Effect of different levels of Nano boron and nano zinc on plant growth and establishment of Passion Fruit (*Passiflora edulis* Sims) Under Prayagraj Agro-Climatic Condition

ABSTRACT

The experiment was carried out at Department Of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj during the year 2023-24.The experiment was laid out in Randomized Block Design comprising of 10 treatments *viz*., T_0 Control, T_1 Nano Boron @ 1ppm (Foliar application), T_2 Nano Boron @ 2ppm (Foliar application), T_3 Nano Boron @ 3ppm (Foliar application), T_4 Nano Zinc @ 1ppm (Foliar application), T_5 Nano Zinc @ 2ppm (Foliar application), T_6 Nano Zinc @ 3ppm (Foliar application), T_7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application), T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) with three replications. The treatments in each replication were allotted randomly. The Observations were recorded as per the Vegetative growth parameters, survival (%) and chlorophyll content (SPAD value). The results reveal that the treatment T_9 Nano Boron 3ppm + Nano Zinc @ 3ppm (Foliar application) was found to be the most suitable over all the other treatments in relation to vegetative growth parameters, survival (%) and chlorophyll content (SPAD value). The lowest cost of Cultivation was found in Treatment T_1 which was 54,191.588/-

The abstract is not well balanced. The methodology section takes up more than half! The results section needs to be developed further.

Key words: - Nano boron, nano zinc, plant growth, establishment and Passion Fruit**, Prayagraj Agro-Climatic Condition**

INTRODUCTION

The passion fruit is a high value and export oriented crop. It belongs to the family Passifloracea, which is represented by 14 genera. The genus Passiflora is the principal representative of the family and comprises of nearly 580 species, distributed throughout the tropical and subtropical regions of the world (Silva and San Jose 1994). More than 150 species are native to Brazil, out of which 60 bear edible fruit but only a few are of commercial importance. Martine and Nakesone (1970) suggested the term passion fruit exclusively to represent the species, Passiflora edulis Sins, which contains two forms-purple fruited (Passiflora edulis Sins) and yellow fruited (Passiflora edulis Sins f. flavicarpa Degener) **Sangita and Birendra (2018).** The passion fruit juice is acidic by nature, has a great flavour, is quite delicious, nutritious, and well-liked by most people for its blending ability. The minerals sodium, magnesium, sulphur, chlorides, and absorbic acid are all present in moderate amounts in passion fruit, which is also an excellent source of vitamin A, riboflavin, and niacin **Chonyaphi *et al.*, (2022)**. In India, passion fruit cultivation is confined to Kerala, Tamil Nadu (Nilgiri hills and Kodaikanal), Karnataka (Coorg) and

North eastern states (Mizoram, Nagaland, Manipur and Sikkim) with an area and production of 9.11 thousand ha and 45.82 thousand tons. The fruit is a good source of vitamins A and C. Purple (*Passiflora edulis* Sims.) and yellow passion fruit are the two varieties that are known to be edible (*Passiflora edulis* f. flavicarpa Deg.) **Chonyaphi *et al.*, (2022)**. Boron has a substantial role in plant metabolism physiological like as nucleic acid metabolism, protein, natural hormone biosynthesis, building and transition of carbohydrates, photosynthesis, cell division, cell wall synthesis membrane action and water uptake **(Kaneko *et al,* 1997; Mengel *et al.*, 2001 and El-Sheikh *et al.*, 2007).** Boron is accountable to activate of dehydrogenase enzymes, sugar translocation, nucleic acids and plant hormones **(Brady and Weil, 1996).** Boron deficiency can cause serious problems such as defective fruit development, less yield and poor fruit quality **(Maurer and Taylor, 1999).** Boron foliar spraying have effective within a limited number of studies to decrease the avalanche of fruit, fruit cracking, controlling boron levels and plant bio regulators (PBR) applications **(Singh *et al.*, 2003).** Application of boron increases fruit set and yields by its role in pollen tube germination and elongation **(Abd-Allah, 2006).** Zn is a divalent cation (Zn++) with completely filled d-shell orbitals, making the element redox-stable thus forming more stable complexes (meaning no redox activity in plants) unlike other metal ions such as Mn, Fe, and Cu **(Brown *et al.*, 1993).** Zinc role in plant metabolism is essential to activates like carbonic anhydrase which is critical in the photosynthesis of C4 and C3 plants. Without zinc, RNA polymerase cannot occur, and the enzyme inactivated. Zinc is also involved in ribosomal fraction stabilization, cytochrome synthesis, and carbohydrate metabolism **(Hafeez *et al* 2013).** Zinc activates enzymes involved in protein synthesis, pollen formation, and regulation of auxin. It is also involved in gene expression which is necessary for the tolerance of environmental stresses in plants. Zinc plays a critical role in plant reproduction, water stress prevention, and protects against toxic effects of reactive oxygen species **(Sharma, 2006).** Presence of Zn as a cofactor, protects plants from oxidative stress. Zinc also provides defense mechanisms against harmful pathogens**.** Thus, this study was taken upto to study the objectives which are framed; To study the effect of Nano Boron and Nano Zinc on vegetative growth and establishment of Passion Fruit crop and to estimate the cost of cultivation.

