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Impact of various growth regulators applied through foliar application on the development and productivity of cabbage (*Brassica oleracea var capitata* L.)

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Abstract

At the Agriculture Research Farm, Rama University, Mandhana, Kanpur, the present experiment, "Impact of Various Growth Regulators Applied through Foliar Application on the Development and Productivity of Cabbage (*Brassica oleracea var capitata* L.)," was carried out from Rabi season 2023–24. Nine treatments (T₁ = Control, T₂ = GA3 25 ppm, T₃ = GA3 50 ppm, T₄ = GA3 75 ppm, T₅ = GA3 100 ppm, T₆ = NAA 30 ppm, T₇ = NAA 60 ppm, T₈ = NAA 90 ppm, and T₉ = NAA 120 ppm) were included in the Randomized Block Design (RBD) trial. The study's findings showed that treatment T₉ (NAA 120 ppm foliar spray at 30, 45, and 60 DAT) produced the highest plant heights at 30 DAT (14.97 cm), 45 DAT (24.81 cm), and 60 DAT (30.21 cm). Treatment T₈ = NAA (90 ppm) foliar spray at 30, 45, and 60 DAT produced the highest number of days to 50% head maturity, which was 47.76 days. Although higher during the experimental year, the day-to-head maturity of the cabbage plant is (99.77) in T₁=Control treatment. Based on these findings, local farmers in the Kanpur areas might be advised to use treatment T₉ in order to get higher plant height and better-quality cabbage.

Keywords: foliar spray, GA3, NAA, cabbage, *Brassica oleracea var capitata* L

Introduction

Cabbage (*Brassica oleracea var capitata* L.) has more nutrients per 100g edible component than cauliflower and knol-khol combined. It includes 2000IU of vitamin A, 0.06 mg of thiamine, 0.03 mg of riboflavin, and 124 mg of vitamin C. Per 100g edible portion, it also contains high concentrations of minerals, including potash (114 mg), phosphorous (44 mg), calcium (39 mg), sodium (14.1 mg), and iron (0.8 mg). Cabbage juice is used as a mouthwash against harshness and as a treatment against toxic mushrooms. Because indole 3-carbinal is present in cabbage, it contains anti-cancer properties and protects against cancer. Because they offer therapeutic advantages in addition to being a vital source of vitamins, minerals, proteins, carbs, and fiber, vegetables are necessary for maintaining a balanced diet. India is the world's second-largest producer of vegetables, behind China, accounting for about 11.4% of the global supply. The National Horticulture Board's most recent report for 2023–24 estimates that India produces 195.77 million metric tons of vegetables. Considering that the majority of Indians are vegetarians, veggies are an important part of their daily diet. The head, composed of densely overlapping thick leaves on a growing Producers choose cabbage above other vegetable crops because of its assured production and transportable capability. Cabbage is a hardy cool-season crop when grown for food. India is mostly cultivated on its plains. At intervals of two years, it is also planted on the Himalayan slopes to generate seeds. The part that is eaten of the head that yields a profit is the most widely used kind. Cabbage is most frequently grown as an annual crop and utilized in pickles, curries, and other food preparations.

Cabbage (*Brassica oleracea var capitata* L.) is a part of the Cole crop family that originated through human selection and adaptation from a single wild ancestor, *Brassica oleracea* L. var. *oleracea* (syn. *sylvestris*), also known as wild cabbage, cliff cabbage, or "Colewart." Historical evidence suggests that wild non-heading leafy cabbage, which evolved in the eastern Mediterranean and Asia Minor and was most likely introduced to western Europe by the Celts, is the ancestor of current hard head white cabbages that developed in Germany (Neelam *et al.* 2023) [2].

Growth regulators are organic compounds that enhance, obstruct, or modify a plant's internal activities. Produce quality and yields are raised as a result. They encourage the synthesis of metabolites and the division of nutrients and metabolic processes among various constituents, ultimately leading to enhanced recovery. Two of the few widely available commercial growth regulators that are very well-liked and used in a range of vegetable crops are gibberellins and NAA. Plant growth regulators work at relatively low doses when applied during the active (vegetable) development stage of the plant (K. Manoj *et al.* 2023) [3] (Mishra 2006) [6]. GA3 and NAA are two of the growth promoters that are most important for enhancing plant development and vegetable harvests. Among the essential growth factors that encourage cell division and proliferation, GA3 plays a crucial role in the expansion and development of several plants. GA3 is known to be engaged in all stages of the angiosperm developmental cycle and to regulate a number of elements of plant development. By changing the rheological characteristics of the cell wall, gibberellins promote cell elongation. This lowers the cell's water potential, which permits water absorption and, in turn, a rise in cell volume (Bista *et al.*, 2022) [1]. Plant development becomes hindered under extremely cold temperatures. Gibberellic acid application can increase the morphological traits of cabbage, such as plant height, leaf count, head diameter, head thickness, and head weight. When compared to the pick season, the price of winter vegetables is often greater in the latter part of the rabi season. If gibberellic acid could be used to increase growth, farmers may receive a larger economic return by meeting off-season demand (Jones and Kaufman, 1983) [5]. NAA has an impact on bodily functions, expedites maturity, and enhances the quality of fruits and vegetables. A few employees underlined the usage of agricultural growth controls to raise several vegetable crops' yields and quality. (Tomar *et al.* 2020) [8] (Rushikesh Gawali *et al.* 2023) [4]. Because certain crop growth controls encourage growth, they have the benefit of increasing the output of many cabbage kinds. Crop growth controls are beneficial and readily accessible, but their application and concentration need to be strengthened. In light of the aforementioned conditions, this study was conducted to determine the ideal GA3 concentration for boosting cabbage production, yield, and financial return. There are few indications for the use of cabbage control leaflets, despite a small number of researchers in India having examined the impacts of crop development on various vegetable crops, particularly in seed treatment, seedling treatment, and leaf usage.

