Impact of Acetylsalicylic Acid Foliar Application and Sowing Dates on Cucumber Growth

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Abstract
This study examines the effects of acetylsalicylic acid (ASA) foliar application and various dates of sowing on the growth and yield of cucumber plants. The research was conducted to ascertain the impact of varying ASA concentrations and planting times on critical growth parameters, including the number of fruits per plant, vine length, fruit length, fruit diameter, fruit weight, and overall fruit yield. Additionally, the male-to-female flower ratio and the days to flowering were studied. Early sowing dates (SD1) exhibited a 40-day delay in flowering, whereas later sowing dates (SD3) resulted in a 34-day early flowering period. Application of ASA also had a substantial impact on flowering time; plants treated with the highest ASA concentration (ASA3, 270 mg L-1) flowered the earliest (34 days), while untreated plants took the longest (41 days) to flower. The duration between the first harvest and the SD1 and SD3 plots differed as well; the former took the longest (62 days) and the other one the shortest (53 days). Plants treated with ASA3 were harvested 54 days earlier than untreated plants, which took 61 days. Early-planted seeds (SD1) had a lower male-to-female floral ratio than late-planted seeds (SD3). This ratio was decreased by ASA application; ASA3 displayed the lowest ratio, 2.93. Early sowing (SD1) yielded higher fruits per plant (11.1), longer vines (167 cm), and larger fruits (4.27 cm), whereas late sowing (SD3) gave the lowest values for these characteristics. The maximum number of fruits per plant (10.9), longest vines (167 cm), and highest fruit output (40.2 tonnes ha-1) were all consistently achieved with the highest ASA concentration (ASA3). The results show that increasing the concentration of ASA and planting the cucumbers earlier can both improve their development and yield.

Keywords: Cucumber, Acetylsalicylic Acid, Nutritional value, Cultivation practices, Growth.

1. INTRODUCTION

Cucumis sativus L., or cucumber, is a popular vegetable crop grown all over the world that is valued for its high nutritional content and diverse range of applications in cuisine. Cucumber, a member of the Cucurbitaceae family, is treasured not only for its refreshing flavour but also for its health advantages, which include hydration, antioxidant capabilities, and key nutrients like vitamin C and potassium. However, various factors influence cucumber plant growth and output, including environmental conditions, growing procedures, and the application of growth regulators. Swamy et al. (2017).

Figure 1: Cucumber (Cucumis sativus L.)

Among the different agronomic procedures, sowing date is a vital component that influences cucumber plant growth, flowering, and fruiting. Sowing too early or too late might disrupt the growing and reproductive periods, reducing overall plant productivity. According to studies, early sowing corresponds to favourable meteorological circumstances, resulting in optimal development, while planting too late may expose plants to severe environmental stresses, thereby limiting yield (Nwofia et al., 2015).

In addition to sowing dates, the use of growth regulators such acetylsalicylic acid (ASA) has gained popularity in recent years due to its potential to improve plant development and tolerance to stress (Santisree et al.,2020). ASA, a salicylate compound, has been extensively investigated for its potential to regulate plant physiological processes, such as photosynthesis, stress response, and growth regulation. It is more commonly called aspirin. Exogenous ASA treatment has been shown to boost plant tolerance to biotic and abiotic stress, promote flowering, and increase yield in a variety of crops (Younis et al., 2023).

The interplay of planting dates and ASA treatment is an intriguing field of study, as these variables may influence cucumber development synergistically. Early research suggests that ASA can reduce the detrimental effects of environmental stressors, potentially compensating the disadvantages of late sowing. Furthermore, ASA's role in increasing photosynthetic efficiency and delaying senescence may result in increased growth and yield, even under inadequate sowing conditions (Ashraf et al., 2010).

The current study seeks to look into the combined impacts of varied planting dates and ASA foliar treatment on cucumber plant growth and yield. This study aims to provide insights into the best agronomic practices for maximising cucumber production by analysing important growth parameters like several days to flowering, days to harvest, male-to-female flower ratio, the number of fruits per plant, vine length, fruit length, fruit diameter, fruit weight, and overall yield (Sahu et al., 2013).