MATERIALS AND METHODS

The experiment was carried out the Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj 2023-2024. The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46 ^{0}C – 48 ^{0}C and seldom falls as low as 4 ^{0}C – 5 ^{0}C. The relative humidity ranged between 20 to 94 per cent. The average rainfall in this area is around 1013.4 mm annually. The meteorological data (November to March) with respective to total rainfall, maximum and minimum temperature, relative humidity. The experiment was laid out in Randomized Block Design (RBD) with three replications. The treatment consisted of different levels of Nano Zinc (1, 2 and 3ppm) and Nano Boron (1, 2 and 3ppm) foliar application. Thus, there were ten treatments combinations. Seedling were raised in polybags and 40 days old seedling were transplanted to the main field. The seedlings of papaya were transplanted in the field adopting a spacing of 5 x 5 m. The data recorded on vegetative growth viz., plant height (cm), number of leaves per plant, number of branches per plant, stem girth (mm), leaf area (cm^2), Leaf area index LAI, chlorophyll content (SPAD) and survival (%) were analyzed statistically (What types of analysis?) **(Panse and Sukhatme, 1967).**

RESULTS AND DISCUSSION

1. **Plant Height (cm).**

It was observed from the Table 1 that the effect of different levels of Nano boron and nano zinc showed significant effect on plant height (cm), number of leaves per plant, number of branches per plant, stem girth (mm), leaf area (cm^2), Leaf area index LAI, chlorophyll content (SPAD) and survival (%) of **Passion Fruit**. The progressive increase in plant height (63.11cm) was recorded in T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) followed by T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T_7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application) and the minimum plant height (42.69cm) was recorded in T_0 Control.

Statistical analyses are not available!

You must discuss your results, basing them on bibliographical references

2. **Number of leaves per plant.**

The progressive increase in number of leaves per plant (43.02) was recorded in T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) followed by T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T_7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application) and the minimum number of leaves per plant (25.83) was recorded in T_0 Control.

Statistical analyses are not available!

You must discuss your results, basing them on bibliographical references

3. **Number of branches per plant.**

The progressive increase in number of branches per plant (4.63) wasrecorded in T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) followed by T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T_7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application) and the minimum number of branches per plant (3.07) was recorded in T_0 Control.

Statistical analyses are not available!

You must discuss your results, basing them on bibliographical references

4. **Stem diameter (mm).**

The progressive increase in stem girth (mm) (6.21) wasrecorded in T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) followed by T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T_7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application) and the minimum stem girth (mm) (4.04) was recorded in T_0 Control.

Statistical analyses are not available!

You must discuss your results, basing them on bibliographical references

5. **Leaf Area (cm^2).**

The maximum leaf area (132.35cm^2) was found in treatment with T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) followed by T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application). Whereas, the minimum leaf area (105.44cm^2) was recorded in T_0 Control.

Statistical analyses are not available!

You must discuss your results, basing them on bibliographical references

6. Leaf Area Index (LAI).

The maximum Leaf area index LAI (5.29) was found in treatment with T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) followed by T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application). Whereas, the minimum Leaf area index LAI (4.22) was recorded in T_0 control

Statistical analyses are not available!

You must discuss your results, basing them on bibliographical references

7. Chlorophyll Content (SPAD Value)

The maximum chlorophyll content (SPAD) (70.05) was found in treatment with T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) followed by T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T_7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application). Whereas, the minimum chlorophyll content (SPAD) (48.81) was recorded in T_0 Control. These are similar findings reported by **Singh *et al.*, (2023).** Boron disorder is widespread micronutrient problem in agriculture, which leads to reduce yield and lack crop quality **(Barker and Pilbeam, 2006).** Boron roles in plants involve effects on fruit set and yield, and is indirectly responsible for the energized dehydrogenase enzymes, sugar translocation, nucleic acids and plant hormones **(Brady and Weil, 1996; El-Sheikh *et al.*, 2007 and Marschner, 2012).**

Statistical analyses are not available!

