enhancing the activity of pathways related to GA biosynthesis and cell wall biosynthesis (Zhao et al., 2025). Through combined morphological and transcriptomic analyses of long-fruited and round-fruited eggplant types, Shi et al. (2023) found that clear fruit-shape differences had already appeared before flowering, indicating that the initiation of fruit differentiation occurs earlier than traditionally assumed. By the sixth day after flowering, the fruits had entered a stage of rapid enlargement. Transcriptomic data further showed that many plant hormone-related genes were already upregulated on the day of flowering, among which SmARF1 maintained consistently high expression, suggesting that auxin signaling plays a crucial role in the early initiation of fruit development. The study also identified multiple differentially expressed genes (DEGs) related to the SUN, YABBY, and OVATE families, among which SmOVATE5 showed a negative regulatory effect, meaning that it suppressed fruit growth. These results clearly indicate that the regulatory window for fruit development has already opened before flowering and during the early flowering stage, and that the timing of regulation is relatively early.

Field data correspond well with the physiological processes described above. Treatment with GA_3 at 50 ppm not only increased the number of fruits per plant, but also raised total dry matter accumulation to 802.40 g per plant, compared with 702.90 g per plant in the control. Results from combination treatments further showed that NAA 40 ppm + GA_3 50 ppm increased single-fruit weight to 180.48 g, while yield per plant reached 2.91 kg (Kropi, 2018). This finding points to a key issue: if only fruit number increases without a simultaneous promotion of fruit enlargement, there is a risk of producing “too many small fruits with only limited improvement in total yield.” By contrast, when NAA and GA_3 are applied together, both fruit number and single-fruit weight can be increased, thereby more effectively enhancing final yield.

3.3 Effects on yield components

In terms of yield components, the number of fruits per plant and single-fruit weight are the two core factors determining eggplant yield level. Because different studies vary considerably in cultivar type, cultivation conditions, and ecological environment, the absolute values obtained in different experiments are not suitable for simple horizontal comparison. However, the general pattern of change is relatively consistent. Research has shown that treatment with GA_3 at 50 ppm increased fruit number per plant from 11.34 to 18.56, while yield per plant rose from 1.38 kg to 1.58 kg (Kropi, 2018). Another study compared the effects of 25, 50, and 75 ppm GA_3 with several micronutrient treatments, and the results indicated that, under those experimental conditions, GA_3 at 25 ppm produced the best improvement in yield traits, especially in fruit number per plant, single-fruit weight, and yield per plant, all of which were superior to the control. This finding highlights an important fact: GA_3 does indeed have the capacity to improve eggplant yield, but its optimum concentration is not fixed; rather, it is jointly influenced by varietal characteristics and ecological conditions. In other words, 75 ppm may perform best in some experiments, whereas under other conditions 25 ppm may produce better results. This indicates that the yield-enhancing effect of GA_3 is objectively real, but its optimal dosage is clearly context-dependent (Bhattarai et al., 2021).

Evaluation of yield stability must also be considered under stress years or unfavorable environmental conditions. Field studies combining water-deficit stress with plant growth regulator treatments provide particularly representative evidence. As irrigation volume gradually decreased from the recommended level, marketable fruit yield rapidly declined to 86%, 74%, 50%, 30%, 12%, and 8% of the control level. However, after the application of regulators such as salicylic acid (SA), potassium nitrate, and thiourea, yield still increased further by 7.3% to 22.7%, while water productivity improved to 5.50–6.77 kg/m^3, compared with only 5.16 kg/m^3 in treatments without regulators (Wakchaure et al., 2020). These results show that the more practical value of plant growth regulators in eggplant production lies not only in further increasing yield under high-yield conditions, but more importantly in reducing the extent of yield loss under stress or difficult seasons, thereby enhancing the stability of yield formation.