substituting micronutrients that has been distant or increasing organic matter to make natural nutrients available, has not received enough courtesy. Application of micronutrients by foliar spray has increased importance in recent years, as the nutrients are sprinkled directly onto the leaves, and can be made accessible to the plants at appropriate time when desired. Boron and Zinc occupies a significant place because of its ability to effect plant development and growth positively and instructs resistance to abiotic and biotic stresses **(**Cakmak, 2008).

Zinc is the important constituent of many enzymes which control many metabolic reactions in the plant and also essential for protein and auxin synthesis. Boron is a constituent of cell membrane and important for cell division. It behaves as a controller of calcium/potassium ratio in the plant and helps in nitrogen translocation and absorption of sugars in plant (Trivedi *et al.,* 2012). Successfully commercial cultivation of improved HYV (high yielding varieties) of papaya crop depends on nutrient management due to its constant growth, flowering and fruiting habit. Papaya needs good amounts of nutrients for its development and fruit production, and it was projected that papaya eliminates about 300 mg Cu, 989 mg B , 1847 mg Mn, 3364 mg Fe, 1385 mg Zn and 8 mg Mo per tonne of fruit (Cunha and Haag, 1981).

PROPOSED RESEARCH OBJECTIVE

Present investigation "Response of Zinc and Boron sprays on Yield, Growth and Quality of Papaya *(Carica papaya L.*) cv. Red Lady" is considered to find out the influence of micronutrient spray on growth, yield, and quality of papaya cv. Red lady. Following are the objectives are proposed in this research:

1. To study the impact of foliar application of Zinc and Boron on growth of papaya.
2. To determine the effect of Zinc and Boron on yield and quality of papaya.

2. REVIEW OF LITERATURE

Micronutrients assume importance in horticulture crop production because of their ability to improve quality, input use efficiency, postharvest shelf life, disease resistance and their by increase in marketable yield. Crop-specific foliar formulation of micronutrients is a novel approach, wherein application of essential micronutrients in very dilute form has been established to regulate and accelerate various growth processes in plants. The literature available on foliar application of micronutrients *viz.,* zinc and boron either unaided or in combination on yield, growth and quality of papaya.

Shanmugavelu *et al.* (1973) observed reduction in staminate flowers per axis as well as increase in hermaphrodite flowers per axis in papaya with the foliar application of boron @ 2 ppm when compared to control.

(Ghanta *et al.,* 1992) Foliar application of boron at 2nd and 3rd month after transplanting of papaya cv. Ranchi recorded maximum number of hermaphrodite flowers which increased femaleness and in turn increased fruit yield**.**

Ghanta *et al.* (1992) reported that foliar spray of 0.1 per cent boron at 60 and 90 days after transplanting produced higher yield of papaya cv. Ranchi then control.

Ahmed *et al.* (1992) on the influence of boron on yield aspects in papaya reported that boron at 5 and 10g per plant significantly increased the production of uniform and healthy papaya fruits, maximum number of fruits (47.2 plant-1) and higher fruit yield hectare-1.

Chattopadhyay and Gogoi (1992) from their studies on influence of micronutrients in papaya cv. Ranchi observed that foliar application of boron @ 40 ppm in papaya produced maximum fruit weight (1000 g) and fruit yield (42.81 kg plant-1) over control.

Ahmed *et al.* (1992) noticed that soil application of 1 kg of lime along with 5 to 10 g boron plant-1 in papaya significantly increased the number of fruits plant-1, yield and uniform shape of fruit as compared to control.

Pant and Lavania (1998) observed that foliar spray of ZnSO4 (0.15 per cent) + FeSO4 (0.15 per cent) significantly increased the percentage of female plants in papaya.

Lokhande and Moghe (1998) concluded that the plants receiving 200 g N + 100 g P via soil + a foliar spray of 1 per cent urea + 0.2 per cent boron + 50 ppm IAA at 90 days interval recorded

maximum fruit weight (1.828 kg fruit-1), fruit shape (0.996 shape index) and fruit yield (32.843 kg plant-1) in papaya cv.Honeydew..

Pant and Lavania (1998) observed the highest fruit yield in Pant Papaya-1 when boron was sprayed alone or in combination with zinc sulphate.

