Research Article

Assessment of Diverse Ber Cultivars Responds to Zinc Practices for Managing Nutrients

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Abstract | Ber is known as the King of Arid fruits and is rich in vitamin C, A, and B complexes. In this study, two years of experimentation with the four (04) cultivars of the Ber for morphological and biochemical attributes were evaluated. Different treatments such as: T_1: control; T_2: (500 g NP + 300 g P_2O_5 plant^{-1}), zinc sulphate spray (0.3%); T_3: (500 g NPK+ 300 g P_2O_5 plant^{-1}), zinc sulphate spray (0.5%); T_4: (500 g NP + 300 g P_2O_5 plant^{-1}), zinc sulphate spray (0.7%). Each cultivar shows a different response to the different amendments due to its genetic makeup. The morphological attributes showed good performance with the application of treatment T3 as compared to other treatments. Similarly, the biochemical attributes showed excellent performance with the treatment T3. The response of each trait to foliar application of zinc nutrient was somehow different in many trait indices. Moreover, an extremely positive correlation was observed among the agronomic traits and biochemical traits. The cultivar's performance for Delhi White was good as compared to the other cultivars in both years.

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Introduction

The Ber (*Ziziphus mauritiana* Lam.) is a great option for food security and the scenario of global climate change (Sharif *et al.*, 2019). It is a member of the Rhamanaceae family, which has 900 species and 57 genera (Hauenschild *et al.*, 2016; Richardson *et al.*, 2000). It is predominantly spread over the world's tropical and subtropical regions (Liu and Cheng 1994). There are only two domesticated species in the world *Ziziphus jujuba* Mill (Chinese date) and *Ziziphus mauritiana* Lam "Indo-Pak jujube" (Liu *et al.*, 2009). However, jujubes have received relatively little attention in terms of research and development (Azam Ali *et al.*, 2001). Pakistan's flora is made up of six *Ziziphus* species from the provinces of Sindh, Punjab, Khyber Pakhtunkhwa (KPK), and Baluchistan (Qureshi, 2012). Early fruit bearing,

wholesome fruit, and high profit margins are some of the distinctive features of ber cultivation (Liu *et al*., 2014; Tripathi, 2014).

The biological properties of *ziziphus* species include essential pharmaceutical activity as antimicrobial (Eslami *et al*., 2016; Ads *et al*., 2017; Al-Ghasham *et al*., 2017), antioxidant and anti-inflammatory properties (Koley *et al*., 2016; Siddiqui and Patil, 2015; Afzal *et al*., 2017) anti-malarial and anthelmintic properties (Jarald *et al*., 2009), Anticancer, antiulcer, analgesic, sedative and antipyretic effects (Hung *et al*., 2012) amongst other important activities. Moreover, the genus's species are known to produce a range of succulent, edible fruits, making them potential foraging materials (Al-Saeedi *et al*., 2017).

The productivity and quality of the current orchards must be improved in order to meet the rising demand for fruits. So, it will be wise to feed the orchards with nutrients to improve the quality of the produce and ber fruit. Moreover, macronutrients like NPK play a vital function in promoting plant production and growth. Similar to other main elements, minor elements like boron, manganese, and zinc sulphate are also necessary for measuring quality and are therefore as important to other key elements. The amount of nitrogen that gives leaves their dark green hue at their optimal level increases their chlorophyll concentration. The intake of phosphorus is connected to cell development and growth and aids in the breakdown of fat and sugar. The augmentation of soil's water-holding capacity is intricately linked to the presence of potassium. Simultaneously, this essential nutrient is instrumental in promoting the synthesis of protein and chlorophyll, both of which play a pivotal role in enhancing soil quality and supporting optimal plant growth (Athani *et al*., 2005; Chaudhary and Singh, 1990).

