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Effect of Boron Fertilisation and Trisodium Phosphate (TSP) Priming on Fruit and Seed Quality of GM-2 Tomato (*Solanum lycopersicum* L.)

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ABSTRACT

GM-2 is a superior tomato accession originating from Indonesia and exhibiting nematode resistance. A problem with GM-2 tomatoes is poor seed quality. Improvements to fruit and seed quality are needed through boron fertilisation and seed priming with Trisodium Phosphate (TSP). The objectives were to evaluate the effect of boron fertilisation on fruit quality and to assess the combined effect of boron fertilisation and TSP priming on seed quality and seedling growth in GM-2 tomato. The study on boron fertilisation was carried out in Ngablak District, Magelang Regency, Indonesia, from October to December 2023, using a CRD with three replications. Boron fertilisation consisted of 0 and 1.25 $g.plant^{-1}$. The study on TSP priming was conducted at the Faculty of Agriculture, Universitas Gadjah Mada, from December 2023 to January 2024, using a RCBD factorial with three blocks as replications. TSP concentrations ranged from 0, 5, 10, and 15 $g.L^{-1}$. The results showed that boron fertilisation significantly increased fruit number and fruit fresh weight by 9.38% and 14.34%, respectively, and improved fruit firmness (5.64%) and seed moisture content (1.02%). TSP concentration significantly influenced seedling growth. The TSP concentration of 15 $g.L^{-1}$ increased root surface area by 427.27%, root fresh weight by 159.04%, shoot fresh weight by 115.22%, root dry weight by 23.08%, and shoot dry weight by 55.56% compared to without seed priming. Overall, this study provides practical recommendations: boron fertilisation can improve fruit quality, while TSP priming can improve seedling growth of GM-2 tomato.

Keywords: Boron fertilisation, fruit quality, GM-2 tomato, seed quality, seedling growth, trisodium phosphate priming

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INTRODUCTION

Tomatoes (*Solanum lycopersicum* L.) are a horticultural commodity that contributes significantly to global production. They are widely cultivated in regions with tropical and subtropical climates (Costa & Heuvelink, 2018; FAO, 2023). Tomato production and quality can be increased by using superior cultivars and improving cultivation management (García-Caparrós, 2024). GM-2 is one of the superior tomato accessions originating from Indonesia. The advantage of GM-2 is that they carry dominant genes conferring nematode resistance (Murti et al., 2012). A challenge that has emerged in recent years is that GM-2 accessions have shown a trend of declining seed and fruit quality, specifically indicated by low germination and vigour. This has implications for increasing tomato productivity. Yilmaz et al. (2017) and Zhou et al. (2019) reported that declines in seed and fruit quality are positively correlated with tomato yield.

Seed quality, pre-harvest, and post-harvest are key factors in successful tomato cultivation (Finch-Savage & Bassel, 2016; Kamran et al., 2020). Nutrient availability plays a crucial role in supporting reproductive development and seed formation (Ahmed et al., 2024; Marschner, 2012; Yousaf et al., 2016). Boron also plays a role in flowering initiation, supporting pollen germination, and maintaining the continued development of flowers and fruits (Thakur et al., 2023). Boron deficiency results in stunted root development, leaf shedding, and reduced plant yield (Aftab et al., 2022; Shireen et al., 2018). Other studies have reported that boron deficiency in several horticultural commodities (including tomatoes) can cause leaf chlorosis, stunted plants, low fruit set, and rough fruit surfaces (Chakraborty & Bose, 2023; Mal et al., 2025; Xu et al., 2021).

The study on boron fertilisation in tomatoes showed that it can improve vigour, increase vitamin C content, and extend fruit shelf life (Milagres et al., 2019; Rodriguez-Espinosa et al., 2020). Naz et al. (2012) found that boron fertilisation at 2 $kg.ha^{-1}$ significantly affected growth, flowering, and yield of tomato. Other functions of boron in several horticultural commodities include minimising flower drop due to environmental stress and increasing fruit set (Boldingh et al., 2016; De Silva et al., 2022). Seed quality can also be improved through seed priming. Seed priming is a method of seed hydration to improve germination and seedling emergence (Sharifi et al., 2016). The use of seed priming technology is due to its many advantages, including ease of use, affordability, time-saving, and proven results. Factors to consider for effective seed priming include optimal concentration and soaking duration (Afzal, 2023; Rifna et al., 2019; Saha et al., 2022). This relates to the induction of internal physiological and biochemical processes in seeds, thereby increasing germination, germination index, and yield (Ali et al., 2020; Devika et al., 2021).