Kavitha *et al.* (2000) reported increase in the yield parameters of papaya cv. CO.5 during the fourth, eighth, twelfth and sixteenth month after planting with the foliar spray of zinc @ 0.5 per cent or soil application of 10 g plant-1 and boron @ 0.1 per cent foliar spray or soil application of 5 g plant-1.

Jeyakumar *et al.* (2001) noticed an improvement in number of leaves plant-1 and stem girth with the combined foliar application of ZnSO4 0.5 per cent and H3BO3 0.1 per cent on papaya at 4th and 8th month after transplanting.

Jeyakumar *et al.* (2001) undertook a field experiment to determine the effect of boron and zinc on the fruit yield of papaya cv. Co 5. In their study, they revealed that foliar application of zinc sulphate @ 0.5 percent in combination with borax @ 0.1 per cent recorded the highest fruit yield.

Morales and William (2003) reported that in papaya application of boron @0.07 mg plant-1 at 35 days after emergence was found to be the best, in terms of shoot diameter, stem height, leaf area, leaf number and shoot dry matter.

Alila *et al.* (2004) detected that foliar application of boron 0.1 per cent in papaya cv. Ranchi hastened flower opening and minimum number of days were taken for flowering when compared to control.

Tyagi and Datt (2004) reported increase in fruit yield with acceptable fruit weight for local and export market, improving the quality of fruits and reduction in bumpiness of fruits in papaya cv. Sunrise Solo with the application of borax @ 5.0kg hectare-1.

Singh *et al.* (2005) opined that foliar application of ZnSO4 0.25 per cent and 0.5 per cent in papaya at two month after transplanting considerably number of leaves per plant, increased the plant growth and length of petiole (5th leaf).

Singh *et al.* (2005) reported that the combined application of 0.5 per cent borax and 0.25 per cent ZnSO4 produced maximum fruit yield (93 t/ha) in papaya as matched to control (61.56 t/ha).

Singh *et al.* (2005) applied borax @ 0.50 per cent + zinc sulphate @ 0.25 percent as foliar spray at two months interval from transplanting and record maximum fruit yield (37.20 kg per plant) in papaya cv. Ranchi.

Mollah *et al.* (2006) from their studies on effect of basal and foliar application of boron on papaya varieties, observed the highest fruit yield (49.01 t ha-1)with foliar application of boron @ 1.0 kg ha-1 in cv. Shahi.

Ray (2009) revealed that foliar application of ZnSO4 0.5 per cent and borax 0.1 per cent either unaided or in combination resulted in better fruit yield in papaya.

Thangaselvabai *et al.* (2009) applied 0.5 per cent ZnSo4, 0.2 per cent FeSo4, 0.2 per cent CuSo4 and borax 0.1 per cent (at 3rd, 5th and 7th month after planting) as a foliar spray and obtained increased fruit yield in banana.

Yadav *et al.* (2010) revealed that foliar application of CuSO4 0.25 percent + MnSO4 0.25 per cent + borax 0.1 per cent increased plant growth in papaya cv. Washington.

Singh *et al.*, (2010) opined that foliar application of borax @ 0.50 per cent + zinc sulphate @ 0.25 per cent at two months interval from transplanting resulted in maximum plant height (171.62 cm), plant girth (39.74 cm) and number of leaves plant-1(31.17) in papaya cv. Ranchi.

Yadav *et al.* (2010) reported that in papaya cv. Washington foliar application of copper sulphate 0.25 per cent + manganese sulphate 0.25 per cent + borax 0.1 percent recorded significantly the highest number of fruits plant-1(30.67), fruit weight (1.30 kg), yield (40.4 kg plant-1 and 993.29 q ha-1), fruit length (25.0 cm) and fruit width (13.17 cm).

Bhalerao and Patel (2012) detected that foliar application of calcium nitrate 1000 ppm + borax 30 ppm + zinc sulphate 200 ppm + ferrous sulphate 200 ppm at 60, 90 and 120 days after planting on papaya cv. Taiwan Red Lady recorded the uppermost fruit yield (80.76 t ha-1).

3. MATERIALS AND METHODOLOGY

The present study entitled "RESPONSE OF ZINC AND BORON SPRAYS ON YIELD, GROWTH AND QUALITY OF PAPAYA (*Carica papaya* L.)cv. RED LADY**"** will be conducted at V.P.O. Maheru, Tehsil Phagwara, District Kapurthala, Punjab under the Department of Horticulture, Lovely Professional University, Phagwara, Jalandhar, Punjab during the year 2018-19.

