

Vegetable growers in the northern San Joaquin Valley of California are facing intensified environmental challenges and more restrictive regulatory pressure to produce more sustainably and environmentally friendly. These challenges heighten the needs of relying on a diverse array of sustainable production practices to maintain productivity, farm profitability, and food safety. However, many sustainable vegetable production practices are still at low adoptions or receive negative feedback of under-performance when being applied to vegetable crops. Therefore, there is an imperative need to evaluate productive and environmental-friendly farming methods to maintain the viability of the vegetable industry in the northern San Joaquin Valley. Vegetable grafting is such a practice that advocates sustainable vegetable production for using less input while gaining more from the field. Research on vegetable grafting in California primarily began in 2016 focusing on improving rootstock performance for yield and quality of processing tomatoes. To combat high costs for rootstock seeds and seedlings, tremendous tomato rootstocks were tested on commercial fields under regular and reduced populations. However, inconsistent yield and quality performance as well as labor challenges did not show horticultural and economic advantages over conventional production, thereby discouraging researchers from further tests. While passion and interest in grafted processing tomatoes eroded, a growth of attention to grafted watermelons initiated in 2019 in California's San Joaquin Valley.

Our research and extension program on promotion of watermelon grafting began in 2019, when the acreage in California was less than 150. Since 2021, we have secured over \$300,000 funds from State, the National Watermelon Boards, and watermelon growers to evaluate economic and horticultural benefits of grafted watermelons among large-scale growers in California. At the beginning, growers and industry had clear knowledge gaps on how to farm grafted watermelons sustainably and profitably (Wang and Buojaylah, 2025). From 2019 to 2021, on-farm experiments were conducted to evaluate multiple in-row spacings (3, 4, 5, and 6 feet) for growing full-size grafted watermelons. The in-row spacing of 4.5 feet has become the industry selection for growing grafted watermelons. By using this spacing, each acre contains only 1,400 plants, which is 40% lower than the non-grafted production without yield drop. We also conducted economic analysis to demonstrate circumstances where growers will achieve profitability by growing grafted watermelons at each spacing (Wang and Fulford, 2021).

Beginning in 2022, further priorities collected from growers' needs assessment focused on screening suitable rootstocks and scions tailored to California's growing conditions. The goal is to ensure California watermelon growers are equipped with knowledge of selecting combinations according to production needs. Since 2022, series of on-farm rootstock and scion variety trials were conducted on multiple commercial fields. Over ten interspecific hybrid squash, citron, and bottle gourd rootstocks were tested for their post-grafting performance on yield, fruit quality, and cost. Simultaneously, various scions differed by horticultural characteristics were tested by grafting onto locally popular rootstocks for the compatibility in terms of yield, fruit quality, and marketability.

Consecutive years of drought since 2021 have been challenging irrigation management for all commodities grown in California's Central Valley. Since 2021, we have implemented numerous on-farm experiments to evaluate the adaptability of "CropManage" (an online based irrigation and nutrient decision-support tool) to guide sustainable water and nitrogen management for grafted watermelons (Wang et al., 2024). Different nitrogen uptake patterns for grafted vs. non-grafted watermelons were identified, thereby indicating the need of adjusting applications to sustain continued productivity (Wang and Fulford, 2022). Our growers have been equipped with knowledge on how grafted watermelons utilize nutrients and demand water and then apply accordingly based on our research results and hands-on trainings courses.

Although subsurface drip irrigation is widely used for commercial watermelon production in California that reduces common moisture-triggered soil-borne pathogens, such as fusarium and verticillium wilt, other diseases triggered by hot and dry conditions, such as charcoal rot (*Macrophomina phaseolina*), pose risks for the viability of watermelon production in California. As the cost for fumigation increases and many pesticides are limited for their applications, using grafting and sustainable biological control in combination has drawn attention by researchers and the watermelon industry. Since 2022, we partnered with the California Department of Pesticide Regulation to assess the combo effects of grafting and Trichoderma biofungicides on reducing the reliance on soil fumigants to manage watermelon plant health and productivity (Buojaylah and Wang, 2024; Buojaylah et al., 2024). Growers now are able to use grafting as a reliable way to prevent vine decline and increase crop yield by being informed of the best practical use of biological fungicides without fumigation. Currently, this application method of Trichoderma biofungicide is becoming a routine practice for many vegetable growers in California.

So far, our efforts have made remarkable impacts on the watermelon production in California.

1. The total economic benefits from successful grafted watermelon fields have brought growers and seed/greenhouse industry over millions of dollars gain.
2. Since 2021, the grafted watermelon in-row spacing of 4-5 feet apart has been widely adopted by the watermelon industry, leading to an average of 20% yield increase and 35% cost reduction per acre for grafted seedlings consistently using the same or even lower amount of water and fertilizers.
3. The average net gain for growing grafted watermelons is up to \$2,500 per acre compared to non-grafted plants.
4. The acreage of grafted watermelons in California increased from less than 150 in 2019 to over 2,500 acres in 2025 (25% of the state total watermelon acreage).
5. By interviewing the cooperative greenhouse nursery (grafted transplant supplier) in California, they benefit from the increase of order from 50,000 grafted watermelon transplants in 2019 (cover only 40 acres) to 2,000,000 in 2025 (cover 1,500 acres). Orders for the 2025 season came from six U.S. states.
6. By 2025, I have disseminated the related techniques and production methods to growers, extension professionals, and academics in many states of the country (Michigan, Massachusetts, Iowa, Indiana, Ohio, Utah, Nebraska, Oregon, Florida, and Washington).

References

- Wang, Z., and Fulford, A. (2021). Is there a pathway to profitability for grafted watermelon? *Vegetables West*. 25, 8-10 <https://vegetableswest.com/2021/09/01/read-september-october-2021-issue/>.
- Wang, Z., and Fulford, A. (2022). Nitrogen fertilization for grafted & non-grafted watermelons: Case study demonstrates different yield response. *Vegetables West*. 25, 10-12 <https://vegetableswest.com/2022/09/01/read-sept-oct-2022-issue/>.
- Buojaylah, F., and Wang, Z. (2024). Two-year summary: Impacts of grafting and Trichoderma biofungicide on watermelon productivity and plant health. *The Adviser-CAPCA*. 27, 42-46 https://capca.com/wp-content/uploads/2024/03/CAPCA_ADV_APR-2024_LowRes.pdf.
- Buojaylah, F., Castrejon, Y., and Wang, Z. (2024). Evaluating Trichoderma-containing biofungicide and grafting for productivity and plant health of triploid seedless watermelon in California's commercial production. *HortScience*. 59, 1709-1717. <https://doi.org/10.21273/HORTSCI18048-24>.
- Wang, Z., Cahn, M., and Buojaylah, F. (2024). Application of CropManage for processing tomato and watermelon production in the northern San Joaquin Valley. *Progressive Crop Consultant*. 9, 28-33 <http://publications.myaglife.com/books/qjqd/#p=1>.
- Wang, Z., and Buojaylah, F. (2025). Seven-year review of watermelon grafting research programs to advance long-term sustainability of watermelon production in California. *Progressive Crop Consultant*. 10, 26-29 <http://publications.myaglife.com/books/cegt/#p=1>.