The significance of this study stems from its potential to provide practical solutions for cucumber cultivation, particularly in areas where weather fluctuation limits agricultural yield. Farmers can improve crop performance, reduce yield losses, and increase overall profitability of cucumber farming by finding the ideal planting timings and using growth regulators like ASA (Zhanbota et al., 2021). Furthermore, this study adds to a greater understanding of plant growth regulators' role in horticulture crops, emphasising the significance of combining scientific research with traditional farming techniques to ensure long-term agricultural progress (Raman et al., 2024).

The study's findings are likely to benefit not just cucumber growers, but also researchers and agricultural extension organisations by giving evidence-based recommendations for better cucumber production practices. As worldwide demand for fresh vegetables rises, optimising the cultivation of cucumbers through innovative agronomic tactics will be critical to satisfying consumer needs and ensuring food security (Taki et al., 2018).

The current study investigates the effect of planting dates and ASA applications on cucumber growth, providing useful insights into how these variables influence important growth indexes and overall yield. This project intends to improve cucumber farming productivity and sustainability by bridging the gap among research and practical application, therefore contributing to the larger goals of agricultural innovations and food security.

2. Material and Methods

2.1. Study Location and Experimental Setup

This study looked into the effects of acetylsalicylic acid (ASA) foliar application and varied sowing dates on cucumber growth and yield. In late March 2023, the study was conducted at the University of Agriculture's.

2.2. Preparation and Planting Process

Cucumber growth was optimised by careful planning of the experimental field. To provide a good seedbed, the area was levelled first, then ploughed and harrowed. Cucumber seeds from the Poinsett 70 variety were sown on ridges with a plant-to-plant distance of 35 cm and a row-to-row spacing of 1.5 m. Seeds were sown two to three centimetres deep, and thinning was done after germination to keep only one healthy plant per hill. To keep the plants healthy and productive during the growing season, typical agronomic techniques were followed, such as weeding, watering, and applying herbicides and insecticides.

2.3. Experimental Design and Treatments

Within the framework of randomised complete block design (RCBD), the study utilised a factorial split-plot design, with three replications to guarantee the dependability of the findings. The experiment's main plots were given three distinct seeding dates: March 5, March 15, and March 25. Subplots were sprayed with foliar sprays of different amounts of acetylsalicylic acid (ASA). The evaluation of the independent and interaction effects of ASA concentrations and planting dates on cucumber growth and yield was made possible by this design.

2.4. Preparation and Application of ASA Solution

The determined amount of ASA (calculated using its molecular weight of 181.156 g) was dissolved in one litre of deionised water to create the acetylsalicylic acid solution. These solutions were administered to cucumber plants at two important growth phases, 25 and 45 days following transplantation. The treatment was performed early in the morning to reduce evaporation and maximise absorption.

2.5. Data Collection Parameters

Various growth and yield parameters were measured to evaluate the effects of ASA application and sowing dates:

Table 1: Overview of Growth and Yield Parameters Measured in Cucumber Plants Across Different Treatments

Days to Flowering	The time from sowing to the onset of flowering was recorded for each treatment group, and the average number of days was calculated.
Days to Harvest	The interval between planting and the first harvest was noted for each treatment group, and averages were calculated.
Vine Length	The length of the vine was measured for five randomly selected plants per treatment using a measuring tape.
Number of Fruits per Plant	The total number of fruits produced per plant was counted and averaged.
Male-to-Female Flower Ratio	The ratio of male to female flowers was calculated by averaging the counts from each treatment.
Fruit Length and Diameter	Five randomly selected fruits from each treatment were measured using a measuring tape and a digital vernier caliper, respectively.
Fruit Weight	The average weight of fruits was calculated by weighing randomly selected fruits from each treatment.
Total Yield (tons per hectare)	The overall yield was calculated using the formula: Yield per subplot (kg) x 1000 (m^2) / Area of subplot (m^2) x 1000.