Using micronutrients greatly boosts crop productivity and plays a crucial metabolic role in the growth and development of plants. Zinc is an essential nutrient that plants absorb and transfer in the form of Zn^{2+}. It performs specialized physiological tasks in all living systems, including as maintaining the structural and functional integrity of cellular membranes, facilitating protein synthesis, and regulating gene expression., enzyme structure, energy production, and kerbs cycle; it also has a positive impact on crop yields. As a result, the quantitative and qualitative yield of crops is therefore highly dependent on zinc. Zinc interacts chemically and biologically with various other elements, including phosphorus, iron, and nitrogen in plants, and it is a dynamic component in organic processes. Copper and phosphorus have an adverse effect on zinc (Mousavi *et al*., 2013).

Zinc deficiency is common throughout the world on a variety of soil types, although semi-arid locations with calcareous soils, tropical regions with heavily weathered soils, and sand textured soils in a number of different climate zones tend to be the most severely impacted (Alloway, 2008; Akay, 2011). Young leaves of plants show the first signs of zinc shortage because older tissues cannot be converted into younger tissues and vice versa (zinc is not a mobile element). Plants with low zinc levels have yellow areas between their nervures (Vitosh *et al*., 1994). Internode distance and leaf size will be short in dicot plants, and bands will appear on both sides of leaves in monocot plants, particularly corns, when zinc levels are low. Zinc deficiency affects the shoot more than the root growing (Boardman and McGuire, 1990; Hacisalihoglu, 2002; Mousavi, 2011).

Foliar fertilization is a way for improving the quality and quantity of fruit in a number of horticultural crops. A solution containing plant minerals is sprayed directly onto plant leaves. Through the stomata and epidermis of the leaves, minerals are absorbed. However, this method is only advised for low-concentration fertilizers because it could be determined to plant leaves. Application of fertilizers to the leaves in essence, supplementing with micronutrients is a tried and true method for treating deficiencies. Micronutrients applied to the soil are far less effective than those applied to the leaves (Shirgure and Srivastava, 2014). Although, combined application of Zn (0.4%) and urea (1%) produced the highest number of fruit and yield of mango, whereas the fruit quality was improved by the application of B (0.4%) + urea (1%) to younger plants (Banik *et al*., 1997). In addition, Nijjar *et al*. (1976) recommended 27.5 mg/kg Zn in deficient leaves and 35.2 mg/kg for healthy leaves to be maintained with three sprays of $ZnSO_4$ to correct the Zn deficiency. Nutrient feeding on foliage as opposed to soil has some advantages. Foliar feedings are very effective, have a quick effect on the plant, and are useful for preserving the plant's appropriate nutrient concentration during growth and fruit development. To make smart fertilizer recommendations for the successful production of

ber, there is, however, a dearth of information on the nutritional characteristics of foliage. Fruit tree foliar feeding has become more crucial in recent years as the requirement for nutrients applied to the soil has grown as some nutrients soak up into the soil while others become unavailable to the plants as a result of soil responses.

Due to the high population pressure, there is a little opportunity of adding new land for fruit cultivation in order to fulfill the growing demand. As a result, only alternatives are left to enhance the population and quality of the existing orchards. As a result, it would be wise to use foliar nutrient feeding to boost the output and quality of ber fruit.

Therefore, present study is envisaged to assess the reaction of different ber cultivars to numerous nutrients management applies.

Materials and Methods

In order to explore the effects of various nutritional management techniques on the growth, flowering, fruiting yield, and quality of eight- year-old ber cultivars, namely Delhi white, Suffan, Karela, and Mehmud Wali, a comprehensive experiment was conducted at Ghazi University in Dera Ghazi Khan, Pakistan. The study involved the application of nitrogen, phosphorous, and foliar zinc sulphate during two critical stages of the ber crop; the flower bud differentiation in September and fruit setting in November. In this experiment, a randomized complete block design was utilized, composing of four treatments and three replications per treatment. The treatments combination were as follow T1: control; T2: (500 g NP + 300 g P2O5 plant-1), zinc sulphate spray (0.3%); T3: (500 g NP + 300 g P2O5 plant-1), zinc sulphate spray (0.5%); T4: (500 g NP + 300 g P2O5 plant-1), zinc sulphate spray (0.7%). The foliar spray of micronutrients was conducted during the flower bud differentiation stage in September and the fruit setting stage in November for each year's ber crop.