The potential phosphorus-based priming agent is trisodium phosphate (TSP) (Baig et al., 2020). Córdoba-Sellés et al. (2007) reported that soaking tomato seeds in a 10% TSP solution for three hours increased germination. There are few studies examining the effectiveness of TSP on horticultural commodities, particularly tomatoes. Furthermore, studies examining the combined effects of boron application in the pre-harvest phase and seed priming with TSP in the post-harvest phase on fruit quality, seed quality, and seedlings are still very limited, particularly in GM-2 tomato accessions. The hypothesis of this study is that boron application during the pre-harvest phase can increase yield components, yield, and seed quality. In contrast, seed priming with TSP can improve tomato seedling growth, especially in GM-2 accessions. The challenge of this study is whether these two approaches can interact positively to increase yield, seed quality, and the number of tomato seedlings.

This study is important because it provides information on an integrated approach combining pre-harvest and post-harvest technologies to improve tomato seed quality. This can provide practical recommendations for farmers, researchers, and seed producers on tomato seed and fruit production, especially for GM-2 accessions in Indonesia. The novelty of this study lies in integrating boron fertilisation and TSP seed priming to evaluate their combined effects on tomato fruit quality, seed quality, and seedling performance. Therefore, the objectives were to evaluate the effect of boron fertilisation on fruit quality and to assess the combined effect of boron fertilisation and TSP seed priming on seed quality and seedling growth in GM-2 tomatoes.

MATERIALS AND METHODS

Study Site

The study on boron fertilisation in a greenhouse in the Tejosari, Sub-district, Ngablak District, Magelang Regency, Central Java, Indonesia, was conducted from October to December 2023. This study site was situated at an elevation of about 1,350 meters above sea level, approximately 26 kilometres to the northeast of Magelang City, with geographic coordinates of 7°24'7" South Latitude and 110°24'5" East Longitude. The study on boron fertilisation and TSP priming was conducted in the greenhouse at the Faculty of Agriculture, Universitas Gadjah Mada, Special Province of Yogyakarta, Indonesia, from December 2023 to January 2024. The study site was approximately 140 metres above sea level and 5.3 kilometres northeast of Yogyakarta city, with the location coordinates 7°46'14" South Latitude and 110°22'39" East Longitude.

Experimental Design and Agronomic Practices

The study on boron fertilisation was carried out utilising a Completely Randomised Design (CRD) with three replications (Welham et al., 2015). Boron fertilisation consisted of 0 and 1.25 $g.plant^{-1}$. The selected tomato seedlings were planted in a greenhouse with beds measuring 4 m × 0.8 m. The seedlings were transplanted 25 days after sowing (DAS), with a spacing of 70 cm × 45 cm. Boron fertiliser was applied when the tomatoes reached the generative phase, 8-11 weeks after transplanting (WAT). The boron dose given in this study was 1 kg per 200 L, equivalent to 1.25 $g.plant^{-1}$, dissolved in 250 mL of water. Harvesting was carried out four times at 14, 15, 16 and 17 WAT. Watering was carried out every two days until field capacity was reached (Panah Merah, 2024; Zharfa, 2024). Seeds were obtained from several harvest criteria (red colour) and from bunches two and three. Bapary et al. (2024) reported that tomatoes harvested at the red stage achieve the highest seed quality.

The study on boron fertilisation and TSP priming was conducted using a Randomised Complete Block Design (RCBD) factorial with three blocks as replications (Welham et al., 2015). Seeds produced from previous boron fertilisation studies (0 and 1.25 $g.plant^{-1}$) were soaked in TSP solution based on the treatments (0, 5, 10, and 15 $g.L^{-1}$) for one hour. The seeds were soaked for one hour and then washed with running water for 30 minutes (Thiruppathi et al., 2018; Zharfa, 2024). Seeding was carried out in trays filled with a planting mix of one part soil and six parts goat manure. We watered the trays every two days, and harvesting occurred after 21 days (Panah Merah, 2024; Zharfa, 2024).

Data Collection

Data collection for the study on boron fertilisation included macro- and microclimate, soil quality, and morphological variables. Macro and microclimate traits were total rainfall, air temperature, relative humidity, sunshine duration, and photosynthetically active radiation (PAR) (Albuja-Illescas et al., 2025; Alsamir et al., 2017; Šalagovič et al., 2024; Shamshiri et al., 2018). Soil quality traits were pH H_2O, soil organic carbon (SOC), cation exchange capacity (CEC), nutrient availability (phosphorus, potassium, and boron), and total boron (Soil Survey Staff, 2017; Sparks et al., 2020). Morphological traits were the number of fruits per plant, fruit length, fruit width, fruit fresh weight, fruit firmness, number of seeds per fruit, 1000-seed weight, and seed moisture content (Urban et al., 2017; Zharfa, 2024).