3.1 Description of Papaya cv. Red lady:

1. Early vigorous and tolerant to papaya ring spot virus.
2. Plants start to bear fruit at 60-80 cm height and have over 30 Fruits per plant in each fruiting season.
3. Fruits are long-shaped on bisexual plants and rather short oblong on female plants. Weighing about 1.5-2 kg.
4. Flesh is thick, red and aromatic with 13% sugar content.

3.2 Materials required

1. Plant cultivar: Taiwan Red Lady 786
2. Micronutrients: Zinc, Boron
3. Spacing - 2m X 2m
4. Number of Treatments - 9
5. Number of Replications - 4
6. Total number of Plants - 36
7. Design Randomized Block Design (RBD)

3.3 Proposed Treatments:

T1. Borax at 0.25%

T2. Borax at 0.50%

T3. $ZnSO_4$ at 0.25%

T4. $ZnSO_4$ at 0.50%

T5. Borax at 0.25% + $ZnSO_4$ at 0.25%

T6. Borax at 0.25% +$ZnSO_4$ at 0.50%

T7. Borax at 0.50% + $ZnSO_4$ at 0.25%

T8. Borax at 0.50% +ZnSO4 at 0.50%

T9. Control (water spray)

3.4 Proposed Methodology

Soil Analysis – pH, concentration of essential micro and macro nutrients.

↓

Field preparation – Raised beds will be prepared along with proper Irrigation channels.

↓

Transplanting – It will be done manually on raised beds.

↓

Irrigation – Regular irrigation will be provided as per requirement.

↓

Applications of Various treatment – Foliar application of treatments.

↓

Growth and Development analysis – Various parameters will be analyzed.

↓

Fruit set – Observations will be recorded on fruit set.

↓

Harvesting – Manually harvesting will be done after ripening of fruits.

↓

Yield – Total yield will be calculated after harvesting of fruits.

4. OBSERVATIONS RECORDED:

4.1 Date of transplanting: Papaya seedlings were manually transplanted on 10/04/2018.

4.2 Irrigation: Irrigation was provided to the transplanted seedlings regularly.

4.3 Observations to be recorded:

A. Morphological Parameters

1. Leaf analysis
2. Plant Height
3. No. of leaves
4. Flowering (%)
5. Fruit set (%)
6. Fruit shape

B. Yield Parameters

1. Number of fruit/plant
2. Total fruit yield

C. Quality Parameters

1. Fruit colour
2. TSS of fruit
3. Acidity of fruit
4. Fruit size
5. Weight of fruit
6. Ascorbic acid content
7. Papain content

5. PROPOSED EXPECTED OUCTOME

Micronutrients play an important role in overall growth and development of plants. They also helps in good quality yield of fruits. Zinc is the important constituent of many enzymes which control many metabolic reactions in the plant and also essential for protein and auxin synthesis. Boron is a constituent of cell membrane and important for cell division. It behaves as a controller of calcium/potassium ratio in the plant and helps in nitrogen translocation and absorption of sugars in plant (Trivedi *et al.*, 2012). From this experiment we expect that by giving certain concentration of foliar application of zinc and boron micronutrient on Papaya cv. Red lady plants will attain good vegetative growth along with greater quality of fruits and good yield.

LITERATURE CITED

A.O.A.C. 1980. Association of Official Agricultural chemists. *Official methods of analysis* AOAC. Washington D.C

Ahmed, A, Biswas, M. and Amzad Hossion, A.K.M. 1992. Effect of lime and boron on yield and quality of papaya fruit. *Acta Hort.* 321:653-658.

Alila, P, Sanyal, D. and Akali Sema 2005. Responses of papaya cv. Ranchi to micronutrient application. *Horticultural Journal.* 18(2): 121-125.

Alila, P, Sanyal, D. and Sema, K.A. 2004. Influence of micronutrient application on quality of papaya cv. Ranchi. *Haryana Journal of Horticultural Sciences.* 33 (1/2): 25-26.

Anonymous. 2012-13. State wise area, production and productivity of papaya. National Horticulture Board, Indian Horticulture Database-2012-13.

Berger, K.C. and Troug, E. 1939. Boron determination in soils and plants. Ind. *Eng. Chem. Anal. Ed.* 11: 540-545.

