

room temperature for one hour before being placed in a floral cooler set at 7 °C for 24 hours to ensure the flowers were properly hydrated before the experiment. The plastic buckets used in this experiment were sanitized with a bleach and water solution prior to the start of the experiment. A total of 200 flowers over two harvests were studied. The first round of 100 flowers was harvested on September 2nd, 2025, and after the 24-hour hydration process, the study began on September 3rd. The second harvest of 100 flowers took place on September 16th, 2025, and the study began on September 17th. There were exactly 2 weeks between the harvest dates.

2.3 Experimental protocol

The experiment was conducted as a 2×2×2 factorial design with vase solution, stem recutting treatment, and harvest date as factors. Each of the four treatment groups had 5 replicates (vases), making a total of 20 vases, 5 flowers per vase, per harvest. All vases were made of clear glass, cylindrical in shape, 19 cm high with an 8.5 cm diameter opening. Treatments were replicated across two harvests collected two weeks apart from the same zinnia plants. Flowers were randomized within each treatment group to reduce bias.

The following are the four independent groups the zinnias were randomly assigned to:

- (1) Stems placed in tap water and left untrimmed;
- (2) Stems placed in tap water and trimmed at an angle;
- (3) Stems placed in tap water with floral food (Floralife, Flower Food 300) and left untrimmed;
- (4) Stems placed in tap water with floral food and stems trimmed at an angle.

The tap water groups were each filled with 355 mL of water measured out with a measuring cup. The floral food solution groups were filled with 355 mL of the solution. The floral solution was prepared by mixing the powdered floral preservative with tap water at 10 g/L. The floral preservative used in this study was FloraLife original 300 flower food (FloraLife, Kent, Ohio). The room in which the experiment took place had an average air temperature of 21 °C with an average 18.29 µmol/m²/s of light available for 12 h/d at 50% to 60% relative humidity. Vases were placed away from heating, ventilation, and air conditioning systems within the room and remained stationary, not being randomly rotated, during the monitoring and evaluation of the vase life of the zinnias. The water and flower food solution was changed in all vases across all treatments every 3 d, with floral food added back into the vases within floral food treatment groups. A new floral preservative solution was made each time the water was replaced in the vases, the pH of the water was not tested. The zinnias within the treatment groups that received additional stem cuttings had approximately 2.54 cm trimmed off the bottom of their stems every 2 d from the time of harvesting.

2.4 Experiment monitoring and evaluation

Flower quality was monitored every 24 hours and evaluated using established protocols in previous studies investigating cut flower vase life longevity (Jones and Hill, 1993; Clark et al., 2010; Aalifar, 2020). Stems were discarded when 50% of the flower was wilted, petals dropped or had turned brown/discolored and/or neck bending/drooping, drying or general stem decline, and/or mold growth of any kind was observed on the flower (Jones and Hill, 1993; Clark et al., 2010; Aalifar, 2020; Kalinowski et al., 2022).

2.5 Data analysis

Data from the survey were entered into IBM SPSS Statistics (version 30; IBM Corp., Armonk, NY, USA) and analyzed using analysis of variance (ANOVA) tests, post hoc Duncan's multiple range test, and frequency statistics.

3 Results and Analysis

3.1 Vase life findings for first harvest of *Zinnia elegans*

ANOVA tests were used to determine if there were differences in vase life between the treatment groups. Significant differences were found in the minimum, maximum, and average vase life within the first harvest. Post hoc tests were used to determine where these differences occurred. Zinnia stems that did not receive a stem cutting and were placed in tap water and stems that did receive a cutting in tap water showed similarities between the test