Data collection for the study on boron fertilisation and TSP priming included macro- and microclimate and morphological variables. Macro and microclimate traits were total rainfall, air temperature, relative humidity, sunshine duration, and PAR (Albuja-Illescas et al., 2025; Alsamir et al., 2017; Šalagovič et al., 2024; Shamshiri et al., 2018). Morphological traits were the germination, vigour index, leaf area, root length, root fresh weight, shoot fresh weight, root dry weight, shoot dry weight, and root-to-shoot ratio (Urban et al., 2017; Zharfa, 2024). Macro- and microclimate observations were conducted at the study site. Soil analysis was conducted at the Agricultural Instrument Standardisation Agency (BSIP) of the Ministry of Agriculture, Yogyakarta, Indonesia. Morphological observations were conducted at the study site and the Crop Production Management Laboratory, Department of Agronomy, Faculty of Agriculture, Universitas Gadjah Mada, Yogyakarta, Indonesia.

Statistical Analysis

Data from the study on boron fertilisation were analysed using the F-test at the 95% confidence level, followed by a Pooled T-test ($p < 0.05$). Data were visualised using box plots with error bars. Data from the study on boron fertilisation and TSP priming were tested for linear model assumptions, namely normality and homogeneity, using Q-Q plots and residual vs value graphs. Data that met the linear model assumptions were then analysed using a two-way ANOVA at a 95% confidence level, followed by an HSD-Tukey test ($p < 0.05$) (Welham et al., 2015).

Relationships between morphological traits were analysed using a correlation metric (Hadd & Rodgers, 2021). PCA-Biplot analysis produced a two-dimensional graph depicting the relationships between morphological traits (Gabriel, 1971). This was achieved by consistently allocating values to the components of the data matrix. The F-test, T-test, Q-Q plots, residual vs value graphs, ANOVA, and HSD-Tukey test were analysed using SAS® OnDemand for Academics software with proc mixed, while correlation metric, and PCA-Biplot using R software version 4.4.0 with the corrplot, FactoMineR, factoextra, GGally, ggplot2, pheatmap, and scatterplot3d packages (Kassambara, 2017; R Core Team, 2017; SAS Institute Inc., 2025; Sievert, 2020).

RESULTS AND DISCUSSION

Site Characteristics

The study on boron fertilisation reported total rainfall, average air temperature, relative humidity, sunshine duration, and PAR of 27.06 mm, 27 °C, 65.50%, 6.47 hours, and 11 $W.m^{-2}$, respectively. The study on boron fertilisation and TSP seed priming reported total rainfall, average air temperature, relative humidity, sunshine duration, and PAR of 617 mm, 25.95 °C, 85.00%, 8.65 hours, and 82.32 $W.m^{-2}$, respectively. In general, both study sites were suitable for tomato cultivation (Pashiardis et al., 2022; Shamshiri et al., 2018; Yang et al., 2022; Yousef et al., 2021; Zheng et al., 2023).

The soil type in the boron fertilisation study was classified as an Andisol. Andisol was formed from volcanic material rich in organic matter, dark in colour, and with a high capacity to retain water and nutrients. Andisol are known to have relatively high fertility, making it highly promising and widely used for the cultivation of horticultural commodities (Hati et al., 2021). Soil analysis results showed high SOC, a slightly acidic pH in H_2O, and a relatively low CEC. Available phosphorus and potassium were categorised as moderate to high, while total and available boron levels were very high. Total boron increased from 15.0 to 18.0 ppm (Table 1). This was influenced by volcanic activity in the surrounding area, which was surrounded by several active volcanoes (Rodriguez-Espinosa et al., 2020).

Table 1
Soil quality characteristics

Soil Quality	Unit	Initial	Final
pH H_2O	-	6.3	6.1
Soil Organic Carbon	%	6.10	6.20
Cation Exchange Capacity	$cmol^{(+)}.kg^{-1}$	7.52	8.28
Available of Phosphorus (Olsen)	$cmol^{(+)}.kg^{-1}$	18.15	12.91
Available of Potassium	$cmol^{(+)}.kg^{-1}$	5.01	4.42
Total Boron	ppm	15.0	18.0
Available of Boron	ppm	2.4	-