Bhalerao, P.P. and Patel, B.N. 2012. Effect of foliar application of Zn, Ca, Fe and B on physiological Attributes, Yield, Nutrient Status and Economics of papaya (*Carica papaya* L.) cv. Red Lady. *Madras Agric. J*. 99(4-6): 298-300.

Chan, H.T. and Tang, C.S. 1978. The chemistry and biochemistry of papaya. *In: Tropical foods*, Inglett GE, Charolambous G. (eds) Vol.1. Academic Press, New York, pp 33-55.

Chattopadhyay, P. K. and Gogoi, S K. 1992. Influence of micronutrients of fruit quality of papaya. *Environment and Ecology.* 10(3): 739-741..

Edward Raja, M. 2008. Effect of boron on yield and post harvest life of papaya in semi arid tropics. *Acta Hort*. 851.

Edward Raja, M. 2009. Importance of micronutrients in the changing horticultural scenario in India. *Journal of Horticulture science.* 4(1): 1-27.

Ghanta, P.K, Dhus, R.S. and Mitra, S.K. 1992. Response of papaya to foliar spray of Boron, Manganese and Copper. *Horticultural Journal.* 5(1): 43-48.

Helail, B. M and Atawia, A. A. R. 1990. Sex expression of papaya plants in relation to some leaf chemical constituents. *Egypt. J. APPL. Sci.* 5 (2): 130-137.Jackson, M.L. 1973. *Soil chemical analysis*. Prentice Hall of India. Pvt Ltd, New Delhi.

Jahir Basha, C.R. 2002. Transmission approaches for management of papaya ring spot virus disease. *M.Sc. (Agri.) Thesis*. Univ. Agric. Sci. Bangalore, pp.(total pages).

Jeyakumar, P, Durgadevi, D. and Kumar, N. 2001. Effect of Zinc and Boron fertilization on improving fruit yields in papaya (*Carica papaya L*.) cv. Co 5. *Development in Plant and Soil Sciences* 92. 356-357.

Kamble, A.B. and Desai, U.T. 1996. Effects of micronutrients on fruit quality of ber. *Journal of Maharashtra Agricultural Universities*. 20(3): 471-472.

Kavitha, M, Kumar, N. and Jeyakumar, P. 2000. Role of Zinc and Boron on fruit yield and associated characters in papaya cv. Co5. *South Indian Horticulture.* 48(1/6): 6-10.

Kudada, N. and Prasad, S.M. 2002. Effect of manuring on incidence of papaya ring spot virus and yield attributes of pot grown papaya cv. Rajdoot. *J. Res*.(BAU) 52(3):224-227.

Kudada, N. and Prasad, S.M. 2006. Effect of planting season and manuring on incidence of papaya ring spot disease and fruit yield. *Indian J. Virol.*17(1):47-49.

Kumar, L.S.S. and Abraham, S. 1942. The papaya its, botany, culture and uses. *J. Bombay. Nat. His. Soc.* pp 55.

Kundu, A, Mitra, S.K, Ghosh, S.K. and Bose, T.K. 1989. Effect of micronutrient on foliar application in papaya. *Mysore j. Agricultural Science*. 23: 65-70.

Kundu, S. and Mitra, S.K. 1999. Response of foliar spray of copper, boron and zinc on quality of guava. *Indian Agric*. 43(1-2): 49-52.

Kunkalikar, S, Byadgi, A.S, Kulkarni, V.R. and Krishna Reddy, M. 2006. Management of papaya ring spot virus disease. *Indian J. virol*. 17(1).

Lindsay, W.L. and Norvell, W.A. 1978. Development of a DTPA Soil test for zinc. *Soil Sci. Soc. Am. J.* 42: 421-428.

Lokhande, N.M. and Moghe, P.G. 1990. Influence of nutrients and hormones on fruit quality traits and their correlation with yield in PRSV infected papaya. *South Indian Hort*. 38(1):8-10.

Lokhande, N.M. and Moghe, P.G. 1991. Nutrients and hormonal effect on growth, promotion and productivity in ring spot infected papaya crop. *South Indian Hort.* 39(1):23-26.

Lokhande, N.M. and Moghe, P.G. 1998. Nutrients and hormonal effect on growth, promotion and productivity in ring spot infected papaya crop. *J. South Indian Hort.* 39:pp. 23-26.