Measurements

Data on various plant traits were collected. The morphological traits of the data were from the experiment for days to flowering, fruit set percentage (%), fruit weight (gram), flesh weight (gram), stone weight (gram), flesh: stone ratio, average fruit length and breadth LxB (cm^2) total yield (kg/tree).

Biochemical trait such as total soluble solids (TSS), total titratable acidity (TTA), ascorbic acid (AA) and total sugar (TS) were collected.

Excel 365 is used to analyze basic data statistically. Using R studio software version 1.2.500.1, the correlation study between the index values of these attributes under stress was carried out using Pearson's Correlation Coefficient.

Results and Discussion

Data on days to flowering revealed that all sprayed treatments had a significant impact on days taken to blossom and the percentage of fruit setting. The T3 treatment had the shortest and longest blooming times (8.02 and 7.78 respectively), while the T1 treatment had the longest and shortest flowering times (13.46 and 13.20, respectively) Figure 1a. The cv "Delhi White" had the lowest number of days (9.70 and 9.97), while the cv "Karela" had the highest number of days (12.95 and 11.66) needed to reach flowering (Figure 1a). The highest fruit setting percent (7.70 and 6.94) was noted in T3 (0.5%), while the lowest fruit setting percent (5.45 and 5.30) was noted in T1 (only NPK). In both seasons, the variety 'Dehli white' had the highest and lowest percentages of fruit setting, respectively (7.17 and 6.89), while variety 'Suffan' had the lowest percentages (6.18 and 5.63) (Figure 1b). In terms of the weight of the fruit from various ber cultivars, there were considerable variances between treatments. Results revealed that all foliar applications of ZnSO4 increased fruit weight, although the trees that received 0.5% ZnSO4 foliar spray had the heaviest fruits (19.80 g and 19.66 g), whereas control trees had the lightest fruits (14.76 g and 14.45 g) (Figure 1c). The fruit weight gained by the cultivar Dehli White was highest (28.24 g and 27 g), while the fruit weight gained by the cultivar Suffan was lowest (9.37 g and 9.33 g) (Figure 1c). Data revealed significant variations in flesh weight, stone weight, and the ratio of flesh to stone as a result of NPK application alone and NPK application in combination with various ZnSO4 concentrations. In both years, ber plants treated with NPK + 0.5% $ZnSO_4$ had the highest values of flesh weight (18.55 g and 18.38 g) and stone weight (1.27 g and 1.28 g), whereas fruit treated with NPK had the lowest values of flesh weight (13.72 g and 13.54 g) and

stone weight (1.05 g and 0.98 g) (Figures 1, 2a). In both seasons, the variety "Dehli White" showed the highest flesh weight and stone weight, whereas the variety "Suffan" showed the lowest flesh weight and stone weight (Figures 1, 2a). While the data shown in Figure 2B showed that NPK + 0.5% ZnSO4 application produced the highest pulp to stone ratio and NPK treatment produced the lowest pulp to stone ratio. The highest pulp: stone ratio (19.38 and 18.29) was found in the variety Delhi White, while the lowest ratio (8.67 and 8.26) was found in the variety "Suffen". As anticipated, several treatments had a considerable impact on fruit volume. According to data on fruit volume, the highest value of fruit volume (21.25 and 21.69 cm^3) was seen in the NPK + 0.5% ZnSO4 treatment, whereas the lowest value of fruit volume (16.40 and 16.36 cm^3) was recorded with NPK application alone (Figure 2c). Maximum fruit volume was seen in the variety Delhi White (29.54 and 29.72 cm^3), while minimum fruit volume (11.09 and 11.30 cm^3) was seen in the variety Suffan in both years.