Effect of Boron Fertilisation on Fruit and Seed Quality

Boron fertilisation significantly affected tomato yield and quality, particularly fruit number and fresh weight, while fruit length and width were not significantly affected (Figure 1). Thakur et al. (2023) explained that boron fertilisation can improve fruit quality, including diameter and weight. Increased boron concentrations negatively affected morphological parameters, yield, and some fruit characteristics in tomatoes. Conversely, high boron concentrations were reported to increase fruit firmness, soluble solids content, and leaf B concentrations (Turhan, 2021). The results of this study also showed that the application of boron at 1.25 $g.plant^{-1}$, compared to the control, resulted in significantly higher fruit number (from 25.37 to 27.75 g, an increase of 9.38%) and fresh weight (from 184.12 g to 210.47 g, an increase of 14.34%). Hapuarachchi et al. (2022) stated that boron fertiliser, when applied correctly and at the correct dosage, can increase fruit weight, diameter, and quality.

Boron fertiliser at a dose of 1.25 $g.plant^{-1}$ resulted in fruit hardness of 35.80 N, an increase of 5.64% compared to the control, while seed moisture content was 12.93%, an increase of 1.02%. The number of seeds per fruit and 1000-seed weight did not differ significantly between boron treatments (Figure 2). This is consistent with the explanation by Harker et al. (2015), who stated that genetic and environmental factors control seed development. In this case, the number of seeds and 1000-seed weight are more influenced by genetic factors.

Boron fertilisation during the generative phase of tomato cultivation revealed several important findings, including that not all morphological traits showed significant differences. The relatively limited responses of some parameters were due to the already high soil boron content. Under such conditions, boron addition may not substantially alter plant physiological responses. The high boron content in the soil is due to the presence of active volcanoes, namely Mount Merapi and Mount Merbabu, in the study area. Volcanic activity naturally releases boron into the environment (Rodriguez-Espinosa et al., 2020).

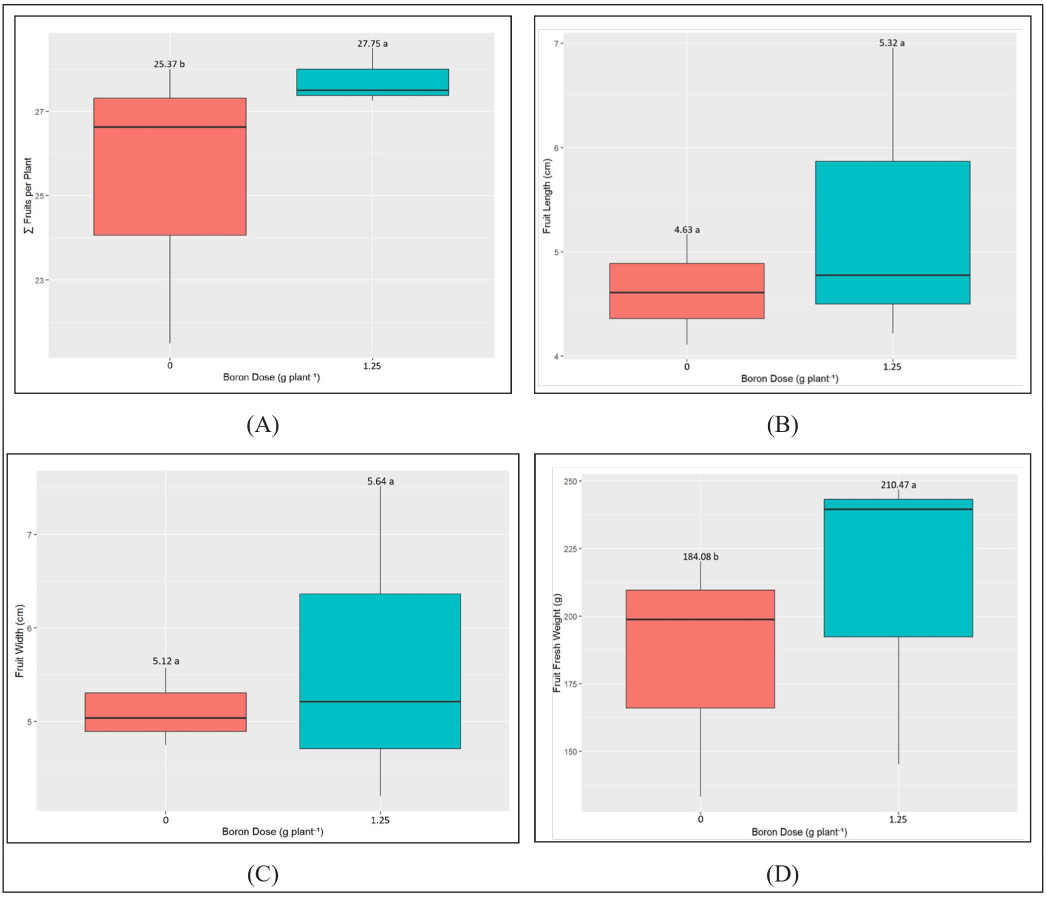

Figure 1. Boxplot of yield components and yield of GM-2 tomato affected by boron fertiliser. (A) Fruit number per plant; (B) Fruit length; (C) Fruit width; and (D) Fruit fresh weight

