declined from 0.48% to 0.30%. Across the two salinity levels, the average relative reduction was approximately 45%. Because this estimate is derived primarily from a single two-season experiment, it should not be interpreted as a universal effect size for pepper. Nevertheless, the direction of the response is consistent with evidence from other plant species showing that Si can restrict Na^+ uptake and its transport to aboveground tissues.

Under salinity stress, the K^+/Na^+ relationship is often more physiologically relevant than the absolute Na^+ concentration alone. As Na^+ competition increases, cellular enzyme activity and stomatal function can both be impaired. The salt-tolerant pepper genotype P300 maintained higher K^+ and lower Na^+ levels after salt treatment, indicating that K^+ retention itself is an important component of the salt-tolerance phenotype (Zhang et al., 2022). By reducing Na^+ load, preserving membrane function, and improving root performance, Si may indirectly increase the K^+/Na^+ ratio.

6.2 Effects on mineral nutrient balance

Ca^{2+} contributes to membrane stability and stress signaling, while Mg^{2+} is a central component of chlorophyll. Under high salinity, uptake of both nutrients may be disrupted by Na^+ competition and root injury. The effects of Si on mineral nutrition are not entirely consistent among crops, but they are generally more evident as a restoration of nutrient balance under salinity stress than as a universal increase in all mineral elements under non-stress conditions. Recent studies of Si-mediated salinity tolerance have also emphasized strong nutritional interactions between Si and K^+, Ca^{2+}, and Mg^{2+} (Dabravolski and Isayenkov, 2024).

Foliar Si application in sweet pepper increased N, P, and K concentrations under saline conditions while simultaneously reducing Na^+ accumulation (Abdelaal et al., 2020). This suggests that the improvement in mineral status cannot be explained solely by a dilution effect. However, particular attention is required when K_2SiO_3 is used as the Si source because potassium is supplied simultaneously. Although many experiments include appropriate comparison treatments, accompanying ions may still differ among Si sources. Bushra et al. (2025) further demonstrated a clear synergistic interaction between K and Si. Future meta-analyses should therefore distinguish the independent effect of Si from combined Si-nutrient effects whenever possible.

6.3 Yield and reproductive growth responses

Compared with studies focusing on seedling physiology, relatively few Si-salinity experiments in pepper have measured fruit yield directly. In the two-season sweet pepper experiment of Abdelaal et al. (2020), plants without Si produced approximately 7.1 and 5.4 fruits per plant under 1 500 and 3 000 ppm NaCl, respectively, whereas Si-treated plants produced 12.8 and 8.6 fruits per plant. These values correspond to relative increases of approximately 80.3% and 59.3%. The magnitude of these responses is substantial, but because they originate from a single experimental system, they are better interpreted as evidence that Si has the potential to restore reproductive growth rather than as estimates of a general effect size.

The same study reported that fruit fresh weight per plant increased from 495 to 781 g under 1 500 ppm NaCl and from 355 to 560 g under 3 000 ppm NaCl, with relative increases of nearly 58% at both salinity levels. This indicates that Si not only improved fruit set but also supported fruit growth. In contrast, Badem and Söylemez (2022) found no significant main effect of Si on marketable fruit yield, showing that improvements in physiological traits do not necessarily translate immediately into higher fruit production.

In the dataset of Abdelaal et al. (2020), total yield increased from 7.1 to 11.1 t/ha under 1 500 ppm NaCl and from 5.4 to 7.8 t/ha under 3 000 ppm NaCl, corresponding to relative increases of 56.3% and 44.4%, respectively. The median effect across the two salinity levels was approximately 50.4%. Although this result is notable, it should be treated conservatively in meta-analysis because the two effect estimates are derived from different salinity levels within the same study. Combined K + Si treatments have also been reported to improve yield substantially under 9 and 12 dS/m salinity, but these responses cannot be incorporated into estimates of the independent Si effect because of the interaction with potassium fertilization (Bushra et al., 2025).