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Effect of nano nitrogen and phosphorus on yield and quality of ber (*Ziziphus mauritiana*)

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Abstract

An experiment was conducted at Agricultural Research Station, Mandor, Jodhpur (Rajasthan) to find out the effects of nano nitrogen and phosphorus fertilizers on growth, yield and quality of ber (*Ziziphus mauritiana* Lam.) using factorial randomized block design with 5 replications during October 2021 to March 2022. There was maximum plant height (6.45 %, 79.17 cm), number of primary branches (14.72), secondary branches (22.09), chlorophyll contents (55.34 SPAD), fruit volume (20.63cm^3), specific gravity (0.95), fruit length (3.42 cm), fruit diameter (3.16 cm), pulp thickness (12.56 mm), pulp weight (15.79 g), pulp: stone ratio (19.20), fruit setting (6.92 %), average fruit weight (18.00 g), yield/ tree (64.57 kg), ascorbic acid (vitamin-C) (65.75 mg/100g pulp), total soluble solid (15.77°Brix), total sugar (9.20 %), reducing sugar (4.83 %), non-reducing sugar (4.37 %), fruit pH (5.50), whereas minimum stone weight (0.82 g) and fruit drop (49.38 %) were recorded with application of nano nitrogen @ 2 ml/ litter water + nano phosphorus @ 2 ml/ litter water spray over the control.

Key words- Ascorbic acid, Arid climate, Nano nitrogen, Nano Phosphorus, Total sugar

Ber (*Ziziphus mauritiana* Lam.), family Rhamanaceae is known as poor man's apple fruits (Majumder *et al*., 2017) and (Choudhary *et al*., 2017). Nano-fertilizers are non-toxic and less hazardous to humans and the environment than traditional fertilizers (Nongbet *et al*., 2022). They improve soil fertility, productivity, and crop quality while minimizing costs and increasing profit (Raj *et al*., 2021). They provide more surface for various metabolic reactions in the plant (Solanki *et al*., 2015). Nano-fertilizer can reduce the rate of nutrients loss through leaching and improves the nutrient-use efficiency of fruit plant (An *et al*., 2022). Nowadays nano-fertilizers are emerging as an alternative to conventional fertilizers (Veronica *et al*., 2014). The use of nano-fertilizers can improve crop production by up to 30 per cent compared with traditional chemical fertilizers (Kah *et al*., 2018). Nano nitrogen and phosphorus are important for improving plant growth and yield, enhance nutrient uptake, stimulate photosynthesis and get better water use efficiency (Gupta *et al*., 2022). Studies have shown their effectiveness in increasing crop productivity, as well as their potential in sustainable agriculture (Elnahal *et al*., 2022). Keeping in view, the study was carried out to determine the effect of nano fertilizers on growth, yield, and quality of fero.

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Materials and Methods

The field experiment was conducted during October, 2021 to March, 2022 at Agricultural Research Station Mandor, Jodhpur, on eight-year-old plant of Gola. Geographically, it is located between 26°30' N to 26°35' North latitude and 70°04' E to 73°15' East longitude at an altitude of 231 meter above mean sea-level, Arid Western Plains Zone of Rajasthan. The experiment was laid out in factorial randomized block design with five replications along with three treatments and each treatment consist with three randomly selected equal size plant block. Nano nitrogen @ 2 ml/ litter water, nano nitrogen @ 2 ml/ litter water + nano phosphorus @ 2 ml/ litter water first spray was applied at the pea size fruit and second spray is applied 25 days prior to harvest.