High soil boron levels at the study site did not cause toxicity in tomatoes. This is because tomato tolerance to boron ranges from 4 to 6 ppm (Flynn, 2015). Several variables observed in this study were not significantly different, possibly due to a calcium deficiency in tomatoes. Boron has antagonistic properties with calcium. Calcium deficiency can affect the quality of tomato fruit and seeds (Chockchaisawasdee et al., 2016; Correia et al., 2017; Galeriani et al., 2022; Matteo et al., 2022; Long & Peng, 2023).

Effect of Boron Fertilisation and TSP Priming on Seedling Traits

The vigour index is used to determine the rate of seed germination (Basu & Groot, 2023). There was no significant difference between boron fertilisation and TSP concentration in the vigour index. Boron fertilisation and TSP concentration did not show significant interactions in all observation variables. Boron fertilisation resulted in a germination rate of 89.16%, which was significantly lower than the 94.41% without boron fertilisation.

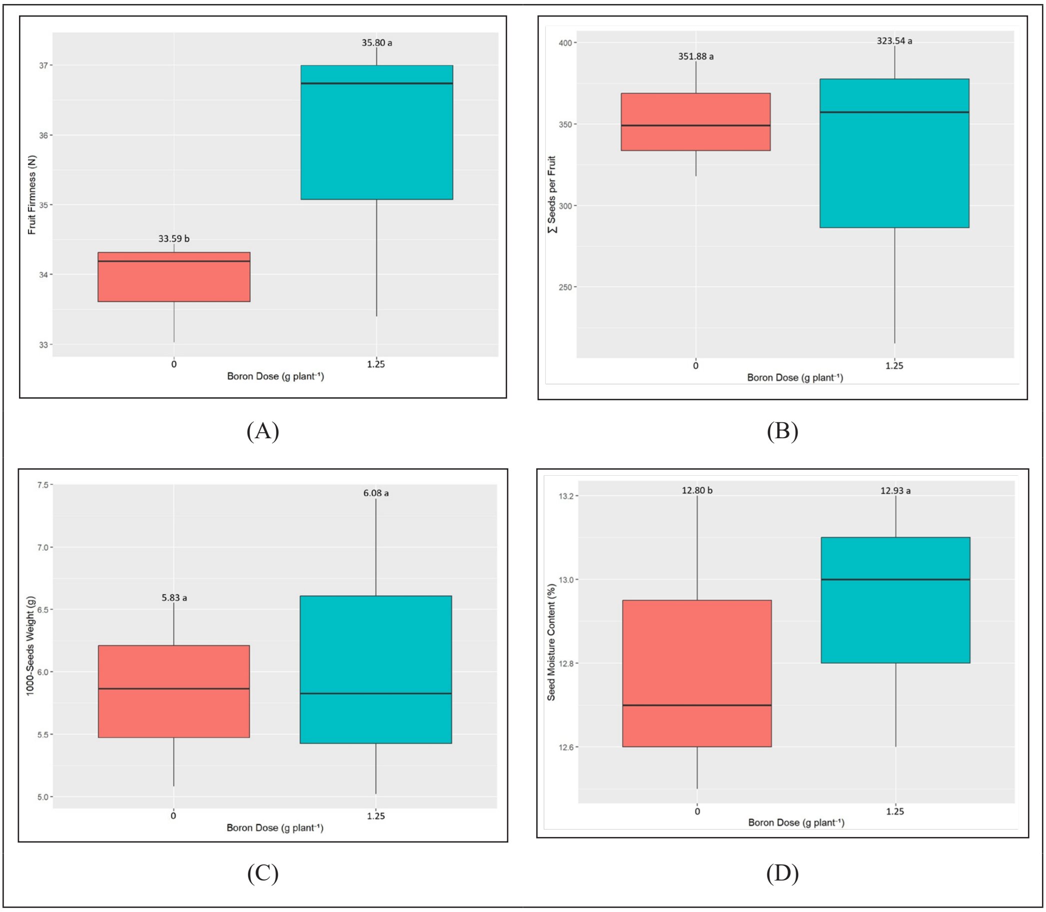

Figure 2. Boxplot of fruit and seed quality of GM-2 tomato affected by boron fertiliser. (A) Fruit firmness; (B) Seeds number per fruit; C) 1000-Seeds weight; and D) Seed moisture content