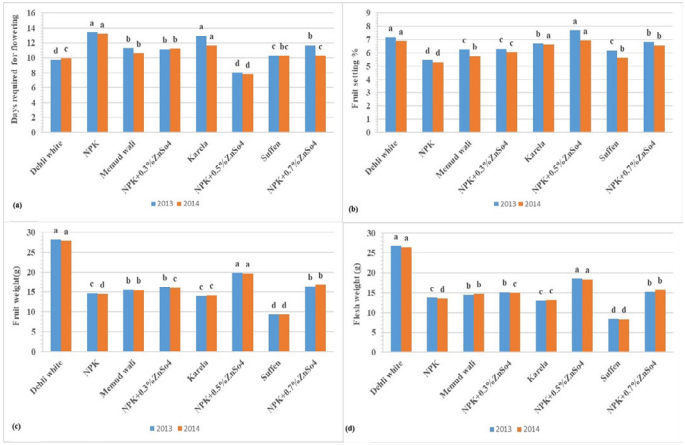

Figure 1: *Agronomic traits of ber cultivars with different amendements of ZnSO4.*

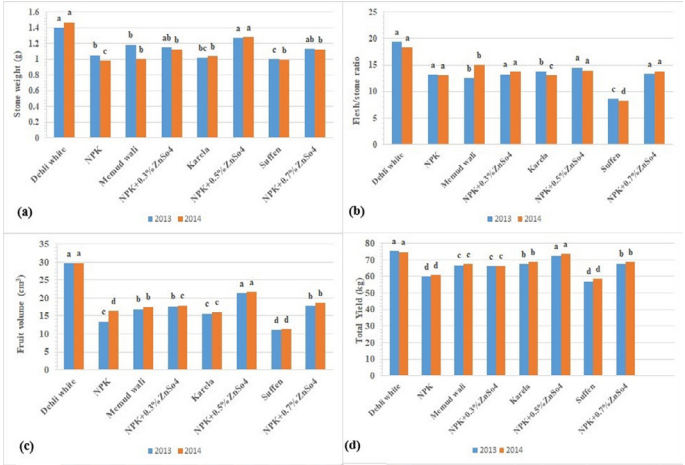

Figure 2: *Agronomic traits of ber cultivars with different amendements of ZnSO4.*

Results for total yield per tree showed that foliar $ZnSO_4$ spray significantly improved the total yield of ber cultivars in both 2013 and 2014, and that there were highly significant variations across cultivars and treatments in both years. The ber trees treated with NPK + 0.5% $ZnSO_4$ produced the highest fruit output (72.33 and 73.58) and the trees sprayed with NPK + 0.7% $ZnSO_4$ produced the lowest fruit yield (60.00 and 60.75). The Dehli White variety had the highest total yield (75.50 and 74.75), whereas the Sufen variety had the lowest total yield (57.08 and 58.50) in both years Figure 2d given that Zn is generally known to support ber yield under all circumstances, an increase in yield caused by $ZnSO_4$ spray could be the result of enhanced

Table 1: *Means value of different germplasm on the biochemical parameters.*

Traits	Dehli white		Mehmud wali		Karela		S	ufen
	2013	2014	2013	2014	2013	2014	2013	2014
TSS	75.5	74.75	66.8	67.33	67.33	68.75	57.08	58.5
TAA	0.65	0.65	0.60	0.60	0.60	0.60	0.42	0.42
AA	32.08	30.91	26.33	26.58	23.75	23.91	21.58	21.75
TS	7.23	7.13	6.34	6.29	7.29	7.28	7.12	7.14

Table 2: *Means value of different treatment on the biochemical parameters.*

Traits	NPK		NPK+0.3% ZnSo4		NPK+0.5% ZnSo4		NPK+0.7% ZnSo4	
	2013	2014	2013	2014	2013	2014	2013	2014
TSS	60.00	60.75	66.08	66.33	72.33	73.58	67.58	68.66
TAA	0.60	0.60	0.56	0.55	0.55	0.55	0.56	0.56
AA	24.25	24.58	25.75	25.16	28.16	28.33	25.58	25.08
TS	6.46	6.42	7.23	7.17	7.25	7.25	7.04	6.99