The treatments are denoted as nano nitrogen @ 2 ml/ litter water (N_1), nano nitrogen @ 2 ml/ litter water + nano phosphorus @ 2 ml/ litter water (N_2), whereas control (N_0) is without application any nano-fertilizers. Data were recorded on growth parameters *viz.* plant height (cm), number of primary and secondary branches

on selected shoots and chlorophyll contents in leaves (SPAD value). Fruit physical parameters, *viz.* fruit volume (cm^3), specific gravity, fruit length at harvest (cm), fruit diameter at harvest (cm), pulp thickness (mm), pulp weight (g), stone weight and pulp: stone ratio. Yield parameters, *viz.* fruit setting, fruit drop (%), average fruit weight (g) and yield/ tree. Quality parameters, *viz.* ascorbic acid (Vit-C) (mg/100g pulp), total soluble solid (°Brix), total sugar (%), reducing sugar (%), non-reducing sugar (%) and fruit pH was also observed standard methods.

Results and Discussion

The treatment N_2 was found best for plant growth, increased number of primary and secondary branches and chlorophyl content compared to other treatments (Table 1). The maximum increase in growth of plant (6.45%), number of primary branches (14.72), number of secondary branches (22.09) and chlorophyll content in leaves (55.34 SPAD value) were recorded with the application of N_2 treatment (Leghari *et al.*,2016). Nano fertilizers increased the availability of plant nutrients for a longer period and slow release with plant growth, which increased the composition of chlorophyll, photosynthesis, and dry matter production and, as a result, improved overall plant growth (Al-Juthery *et al.*, 2018). It may be due to role in various physiological processes and gives the green parts of plant the dark green colour (Yadegari *et al.,* 2013). It is also better for nutrient absorption, improving nitrogen-use efficiency and increase nitrogen contain in plant which resulted in enhances of plant growth (Sami *et al.,* 2019). The increases of chlorophyll is due to the role of nano particle in improvement of leaves photosynthesis and decreasing the respiration rate (Mahmoud *et al.*, 2019).

There were maximum fruit volume (20.63 cm^3), specific gravity (0.95), length of fruit (3.42 cm), fruit diameter (3.16 cm), pulp thickness (12.56 mm), pulp weight (15.79 g), and pulp: stone ratio (19.20), whereas minimum stone weight (0.83 g) was recorded in treatment N_2 (nano nitrogen @ 2 ml/ litter water + nano phosphorus @ 2 ml/ litter water), however minimum fruit volume (18.92 cm^3), specific gravity (0.93), fruit length (2.73 cm), fruit diameter (2.86 cm), pulp thickness (10.71 mm), pulp weight (12.93 g), and pulp: stone ratio (15.00) were recorded with the application of N_0 (control). The higher nitrogen-use efficiency and significantly lower nutrient losses of nano-fertilizers lead to higher productivity (6–17%) and nutritional

Table- 1: Effect of nano fertilizers on growth and physical attributes of ber

Treatment	Plant height (cm)	Number of primary branches	Number of secondary branches	Chlorophyll content in leaves (SPAD value)	Fruit volume (cm^3)	Specific gravity	Fruit length at harvest (cm)	Fruit diameter at harvest (cm)	Pulp thickness (mm)	Pulp weight (g)	Stone weight (g)	Pulp: stone ratio
N_0	74.37	12.50	19.53	50.72	18.92	0.93	2.73	2.86	10.71	12.93	0.86	15.00
N_1	76.67	14.03	20.98	53.91	19.90	0.94	3.26	3.04	12.31	14.82	0.85	17.53
N_2	79.17	14.72	22.09	55.34	20.63	0.95	3.42	3.16	12.56	15.79	0.83	19.20
SEm(±)	1.325	0.213	0.260	0.427	0.345	0.0043	0.058	0.057	0.202	0.261	0.0066	0.12
CD (P = 0.05)	**3.809**	**0.612**	**0.747**	**1.228**	**0.991**	**0.0139**	**0.167**	**0.163**	**0.580**	**0.750**	**0.0192**	**0.34**

quality of vegetable crops was reported (Zahedi *et al.,* 2020).

The application of nano-fertilizers increased fruit productivity, quality and shelf-life through their positive effects on anatomical, morphological, physiological, physico-chemical, gene expression, regulation and translocation for mitigating abiotic stresses and molecular traits (Sharma *et al.*, 2021). It increased cell division, cell elongation, photosynthetic activity, enhanced rapidly reactivity of nutrient in plant (Davarpanah *et al.*, 2017).