Boron application reduced germination by approximately 5.6%, whereas TSP concentration had no significant effect on germination (Table 2). Although the findings in this study indicate that boron fertiliser significantly affected germination, the resulting germination rates remained within the high range. Wijnker et al. (2025) stated that a high germination rate is an important indicator of seed quality (> 85% germination). Seed germination is influenced by species type and genetics, seed structure, and physiological properties (Forti et al., 2020; Sumbal et al., 2023; Wong et al., 2021).

Boron fertilisation of 1.25 g.plant^{-1} did not increase root length, leaf area, or root surface area (Table 2). Whereas TSP concentration significantly increased the root surface area. The TSP concentration of 15 g.L^{-1} resulted in a root surface area of 12.76 cm^2, a 427.27% increase compared to the control. Phosphorus availability enhances plant growth and development, particularly in apical meristematic tissue.

TSP can function as a growth regulator, and the phosphorus source provided can significantly alter root system architecture (Robles-Aguilar et al., 2020). Wen et al. (2017) reported that phosphorus application increased root length and root proportion in maize. Boron fertilisation had no significant effect on tomato biomass (fresh and dry weight). In contrast, TSP concentration showed a significant difference. The TSP concentration of 15 g.L^{-1} tended to produce the highest biomass. Root fresh weight values ranged from 0.083 to 0.215 g, indicating a 159.04% increase compared to the untreated TSP concentration. Meanwhile, shoot fresh weight values ranged from 0.92 to 1.98 g, indicating a 115.22% increase compared to the untreated TSP treatment (Table 2).

Root dry weight and shoot dry weight values ranged from 0.026-0.032 g and 0.09-0.14 g, respectively. TSP application at the highest concentration increased root dry weight by 23.08% and shoot dry weight by 55.56%. Furthermore, the root-to-shoot ratio remained relatively stable across all treatments, ranging from 1.00 to 1.13 (Table 3). This indicates that the distribution of biomass between shoots and roots did not change significantly. Seed priming using phosphorus-based compounds can affect seedling development from the early stages of growth (Baig et al., 2020). This relates to the role of phosphorus in various important physiological processes. Razaq et al. (2017) stated that phosphorus has a function in cell division and elongation, regulating enzyme activity, and plant glucose metabolism.

Table 2
Germination, vigour index, leaf area, root length, and root surface area of GM-2 tomato were affected by boron fertilisation and TSP concentration in 21 days after seedling

Treatment	Germination (%)	Vigour Index	Leaf Area (cm^2)	Root Length (cm)	Root Surface Area (cm^2)
Boron Dose:					
0 g.plant^{-1}	94.41 ± 1.21^a	29.33 ± 0.65^a	29.7 ± 3.37^a	8.73 ± 0.82^a	7.67 ± 2.19^a
1.25 g.plant^{-1}	89.16 ± 1.90^b	26.93 ± 0.96^a	27.2 ± 4.14^a	10.12 ± 0.55^a	4.11 ± 1.30^a
TSP Concentration:					
0 g.L^{-1}	92.16 ± 2.79^p	28.37 ± 1.03^p	23.7 ± 5.85^p	10.06 ± 0.71^p	2.42 ± 0.63^q
5 g.L^{-1}	92.50 ± 1.57^p	28.89 ± 0.72^p	30.5 ± 2.79^p	9.05 ± 0.88^p	3.79 ± 1.30^q
10 g.L^{-1}	89.00 ± 3.46^p	27.36 ± 1.46^p	20.8 ± 3.03^p	8.47 ± 1.24^p	4.59 ± 0.99^q
15 g.L^{-1}	93.50 ± 1.82^p	27.89 ± 1.75^p	38.8 ± 6.09^p	10.11 ± 1.22^p	$12.76 \pm 3.86_p$
Boron × TSP	(-)	(-)	(-)	(-)	(-)
CV (%)	1.43	3.34	18.26	10.37	32.25

Note. Mean ± SE values with different letters in the column indicate significantly different based on the HSD-Tukey test ($p < 0.05$); The (-) indicates no interaction between boron fertilisation and TSP concentration

Table 3
Root fresh weight, shoot fresh weight, root dry weight, shoot dry weight, and root-shoot ratio of GM-2 tomato affected by boron fertilisation and TSP concentration in 21 days after seedling