TSS analysis indicated highly significant variations among the treatments and cultivars of ber trees during both 2013 and 2014. Ber tree treated with NPK + 0.5% $ZnSO_4$ demonstrated significantly elevated TSS levels, while the control tree treated solely with NPK exhibited the lowest TSS values. The highest TSS content, observed as 15.16 and 15.33, was recorded in the Suffan cultivar, whereas the 'Mehmud Wali' cultivars displayed reduced TSS levels of 11.33 and 11.25 in both years (Tables 1 and 2). The results obtained from the analysis of TA percentage revealed effects of different treatment on various ber cultivars, as described. Ber plants that received NPK fertilizer alone exhibited a significantly higher TA value of

0.60 %. Conversely, when NPK was combined with different concentration of $ZnSO_4$, all other treatments resulted in comparable. TA percentage throughout both seasons. Among the cultivars, the 'Dehli white' variety displayed the highest TA value of 0.65, while the 'Suffen' variety had the lowest TA value of 0.42 (Tables 1 and 2). The ascorbic acid concentration results showed notable differences across ber tree treatments and cultivars. In comparison to plants treated alone with NPK, ber plants treated with NPK + 0.5% ZnSO4 had considerably greater ascorbic acid levels. According to (Tables 1 and 2), the 'Delhi White' cultivar had the greatest ascorbic acid values, reaching 32.08 and 30.91, while the 'Suffan' cultivar had the lowest levels, 21.58 and 21.75. Different treatments had a substantial impact on the total sugar (TS) levels of ber fruits, resulting in variances. Ber plants treated with NPK + 0.5% $ZnSO_4$ consistently showed noticeably higher TS levels of 7.25% in both seasons, whereas the control plants treated with NPK alone consistently showed the minimal TS values of 6.46% and 6.42%. As seen in Tables 1 and 2, the 'Karela' variety stood out among the cultivars with noticeably higher TS values of 7.29% and 7.28%, while the 'Suffen' cultivar had the lowest TS levels of 7.12% and 7.14%.

The correlations between two years of ber traits are described in Figure 1. Most of all the traits have extremely highly positively significantly with each other in both years. The year of 2013 years of the flowering trait is highly positively significantly with Fruiting (r= 0.89), FRW (r= 0.62), FRL (r= 0.62), Yielding (r=0.69), Fruit vol (r=0.62), Vit C (r =0.71), F/S ratio (r= 0.52) and positively with, S.W (r= 0.49) and Zn pp (0.33). Fruiting is highly positively significantly with Yielding (r= 0.81), Vit C (0.86) and positively with S.W (r= 0.61), F/S ratio (r = 0.69) and N % (r= 0.69). FRW is highly positively significantly with S.W (r= 0.66) and N% (r= 0.57), Similarly, the FLW is also positively N% (r= 0.57). S.W is highly positively significantly with Fruiting (r= 0.61), FRW (r= 0.66), FLW(r=0.64) Fruit Vol (r= 0.67) and Vit C (r= 0.67). F/S ratio is highly positively significantly with Yielding (r= 0.73), Vit C (r= 0.76) and N% (r= 0.50). Fruit Vol is highly positively significantly with Yielding (r=1.00), Vit C (r=0.75), N% (r= 0.69) TA (0.51) and TS (r= 0.55). TSS is extremely negatively correlated mostly with all the traits. Vit C is significantly positively correlated with TA (r= 0.62). TS is significantly positively correlated with the Zn pp (0.44) and N% (r= 0.40). There is not much difference between the correlation of the ber traits of 2013 and 2014 as shown in Figure 3.