8. Survival Percentage (%)

The maximum survival (%) (100) was found in treatment with T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) followed by T_8 Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application) and T_7 Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application) and the minimum survival (%) (67.66) was recorded in T_0 Control. These are similar findings reported by **Singh *et al.*, (2023).**

Statistical analyses are not available!

CONCLUSION

On the basis of the investigation, it is concluded that T_9 Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application) performed best in terms of plant height (63.11cm), number of leaves per plant (43.02), stem girth (mm) (6.21), leaf area (132.35cm^2), Leaf area index LAI (5.29), chlorophyll content (SPAD) (70.05) and survival (%) (100).

The conclusion is very limited! You need to take it up again, giving your scientific deductions and your proposals for continuing this type of work.

REFERENCES

Barker, A.V. and Pilbeam, D.J. (2006). Handbook of Plant Nutrition. CRC Press, Boca Raton, Florida, p. 3-13.

Brady, N.C. and Weil, R.R. (1996). The nature and properties of soil. Prentice-Hall, New Jersey, U.S.A.

Brown P.H., Cakmak I., Zhang Q. (1993) Form and Function of Zinc Plants. In: Robson A.D. (eds) Zinc in Soils and Plants. Developments in Plant and Soil Sciences, vol 55. Springer, Dordrecht

Chonyaphi Vashum, Topno Samir E., Kerketta Anita, Bahadur Vijay aand Prasad V. M. (2022). Effect of Different Organic Manures on Establishment of Passion Fruit (Passiflora edulis Sims.) cv. Coorg Purple and Coorg Yellow under Prayagraj Agro-climatic Conditions. International Journal of Plant & Soil Science34(23): 1345-1350.

El-Sheikh, M.H., Khafgy, S.A.A. and Zaied, S.S. (2007). Effect of foliar application with some micronutrients on leaf mineral content, yield and fruit quality of Florida prince desert red peach trees. J. Agric. Biol. Sci., 3: 309-315.

Hafeez, B., Khanif, Y. M., & Saleem, M. (2013). Role of zinc in plant nutrition-a review. American journal of experimental Agriculture, 3(2), 374.

Kaneko, S., Ishil, T. and Matsung, T. (1997). A boron rhamnoyalcafurnan. II- Complex from bamboo shot cell walls. Phytochemistry, 49: 243-248.

Marschner, H. (2012). Mineral nutrition of higher plants. 3rd Edition, Academic Press Limited Harcourt Brace and Company, Publishers, London, pp 347-364.

Maurer, M.A. and Taylor, K.C. (1999). Effect of foliar boron sprays on yield and fruit quality of navel oranges. University of Arizona College of Agriculture, Citrus Research Report. http://ag.arizona.edu/pubs/crops/az1138.

Mengel, K.E., Kirkby, A., Kaesgarten, H. and Appel, T. (2001). Principles of plant nutrition. 5th El-Kluwer Academic Publishers, Dordrecht, p. 1-34.

Sangita Mehta and Birendra Prasad (2018). Effect of Different Treatments and Pruning on Reproductive, Fruit and Quality Characters of Passion Fruit. Int.J.Curr.Microbiol.App.Sci Special Issue-7: 3031-3038

Sharma, A. K., Johri, B. N., & Gianinazzi, S. (1992). Vesicular-arbuscular mycorrhizae in relation to plant disease. World journal of microbiology and biotechnology, 8(6), 559563.

Sing, D.B., Sharma, B.D. and Bhargava, R. (2003). Effect of boron and GA3 to control fruit cracking in pomegranate (Punica granatum). Current Agric., 27 (1/2): 125127.

Singh Rupinder, Bakshi Manish, Singh Shailesh K., Ahmed Anis, Rehlan Ankush (2023). Effect of nano boron and nano zinc on leaf nutrient status in kinnow mandarin. Eur. Chem. Bull. 2023, 12(Special Issue 10), 2048 – 2052

Table 1. Effect of different levels of Nano boron and nano zinc on plant growth and establishment of Passion Fruit Under Prayagraj Agro-Climatic Condition

The meaning of statistical analyses must be included in the tables.