Treatment	Root Fresh Weight (g)	Shoot Fresh Weight (g)	Root Dry Weight (g)	Shoot Dry Weight (g)	Root-shoot Ratio
Boron Dose:					
0 g.plant^{-1}	0.132 ± 0.03[a]	1.28 ± 0.15[a]	0.027 ± 0.004[a]	0.10 ± 0.011[a]	1.11 ± 0.01[a]
1.25 g.plant^{-1}	0.114 ± 0.02[a]	1.31 ± 0.18[a]	0.029 ± 0.004[a]	0.11 ± 0.013[a]	1.12 ± 0.02[a]
TSP Concentration:					
0 g.L^{-1}	0.083 ± 0.02[q]	0.92 ± 0.22[q]	0.026 ± 0.008[q]	0.09 ± 0.019[q]	1.13 ± 0.03[p]
5 g.L^{-1}	0.095 ± 0.01[q]	1.25 ± 0.10[q]	0.028 ± 0.003[q]	0.11 ± 0.005[q]	1.12 ± 0.02[p]
10 g.L^{-1}	0.100 ± 0.01[q]	1.04 ± 0.15[q]	0.026 ± 0.004[q]	0.09 ± 0.012[q]	1.13 ± 0.02[p]
15 g.L^{-1}	0.215 ± 0.05[p]	1.98 ± 0.17[p]	0.032 ± 0.007[p]	0.14 ± 0.019[p]	1.00 ± 0.04[p]
Boron × TSP	(-)	(-)	(-)	(-)	(-)
CV (%)	3.26	11.00	0.75	1.89	2.34

Note. Mean ± SE values with different letters in the column indicate significantly different based on the HSD-Tukey test ($p < 0.05$); The (-) indicates no interaction between boron fertilisation and TSP concentration

Relationship between Morphological Traits

Correlation analysis was used in this study to examine relationships among variables. Leaf area was highly correlated with shoot fresh weight (r = 0.865**) and shoot dry weight (r = 0.920**) (Figure 3A). Root and leaf structure play an important role in increasing plant biomass accumulation (Taraldsen, 2023). Improvement in root shape is positively correlated with increased fresh weight and dry weight of tomatoes (Ali et al., 2020). PCA-Biplot analysis is an effective approach for simplifying multivariate data without losing important information (Vafakhah & Janizadeh, 2021). In this study, the first two principal components explained most of the data variation, with PC1 contributing 50.50% and PC2 contributing 21.50% (Figure 3B). If examined further, the PCA-Biplot showed a fairly clear pattern of treatment groupings based on morphological characters, with four quadrants.

Quadrant I included B1P1, B1P0, and B1P2. This quadrant had similarities in root-shoot ratio (RSR). Quadrant II includes the B0P3. This quadrant was more closely linked to root growth and biomass. These included root length (RL), root fresh weight (RFW), root dry weight (RDW), and shoot dry weight (SDW). Quadrant III included B1P3. This showed a stronger pathway related to early growth performance. This included root surface area (RSA), shoot fresh weight (SFW), leaf area (LA), germination percentage (GM), and vigour index (VI). Quadrant IV, comprising B0P1, B0P0, and B0P2, showed no specific trends in morphological variables (Figure 3B).