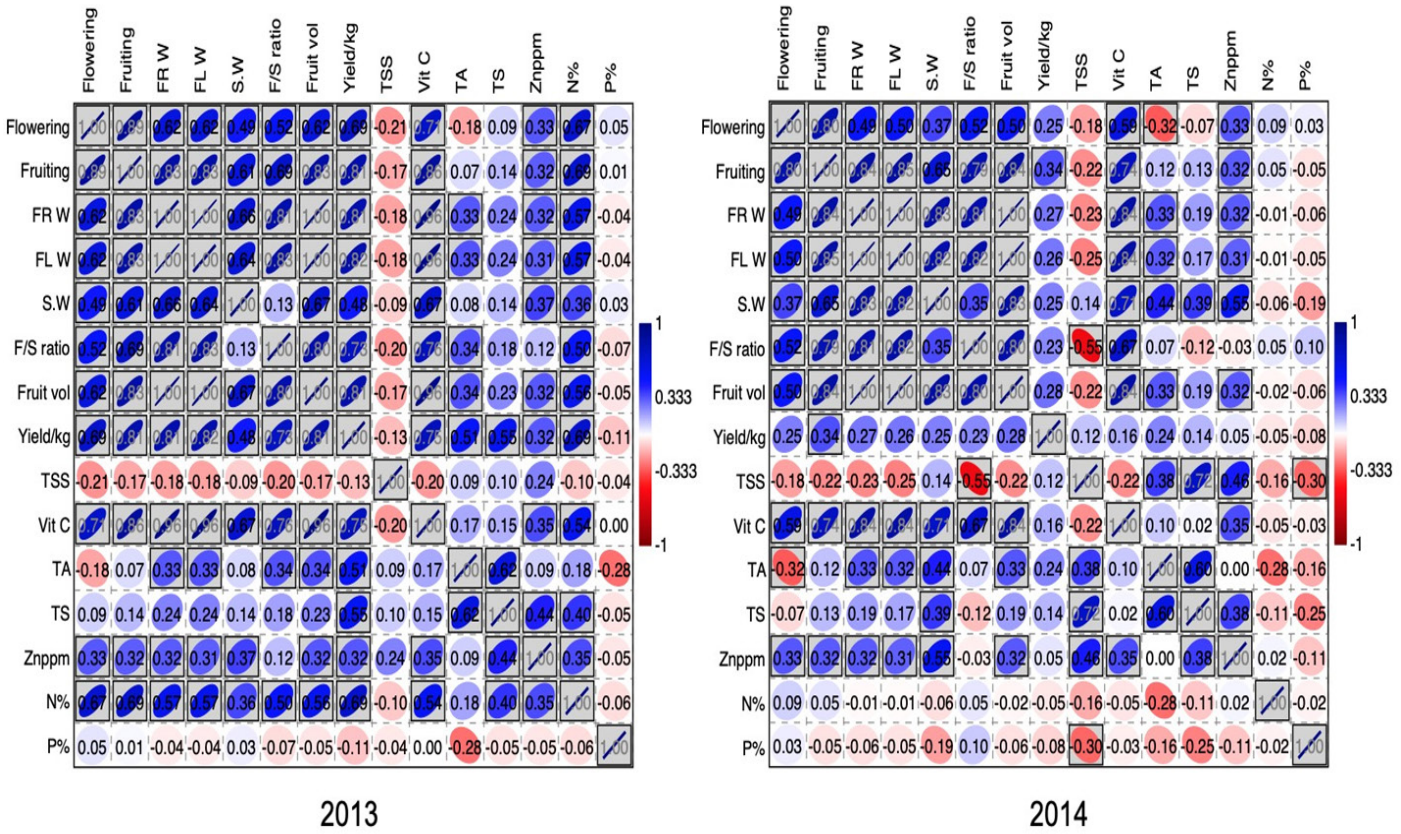

Figure 3: *Correlation of different traits of ber cultivar comparison of two years.*

Micronutrients play an indispensable role in the growth and development of crops. The nutritional value of crops is becoming a major issue; therefore, the application of micronutrients to sustain soil health and crop productivity, besides maintaining the quality of crops, is of profound importance. Micronutrients are beneficial for improving yield, quality, earliness, fruit setting, increasing post-harvest life, and developing resistance to biotic and abiotic stresses (Sidhu *et al*., 2019).

The results of the current investigation showed that all sprayed treatments significantly impacted the percentage of ber trees that set fruit and the extent of days required for flowering. There were differences between treatments and varieties in the improved fruit setting and decreased days to flowering. The existence of numerous proteinase and dehydrogenase enzymes involved in the manufacture of auxin, which in turn promotes flowering and fruit setting, may be linked to an increase in flowering and fruit setting % by the administration of zinc (Mena *et al*., 2014). The results of this study showed that plants treated with 0.5% $ZnSO_4$ in addition to urea had significant values for blooming and fruit setting percentages. The findings are consistent with the outcomes (Bhatti *et al*., 2021). The application of different growth regulators to plants and zinc sulphate at varying doses considerably improved acid lime fruit setting by reducing the number of days required for blooming initiation and amplification.