2.6. Data Analysis

Microsoft Excel and Statistic 8.1 software were used to statistically analyse the gathered data in accordance with the randomised complete block design model. According to Steel and Torrie's (1980) instructions, the least significant difference (LSD) test was used at a 5% probability level to ascertain the significance of differences between means. This careful study validated the data' reliability and validity, offering insights into how ASA application and sowing dates affect cucumber development and yield.

2.7. Analysis of Variance (ANOVA) for Growth and Yield Attributes

The analysis of variance (ANOVA) was used to determine the influence of different sowing dates and acetylsalicylic acid (ASA) administration on various cucumber growth and yield parameters. The data were analysed using Mean Square (MS) values to assess the significance level, which was expressed as **($p \leq 0.01$), *($p \leq 0.05$), or ns (non-significant).

2.8. Days to Flowering (DTF)

The application of acetylsalicylic acid had a highly significant effect at the 1% level (**$p < 0.01$), according to the data, whereas the sowing dates had a significant effect on the days to flowering (DTF) at the 5% significance level. However, there was no significant interaction found between the application of ASA and the sowing dates, suggesting that ASA's influence on DTF is constant throughout a range of sowing dates.

2.9. Days to First Harvest (DTFH)

Sowing dates and ASA application had a substantial effect on days to first harvest (DTFH) (**$p \leq 0.01$ for sowing dates and *$p \leq 0.05$ for ASA treatment). As with DTF, there was no significant interaction found between the application of ASA and the sowing dates, indicating that the effects of ASA and sowing dates on DTFH are unrelated to one another.

2.10. Male to Female Flower Ratio (MTFFR)

Sowing dates and ASA treatment had a substantial effect on the male-to-female flower ratio (MTFFR) at the 5% significance level. On the other hand, the non-significant interaction between the two components suggests that the application of ASA and the sowing dates have independent effects on the ratio.

2.11. Vine Length (VL)

Sowing dates (*$p < 0.05$) and ASA spraying had a substantial effect on vine length (VL). However, the combination of these factors was not significant, showing that the effect of ASA on vine length is consistent across sowing dates.

2.12. Number of Fruits per Plant (NOFPP)

Both the ASA application (*$p \leq 0.05$) and the planting dates (**$p \leq 0.01$) had a substantial impact on the number of fruits per plant (NOFPP). According to the non-significant interaction effect, the variance in fruit number can be attributed to the separate contributions of ASA treatment and sowing date.

2.13. Fruit Length (FL)

The application of ASA (*p ≤ 0.05) and the planting dates (*p ≤ 0.05) had a substantial impact on fruit length (FL). The absence of a significant interaction suggests that the individual effects of planting dates and ASA application on fruit length are independent.

2.14. Fruit Diameter (FD)

Fruit diameter (FD) was greatly impacted by ASA application (*p ≤ 0.05) and very significantly by planting dates (**p ≤ 0.01). The interaction between these variables was found to be non-significant, showing that the effect of ASA on fruit diameter is constant throughout sowing dates.

2.15. Fruit Weight (FW)

Fruit weight (FW) responded to ASA treatment in a significant way (*p ≤ 0.05) and to sowing dates in a highly significant way (**p ≤ 0.01). The non-significant interaction effect indicates that the weight of the fruit was affected independently by the dates and ASA that were sown.

2.16. Total Yield (TY)

The sowing dates had a substantial impact on total yield (TY; *p ≤ 0.05), while the use of ASA had a highly significant impact (**p < 0.01). The non-significant interaction effect suggests that the yield response to ASA spray is stable across different sowing dates.

3. DISCUSSION

This study looked at how acetylsalicylic acid (ASA) applied topically and various sowing dates affected the production and growth of cucumber plants. Significant effects of these parameters on a range of agronomic traits were found by the analysis, suggesting that careful control over planting schedules and the use of growth-regulating agents could optimise cucumber production.