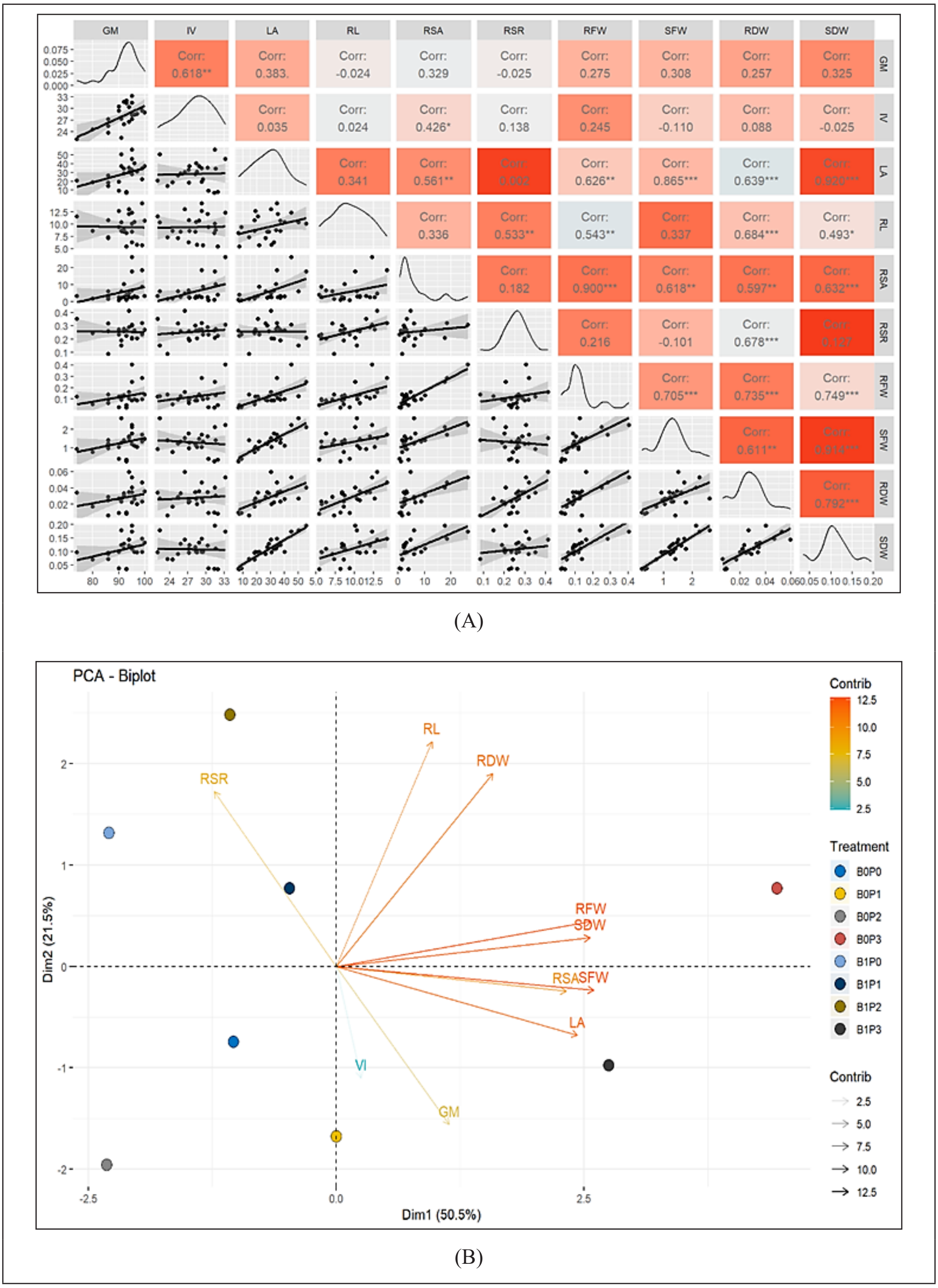

Figure 3. Relationship between morphological traits: (A) Correlation matrix and (B) PCA-Biplot. B0 and B1 indicate without boron fertilisation (0 $g.plant^{-1}$) and boron fertilisation (1.25 $g.plant^{-1}$). P0, P1, P2, and P3 indicate Trisodium Phosphate (TSP) at the concentration levels of 0, 5, 10, and 15 $g.L^{-1}$

Wider leaves can improve the plant's ability to trap light. This contributes to increased tomato biomass accumulation. A good root system supports water and nutrient absorption, thus increasing the availability of materials for photosynthesis (Cochavi et al., 2020). The findings of this study indicate that boron fertilisation can improve traits related to fruit quality (number, fresh weight, and firmness). While, the TSP seed priming treatment had a greater impact on tomato seedling growth. Interestingly, there was no significant interaction between the two boron fertilisation treatments and TSP concentration. This study is important because it provides information on an integrated approach combining pre-harvest and post-harvest technologies to improve tomato seed quality. Overall, boron fertilisation and TSP seed priming can be applied to increase tomato production, especially for GM-2 accessions in Indonesia.

CONCLUSION

Boron fertiliser of 1.25 g.plant^{-1} significantly increased the number of fruits, fresh weight of fruits, fruit firmness, and seed moisture content by 9.38%, 14.34%, 5.64%, and 1.02%, respectively, compared to no boron fertilisation. There was no interaction between boron fertilisation and TSP seed priming treatment. TSP concentration of 15 g.L^{-1} increased root surface area, root fresh weight, shoot fresh weight, and shoot dry weight by 427.27%, 159.04%, 115.22%, 23.08%, and 55.56%, respectively, compared to those without TSP seed priming. Overall, boron fertilisation and TSP seed priming can be applied to increase tomato production. This study had limitations, namely, that it was conducted in soil with relatively high boron content. In addition, this study still focused on a single tomato accession, so conclusions about effects across various cultivars cannot be drawn.

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