It is essential for formation of adenosine triphosphate (ATP), which is currency of plant cell and it is also necessary for development of strong root system which are critical for nutrient uptake and water absorption (Kazem *et al.*, 2021). Nano fertilizers activate enzyme that are responsible for breakdown of organic acid and converting into energy, this energy is used for fruit growth and development and it is crucial component of amino acid which are building of blocks of protein (Al-Juthery and Al-Shami, 2019).

There was maximum fruit setting (6.92 %), average fruit weight (18.00 g) and yield/tree (64.57 kg) and minimum fruit drop (49.38 %) N_2 treatment. The combination of nano fertilizers (nano nitrogen @ 2 ml/ litter water + nano phosphorus @ 2 ml/ litter water) increased fruit setting, fruit weight and yield. There was increase in fruit size (length and width), weight and volume and minimum fruit setting (5.76%), average fruit weight (14.08 g) and yield/ tree (57.90 kg), whereas maximum fruit drop (56.35%) was recorded in N_0 (control).

Yadegari *et al. (*2013) and Meghany *et al.* (2019) also supported this study. Nano fertilizer has unique properties due to its small surface area with high absorption, which increase in photosynthesis and leaves area (Sekhon, 2014). It improves yield and quality of fruits and increase average weight of fruits through optimum use of nutrients (Al-juthery *et al.*, 2018; Davarpanah *et al.*, 2017). The presence of these elements also reduce stomatal resistance and increase stomatal conductivity, which provides the plant with enough carbon dioxide and water to continue photosynthesis and withdraw nutrients from soil leading to an increase in yield (Sharma *et al.*, 2021). Additionally, it is increasing the activity of enzyme involved in photosynthesis, stimulate production of growth-promoting hormones and improve nutrient uptake by plants (Kazem *et al.*, 2021). They also helping reduce plant stress caused by environmental

Table- 2: Effect of nano fertilizers on yield and quality attributes of ber

Treatment	Fruit setting (%)	Fruit drop (%)	Average fruit weight (g)	Yields (kg\tree)	Ascorbic acid (Vit-C) (mg/100g Pulp)	Total soluble solid (°Brix)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	pH
N_0	5.76	56.35	14.08	57.90	59.75	15.05	7.74	4.08	3.66	5.28
N_1	6.44	50.65	16.73	61.77	63.71	15.62	8.37	4.45	3.92	5.39
N_2	6.92	49.38	18.00	64.57	65.75	15.77	9.20	4.83	4.37	5.50
SEm(±)	0.089	0.750	0.147	1.257	0.569	0.036	0.0521	0.037	0.020	0.013
CD (P = 0.05)	0.257	2.157	0.422	3.613	1.636	0.106	0.1498	0.108	0.050	0.0397

factor such as drought or high salinity (Sharma *et al*., 2022) (Table 2).

The maximum ascorbic acid (65.75mg/100g pulp), total soluble solid (15.77°Brix), total sugar (9.20 %), reducing sugar (4.83 %), non-reducing sugar (4.37 %) and pH (5.50) were significantly higher over the control (Table 2). Similar results were also reported by Yadegari *et al.* (2013), Sharma *et al.* (2021), Davarpanah *et al.* (2017) and Kazem *et al.* (2021). The application of nano nitrogen @ 2 ml/ litter water + nano phosphorus @ 2 ml/ litter water had a positive effect in improving the quality of ber fruits, and higher T.S.S. due to higher chlorophyll activities, which is responsible for accumulate more photosynthates and sugar in fruit tissue, leading to increase in T.S.S. (Mishra *et al*., 2020) and also increase in the maturity index, total sugars and total phenols (Davarpanah *et al*., 2016).

Conclusion

It can be inferred that the application of nano nitrogen @ 2 ml/ liter water + nano phosphorus @ 2 ml/ litter water could give maximum growth, yield and fruit quality.

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