residue limits can support safer adoption while maintaining the yield and uniformity benefits sought in commercial eggplant production (Le et al., 2020; Zhou et al., 2025).

## 7 Concluding Remarks

A synthesis of the available studies shows that plant growth regulators can indeed improve eggplant yield and, to some extent, enhance fruit uniformity, although different types of regulators differ in their primary functions. For example, $GA_3$ is more effective at improving flowering quality, increasing fruit number, and promoting fruit enlargement; NAA is more beneficial for stabilizing fruit set, reducing flower and fruit drop, and supporting fruit shape formation; whereas 6-BA, SA, and EBR are better suited to maintaining growth continuity under stress conditions and reducing developmental differences among fruit batches. For commercial production, the most practical benefits lie in a more stable fruiting process, more uniform fruit shape, and a more concentrated ripening period. Mechanistically, these effects are not independent of one another. Auxins, gibberellins, and cytokinins collectively participate in fruit initiation, cell division, and enlargement, while central carbon metabolism, cell wall synthesis, and stress-related antioxidant systems determine whether these hormonal signals can ultimately be translated into successful fruit elongation and stable fruit development. Precisely because this regulatory network is complex, the same regulator often shows considerable variation in performance across different cultivars, seasons, and protected cultivation conditions.

At present, the most prominent issue is whether the effects of plant growth regulators can be reproduced consistently. On the one hand, existing field trials on plant growth regulators in eggplant are still strongly region-specific, with substantial differences in cultivar type, seasonal conditions, and cultivation management background, making it difficult to apply optimal dosages and treatment timing directly across production systems. On the other hand, studies on fruit uniformity are clearly fewer than those on yield. Many papers report only fruit number, single-fruit weight, and total yield, while giving much less attention to indicators such as coefficients of variation, marketable grading proportion, and ripening synchrony index. As a result, assessments of consistency often remain at the level of indirect inference. At the molecular level, although a number of key regulatory factors have been identified, including *SmARF*, *SmRR*, *SmOVATE5*, and *SmMYB113*, there are still relatively few studies that fully connect the chain from "exogenous regulator–signal transduction-fruit shape uniformity-commercial grading." In particular, direct field evidence for the roles of cytokinins, ethylene inhibitors, and brassinosteroids in regulating eggplant uniformity remains limited, indicating that this field still has substantial room for expansion.

Future research may be advanced from three main directions. First, greater emphasis should be placed on the study of hormonal interactions, rather than continuing to focus primarily on the effects of single compounds. Existing studies have already shown certain advantages of combined NAA and $GA_3$ treatment, and future work could incorporate auxins, gibberellins, cytokinins, and brassinosteroids into a unified temporal framework for systematic investigation. Second, the evaluation system for fruit uniformity should be further improved. Instead of judging treatment effects only by mean values, comprehensive assessment should include indices such as fruit length variation, dispersion of single-fruit weight, ripening concentration, and commercial grading rate. Third, the application of plant growth regulators should be increasingly integrated with precision regulation and smart agriculture technologies. As fruit recognition and counting technologies in greenhouse production continue to mature, it should become entirely feasible to further combine flowering-stage recognition, environmental monitoring, and site-specific spraying technologies, thereby shifting regulator application from traditional experience-based operation to precise intervention based on key developmental stages.

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### Conflict of Interest Disclosure

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