

recommended that flower preservatives be added to the water when storing and arranging cut flowers (Nguyen and Lim, 2021). Flower preservatives are specifically formulated for cut flower use and are comprised of three main ingredients; sugars, acidifiers, and biocides (Da Silva, 2003; Nguyen and Lim, 2021). Flower preservatives enhance water absorption by lowering the pH of the solution, suppress microbial development, and supply carbohydrates necessary for the metabolic processes of cut flowers (Han 2003; Nguyen and Lim, 2021). In a study completed by (Iqbal et al., 2012), researchers studied zinnias placed in water with various levels of preservation enhancers, Indole-3-acetic acid (IAA), 1-naphthylacetic acid (NAA), and salicylic acid (SA), it was found that salicylic acid was the most beneficial to the flowers, maintaining the longest average vase life. Additionally, it has been found adding a solute such as aluminum sulfate to the water can enhance water uptake and extend the vase life of zinnias (Kalinowski et al., 2022). Blockage of the xylem vessels can hinder water uptake in cut flowers, this can be caused by various factors such as bacterial proliferation and pinched or damaged stems (Chen et al., 2023). Past research has found that bacterial build up can shorten flower life and cause inferior flower quality (Balestra et al., 2005; Jowkar 2015). Bacterial organisms contribute to the breaking down of cells at the end of flower stems, thus creating an obstruction in a flowers vascular system, slowing water uptake. Stems obstruction may also occur due to injuries to the stem during harvest (Dixon and Peterson, 1989). Wound-induced xylem occlusion is a condition that has been found to affect some species of cut flowers (Manzoor et al., 2024). Wound occlusions have been found to occur as a stress response when a flowers stem is cut (Manzoor et al., 2024). Symptoms of water stress due to stem blockage or damage often present as wilting of the flower petals or bending in the neck of the flower, the area just below the flower structure (Dixon and Peterson, 1989).

While various factors can influence the longevity of cut flowers, two commonly recommended practices; recutting stems after harvesting and adding floral food to vase water are widely used to enhance vase life (Nell and Reid, 2001; Ahmad and Dole, 2014; Kalinowski et al., 2022). However, recent research has indicated that recutting zinnia stems once cut from the mother plant can reduce the overall vase life of the flower in certain instances (Kalinowski et al., 2022). These findings leave questions regarding best post-harvest practices for *Zinnia elegans*.

The purpose of this study was to investigate how stem cutting and the application of floral food affect the vase life of *Zinnia elegans*. Specifically, the study aims to determine whether cutting the ends of the stems enhances flower longevity, whether floral food extends vase life when used with both cut and uncut stems, and to identify which combination of these treatments results in the greatest extension of vase life for *Zinnia elegans*. By comparing the effects of these common postharvest practices, the study seeks to provide evidence-based recommendations for improving the freshness and ornamental value of *Zinnia elegans* in vase arrangements.

2 Materials and Methods

2.1 Zinnia propagation protocol

The seeds for this study were purchased from Johnny's Selected Seeds, and the variety was Benary's Giant Deep Red. The zinnia seeds were initially planted on May 27th, 2025, in 72 cell seed trays, for a total of 864 possible plants. The seeds were then placed in greenhouses located on Mississippi State University campus for 4 weeks to germinate. After the initial 4-week germination period, the seedlings were transplanted into raised beds located in the Thad Cochran research center at Mississippi State University's on June 25th, 2025. Each seedling was planted approximately 15 cm apart in soil consisting of a mixture of topsoil and humus. There were 400 seedlings planted over 11 beds. Each raised bed was equipped with soaker hoses, allowing the plants to receive adequate water during their growing season. Plants received one application of an all-purpose fertilizer (Expert Gardner 10-10-10, Fort Lauderdale, FL). The fertilizer was evenly spread over the raised bed and worked into the top 5-10 cm of soil.

2.2 Zinnia harvest protocol

For this study, zinnia stems were harvested when the outer petals fully expanded and one row of florets opened (Kalinowski et al., 2022). Zinnia stems were cut to a uniform length (45 cm) and placed in tap water to maintain hydration overnight (Kalinowski et al., 2022). The zinnias were left to hydrate in a plastic bucket of tap water at