Regarding the fruit weight of various ber cultivars, there were considerable variances in treatment. Our findings are compared to those of Omar *et al*. (2015), who found that the greatest weight in the ber cv "Puyin" under dry conditions was spary with 2% $ZnSO_4$. Similar to this, Abd El-Rehman and Shadia, (2012) found that foliar applications of $ZnSO_4$ in combination with urea boosted fruit weight in various jujube genotypes. As demonstrated in other fruits, Zn application has a dynamic function in raising fruit weight. For example, foliar Zn spray boosted guava fruit weight (Waskela *et al*., 2013). Zn has a favorable impact on fruit weight due to its role in photosynthesis, which is enhanced by an increase in carotenoids and chlorophyll production (Rajput *et al*., 2017). Further, Devi *et al*. (2019) concluded that considerable if, support our findings. By adding micronutrients, the fruit and flesh weight of the ber cv. "Banarasi karaka" increased. Kaseem *et al*. (2011) previously reported that pre-harvest treatment of agro chemicals to the pu-yun jujube trees cultivar enhanced produce and fleshy weight, as well as the flesh-to-stone ratio. In contrast, Ram (2004) discovered no significant effect of Zn on stone weight in ber cv. Umran, but the pulp: stone ratio was significantly improved. This could be explained by varietal differences between our experiment and the reference, which only contained one variety for the application of zinc. Chandra and Sigh (2015) showed that 0.5% $ZnSO_4$ application increased the pulp to stone ratio in Emblica officinalis cv. N-A-7.

As expected, various treatments had a significant impact on fruit volume. The current study's findings are similar to those of Kassem *et al*. (2011), who concluded that $ZnSO_4$ application increased fruit volume in jujube tree genotypes. Another study, similar to this one, found that applying $ZnSO_4$ to *Emblica officinalis* cv. 'N-A-7' increased fruit volume significantly. On the contrary, adding $ZnSO_4$ boosted the fruit volume of the Japanese plum cultivar Kala Amristsari as also reported by (Rajput *et al*., 2017). Moreover, Singh *et al*. (2016) observed similar results in guava cv. Allahbad Safeda in terms of increased fruit volume due to the application of $ZnSO_4$. The increased production of more photosynthetic products and their subsequent transfer to the fruit, which eventually increased fruit weight and volume, may be the cause of the rise in fruit volume caused by the spraying of zinc sulphate.

The total yield per tree data in 2013 and 2014 showed very significant differences across cultivars and treatments, and foliar $ZnSO_4$ spray greatly increased the overall output of the ber cultivars. Zinc is well known to support ber yield under all circumstances, so an increase in yield from $ZnSO_4$ spray may be attributable to increased fruit retention. To maximize yield from ber, the optimum tonic should be used. The earlier reports that are still available support the current findings that zinc sulphate foliar spray helped to increase fruit output. Increased nutrient intake and efficient absorption lead to more dense vegetative growth in the early stages, which later produced metabolites for growing fruits, increasing fruit output. Earlier studies confirmed our findings that applying zinc alone or in combination with other inorganic/organic sources considerably increased ber yield (Ram, 2004; Kassem *et al*., 2011).