S. No.	Treatments No.	Treatments details	Parameters							
			Plant height (cm)	Number of leaves per plant	Number of branches per plant	Stem girth (mm)	Leaf area (cm2)	Leaf area index LAI	Chlorophyll content (SPAD value)	Survival (%)
1	T_0	Control	42.69	25.83	3.07	4.04	105.44	4.22	48.81	67.66
2	T_1	Nano Boron @ 1ppm (Foliar application)	51.68	31.69	3.49	4.23	113.30	4.53	49.16	100.00
3	T_2	Nano Boron @ 2ppm (Foliar application)	54.41	34.93	3.76	5.25	116.39	4.66	50.54	100.00
4	T_3	Nano Boron @ 3ppm (Foliar application)	52.05	31.57	4.14	5.51	115.89	4.64	62.02	100.00
5	T_4	Nano Zinc @ 1ppm (Foliar application)	53.88	30.35	4.18	5.34	109.13	4.37	64.48	100.00
6	T_5	Nano Zinc @ 2ppm (Foliar application)	54.33	29.29	4.36	5.44	112.80	4.51	66.69	99.98
7	T_6	Nano Zinc @ 3ppm (Foliar application)	53.72	37.50	4.46	5.63	117.32	4.69	64.92	100.00
8	T_7	Nano Boron 1ppm + Nano Zinc @ 2ppm (Foliar application)	55.01	38.30	4.50	5.89	119.93	4.80	67.64	100.00
9	T_8	Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application)	57.51	40.44	4.58	6.07	125.98	5.04	66.11	100.00
10	T_9	Nano Boron 3ppm + Nano Zinc @ 2ppm (Foliar application)	63.11	43.02	4.63	6.21	132.35	5.29	70.05	100.00
		F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
		C.D.at 0.5 %	**2.25**	**1.53**	**0.113**	**0.15**	**4.98**	**0.199**	**1.72**	**0.024**
		S.Ed. (+)	**1.07**	**0.72**	**0.054**	**0.07**	**2.37**	**0.094**	**0.82**	**0.011**
		CV	**2.44**	**2.60**	**1.61**	**1.72**	**2.48**	**2.48**	**1.64**	**0.014**

Table 2. Cost of cultivation of PASSION FRUIT for 1ha of land

Sl. No.	**Particulars**	**Unit**	**Qty.**	**Rate/Unit (Rs.)**	**Cost (Rs. / ha)**
A.	**Land Preparation**				
1	Ploughing	Hours	4	800	3200
2	Harrowing	Hours	4	800	3200
3	Layout for pit/ Ring basin	Labour	25	350	8750
B.	**Transplanting**				
1	Cost of the plant	No.	400	30	12000
2	Transplanting of plant	Labour	20	350	7000
C.	**Foliar application**				
1	Labour for application of fertilizer	Labour	6	350	2100
D.	**Irrigation**				
	2 Labours per irrigation (6 days interval for 2 Hrs)	Water	12	350	4200
E.	**Inter-culture**				
	Weeding (6 labours per weeding)	Labour	12	350	4200
I.	**Rental value** of land	Months	3	1000	3000
J.	**Supervision charges**	Months	3	500	1500
k.	**Transportation**				5000
		Total fixed cost (Rs./ha)			**54,150/-**

Table 3. Cost Of Treatments for Cultivation for Passion Fruit

Treatments No.	Treatments combinations	Nano Boron @ (100g) Rs.8400		Nano Zinc @5g (Rs. 5500/kg)		Cost Treatment
		g ha^{-1}	Amount	g ha^{-1}	Amount	
T_0	Control	-	-	-	-	-
T_1	Nano Boron @ 1ppm (Foliar application)	0.495g	41.58			41.58
T_2	Nano Boron @ 2ppm (Foliar application)	0.990g	83.16			83.16
T_3	Nano Boron @ 3ppm (Foliar application)	1.485g	124.74			124.74
T_4	Nano Zinc @ 1ppm (Foliar application)			0.495g	544.5	544.5
T_5	Nano Zinc @ 2ppm (Foliar application)			0.990g	1089	1089
T_6	Nano Zinc @ 3ppm (Foliar application)			1.485g	1633.5	1633.5
T_7	Nano Boron 1ppm + Nano Zinc @ 1ppm (Foliar application)	0.495g	41.58	0.495g	544.5	586.08
T_8	Nano Boron 2ppm + Nano Zinc @ 2ppm (Foliar application)	0.990g	83.16	0.990g	1089	1172.16
T_9	Nano Boron 3ppm + Nano Zinc @ 3ppm (Foliar application)	1.485g	124.74	1.485g	1633.5	1758.24