2.2 Gibberellins and cytokinins

Gibberellins, especially GA_3, function in eggplant production more like regulators with an “amplifying effect”, as their action is often expressed through simultaneous increases in flower number, fruit number, and individual fruit size. Field trial results showed that treatment with GA_3 at 50 ppm increased the number of fruits per plant to 18.56, compared with 11.34 in the control. Yield per plant increased from 1.38 kg to 1.58 kg, representing an increase of about 14.5%, while the increase in fruit number reached 63.7%. These results indicate that the role of GA_3 in eggplant is not limited to promoting fruit enlargement, but also has a significant effect on the fruit-bearing structure of the plant (Kropi, 2018). GA_3 at 75 ppm is also frequently included in optimal treatment combinations, as it can not only advance the time to 50% flowering, but also further increase fruit number per plant and total yield (Pradeepkumar et al., 2020).

Compared with auxins and GA_3, there is relatively less direct field evidence for cytokinin application in eggplant, but its role in regulating early cell division and buffering stress has become fairly clear. Studies have shown that 6-BA treatment can alleviate the decline in chlorophyll content, reactive oxygen species accumulation, and membrane lipid peroxidation caused by low-temperature stress, while increasing the activities of antioxidant enzymes such as SOD, POD, CAT, APX, and GR. In other words, cytokinins may not show as direct an effect on yield improvement as GA_3, but they play a strong foundational role in seedling uniformity, maintenance of plant vigor, and the eventual formation of uniform fruit set. Further molecular evidence shows that the SmRR family in eggplant is closely associated with cytokinin signal transduction, and some of these genes also respond sensitively to IAA and stress conditions. This suggests that cytokinins do not act independently, but instead participate together with auxins in regulating the developmental rhythm of the plant (Chen et al., 2016).

2.3 Other types of regulators

The role of ethylene and its inhibitors in eggplant cultivation is more closely associated with two aspects: “preventing abscission” and “delaying senescence”. The former mainly occurs before fruit formation, as ethylene generally exerts a certain inhibitory effect on fruit set; the latter is mainly expressed during the postharvest stage, when ethylene accelerates fruit senescence and softening. Sharif et al. (2022) reported that the ethylene inhibitor 1-MCP can promote parthenocarpy in some fruit vegetables. In postharvest treatment of eggplant, application of 1-MCP at 5–10 μL/L can significantly delay fruit softening, inhibit the activity of cell wall hydrolytic enzymes, and extend shelf life. These findings suggest that although ethylene inhibitors are not the main regulatory tools for increasing yield in the field, they are of great value in maintaining marketable uniformity and extending the marketing period.

New regulators in the brassinosteroid group are better understood from the perspective of yield stability rather than yield maximization. Studies have shown that under low-temperature stress or during recovery from chilling injury, treatment with 0.1 μM 24-epibrassinolide can reduce the accumulation of MDA, H_2O_2, and superoxide anions in eggplant seedlings, while increasing the activities of enzymes related to the AsA-GSH cycle. This type of regulator has shown certain potential in promoting early recovery of growth, maintaining leaf photosynthesis, and supporting subsequent uniform fruit enlargement (Wu et al., 2015). However, based on currently available public research evidence in eggplant, the conclusion that brassinosteroids can directly increase yield under field conditions is still less consistent than for GA_3 and NAA. Therefore, a more practical application strategy is to regard them as important supplementary tools for regulating plant growth, stabilizing yield, and maintaining quality during stress-prone seasons.

3 Effects of Plant Growth Regulators on Eggplant Yield

3.1 Regulation of flowering and fruit set

The starting point of eggplant yield formation lies in flowering, and many production problems also first emerge during the flowering stage. A high proportion of heterostylous flowers, together with factors such as low temperature, weak light, and fluctuations in water availability, may frequently result in the phenomenon of “flowering without fruit set” (Figure 1). A study on 13 eggplant genotypes showed that the proportion of