In terms of biochemical characteristics of fruit, there were significant differences between treatments in terms of different ber cultivars. Total soluble solids revealed a highly significant difference between treatments and ber cultivars. TSS levels were significantly higher in ber plants treated with NPK+ 0.5% $ZnSO_4$. These findings support Ram's (2004) conclusion that the effect of micro and macro nutrients on the physio-chemical behaviour of ber. According to another source, K_2SO_4 @ 1.0% sustained greater TSS in CV, followed by $ZnSO_4$ @0.5%. Puyin (Omar *et al.*, 2015). The increased TSS value may be the result of hormone-directed sugar translocation to the fruits and increased alpha-amylase activity, which may have caused starch to be converted to sugar. Moreover, Gill and Ball (2009) observed that the use $ZnSO_4$ in ber cv. Sanaur-2 increased TSS. The rise in TSS brought on by urea and zinc sprays could be attributed to prunus salicina cv Kala Amritsari increased auxin synthesis, which would increase photosynthesis and result in the formation of more assimilates (Rajput *et al.*, 2017). Results collected for titratable acidity % showed a substantial impact of different treatments among different Ber cultivars. The findings of our investigation are consistent with those of Gill and Bal (2009) who found that treating Ber cv. "Sanaur-2" with 0.5% $ZnSO_4$ decreased acidity. In a different study, Yadav *et al.* (2014) revealed how the treatment of K_2SO_4 significantly reduced the acid contents of the ber cultivar Banarasi Kakra. Fruits treated with nutrients may have less acidity since their total soluble solids content has increased. Information on ascorbic acid content revealed substantial differences between treatments and cultivars. Gill and Ball (2009) showed that the treatment of $ZnSO_4$ increased the ascorbic acid concentration in ber cv. 'Sanaur-2'. Prior to this, Abd El-Rehman and Shadia (2012) found that the administration of zinc along with foliar sprays of urea increased the ascorbic acid concentrations in different ber genotypes. Increased ascorbic acid levels were found in Ber cv. "Puyin" treated with $ZnSO_4$, according to Omar *et al.* (2015). Indole-3-acetic acid, a plant auxin, and zinc work together in the production of this acid, which raises the ascorbic acid content in ber fruits (Yadav *et al.*, 2014). Based on various treatments, the total sugar content of ber fruit was determined. Ram (2004) came to the conclusion that the Ber cv. "Umran" treated with 1% $ZnSO_4$ and afterwards with 0.5 $ZnSO_4$ had a greater value of sugars. Our findings are in accordance with (Chandra and Singh, 2015) findings in anola when $ZnSO_4$ was applied. Increasing photosynthetic activity and leaf chlorophyll content may be to responsible for the increase in sugars. Enhanced catalase, peroxidase, and polyphenol oxidase enzyme activity may have contributed to a larger sugar accumulation in fruits.

The majority of the agronomic characteristics in our study showed extremely significant correlations with each other, and each trait's ratio differed considerably from the others. These findings are consistent with the previous study in sorghum (Reddy *et al.*, 2010), pistachio (Karimi and Roosta, 2014) and garlic (Ahmad *et al.*, 2021, 2023). In the biochemical traits, the correlation study revealed that, while certain correlation coefficients were not particularly high, they were significant. The dependability of the lesser correlation findings from large-scale at an increased significance level of P 0.001, in addition to P 0.01 and P 0.05, is recognized as the high correlation in small samples (Abdelghany *et al.*, 2020; Azam *et al.*, 2021). These results are in consistent with the previously reported in marigold.

Conclusions and Recommendations

Foliar application of zinc with different amendments shows different responses in ber cultivars. The overall performance of ber cv in terms of physical and biochemical characteristics performs well with the application of $ZnSO_4$ and NPK. Further, the cultivar of Delhi White had good performance in terms of morphological and biochemical attributes. Moreover, an extremely positive correlation was observed among the agronomic traits and biochemical traits. The cultivar's performance for Delhi White was good as compared to the other cultivars in both years.

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Novelty Statement

Significant difference was detected among investigated Ber cultivars for foliar application of Zinc sulphate for morphological, biochemical attributes in desert condition of Dera Ghazi Khan. Hence, the present study can provide insights for growing these cultivars

in desert region of the country.

Author's Contribution

Javaria Sherani: Did Experiment and wrote the MS.
Tehsin Ali Jilani: Helped in assessing biochemical characters and manuscript writing.
Jalil Ahmad and Rashid Jawad: Helped in the field experiment and data collection.
Shabana Nazeer and Muhammad Jan: Helped in soil analysis and format setting of the MS.

Conflict of interest
The authors have declared no conflict of interest.

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