3.1. Impact of Sowing Dates on Growth and Yield

There were big changes in a lot of important factors because of when the seeds were planted. These included the days to blooming (DTF), the days to first harvest (DTFH), the male-to-female flower ratio (MTFFR), the vine length (VL), the number of fruits per plant (NOFPP), the fruit length (FL), the fruit diameter (FD), the fruit weight (FW), and the total yield (TY). These findings are consistent with prior research that emphasises the significance of sowing time in influencing crop performance (Hamid et al., 2022). The considerable effects reported in this study indicate that planting date has a significant impact on microclimatic conditions during the growing season, which influences plant development and output.

The large effect of sowing dates on overall yield is especially remarkable. The best sowing dates most likely provided favourable conditions for cucumber growth, such as adequate temperatures and photoperiods, which are crucial for yield maximisation (Majeed et al., 2020). In contrast, inadequate planting times may subject plants to stress conditions such as high temperatures or inconsistent rainfall, thereby lowering fruit set and overall output (Abd El-Kader et al., 2019).

3.2. Role of Acetylsalicylic Acid in Enhancing Cucumber Growth

The use of ASA also had a considerable impact on key growth indicators and yield characteristics. ASA, which is recognised for producing systemic acquired resistance and modulating plant growth hormones, has been extensively researched for its effects on crop productivity (Hussain et al., 2021). This study's findings are similar with prior research, which found that ASA application boosted physiological processes like as photosynthesis, transpiration, and nutrient uptake, resulting in increased growth and yield (Ali et al., 2022).

The considerable impact of ASA on days to flowering and days to first harvest implies that it may influence cucumber plant phenology, presumably by modifying endogenous hormone levels such as gibberellins and cytokinins (Khan et al., 2018). This faster development may result in earlier fruiting and blooming, which would be advantageous for crop turnover and market timing.

Furthermore, the considerable increase in vine length, fruit diameter, fruit weight, and total yield seen following ASA application suggests that it has the ability to improve both vegetative growth and fruit development. The improvement in yield attributes could be due to ASA's involvement in stress tolerance, which allows plants to grow optimally even under adverse environmental conditions (Yadav et al., 2021).

3.3. Interaction between Sowing Dates and ASA Application

It's interesting to note that whereas ASA treatment and sowing dates individually impacted most growth and yield characteristics, their interplay did not have a meaningful effect. It appears from this that the advantages of applying ASA on varied dates of sowing are not affected, giving farmers choice in when to use ASA without having to make adjustments for different sowing schedules.

The lack of a substantial relationship between sowing dates and ASA application suggests that ASA can be employed as a growth enhancer regardless of planting time. This is an important result for farmers who may encounter fluctuating climatic circumstances during the growing season and require consistent agronomic methods (Zhang et al., 2022).

3.4. Implications for Cucumber Cultivation

The study's findings have practical applications in cucumber farming. Farmers may be able to achieve higher yields and better crop quality by optimising sowing dates and including ASA application into management procedures. The stability of ASA's effects across different sowing dates shows that it could be a useful tool in cucumber production, helping to stabilise yield in the face of environmental fluctuation.

Future research could look at the processes by which ASA affects cucumber growth, specifically its interactions with other plant hormones and stress pathways. Furthermore, research involving several cucumber cultivars and environmental situations might aid in generalising these findings and providing more specific advice to farmers.

Conclusion

This study's findings have important implications for cucumber agriculture. Farmers that optimise sowing dates and incorporate ASA treatment into their management techniques have the potential to achieve higher yields and improved crop quality. The stability of ASA's effects across several sowing dates shows that it can be a useful tool in cucumber production, stabilising yield in the face of environmental fluctuation.

Future research could look at the processes by which ASA promotes cucumber growth, specifically its interactions with other plant hormones and stress-related pathways. Furthermore, investigations incorporating several cucumber cultivars and climatic situations would assist to generalise these findings and make more specific recommendations to farmers.

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