Materials and Methods

During the Rabi season of 2023–24, at the Agriculture Research Farm, Rama University, Mandhana, Kanpur, an experiment titled "Effect of foliar spray of GA3 and NAA on Plant height and Number of leaves plant-1 at 30, 45, and 60 DAS of cabbage (*Brassica oleracea* var. *capitata* L.)" was carried out. Nine treatments (T₁ = Control, T₂ = GA3 25 ppm, T₃ = GA3 50 ppm, T₄ = GA3 75 ppm, T₅ = GA3 100 ppm, T₆ = NAA 30 ppm, T₇ = NAA 60 ppm, T₈ = NAA 90

ppm, and T₉ = NAA 120 ppm) were included in the Randomized Block Design (RBD) trial. The crop was grown in 60 by 60 cm plots with a 30 cm x 30 cm spacing between each plant. All of the standard cultivation procedures for cabbage were adhered to all experimental plots. Experimental data was subjected to statistical analysis as per the standard statistical procedure given by (Gomez and Gomez (1984).

Results growth parameters

The results indicated that the maximum plant height measured at 30, 45, and 60 days after flowering (14.97 cm at 30 DAT, 24.81 cm at 45 DAT, and 30.21 cm at 60 DAT) was recorded in treatment T₉ (NAA 120 ppm foliar spray at 30, 45, and 60 DAT), and the maximum number of days to 50% head maturity and (47.76) was recorded in treatment T₉ (NAA 120 ppm foliar spray while higher). In T₁=Control treatment during 2023–24, the day-to-head maturity of cabbage crop plants is (99.77), correspondingly. On the other hand, under treatment T₁=control at 30, 45, and 60 DAT (Table -1), the minimum plant height is 9.47 cm, 12.98 cm, and 16.69 cm, with the lowest number of days to 50% head. Under treatment T₁=control, maturity is (54.34) (Table -2). Regarding the quantity of leaves per plant, plant growth regulators responded significantly. The results show that the minimum number of days required for cabbage crop plants to reach maturity is 90.40. These data were obtained for T₉ (foliar spraying with NAA (125 ppm) at 30, 45, and 60 DAT) (Table 3).

Table 1: Effect of different growth regulator doses affect on cabbage crop plant height at 30,45 and 60 DAS.

Symbols	Treatments	30 DAS	45 DAS	60 DAS
T ₁	Control	9.47	12.98	16.69
T ₂	GA ₃ (25ppm)	10.03	13.38	17.61
T ₃	GA ₃ (50ppm)	11.32	15.42	18.55
T ₄	GA ₃ (75ppm)	12.43	18.43	24.71
T ₅	GA ₃ (100ppm)	13.81	23.26	27.61
T ₆	NAA (30ppm)	12.61	22.43	22.91
T ₇	NAA (60ppm)	13.21	22.98	25.11
T ₈	NAA (90ppm)	14.01	23.85	27.56
T ₉	NAA (120ppm)	14.97	24.81	30.21
S.Em ±	-	0.296	0.310	0.322
CD (0.05)	-	0.902	0.927	0.982

Table 2: Effect of different growth regulator doses effect on cabbage crop on Number of days to 50% head maturity at 30, 45 and 60 DAT.

Symbols	Treatments	At 50% head maturity
T ₁	Control	54.34
T ₂	GA ₃ (25ppm)	51.81
T ₃	GA ₃ (50ppm)	40.05
T ₄	GA ₃ (75ppm)	44.81
T ₅	GA ₃ (100ppm)	44.69
T ₆	NAA (30ppm)	43.61
T ₇	NAA (60ppm)	45.98
T ₈	NAA (90ppm)	46.98
T ₉	NAA (120ppm)	47.76
S.Em ±	-	0.421
CD (0.05)	-	1.304

Table 3: Effect of different growth regulator doses affect on cabbage crop on Number of days to At day to head maturity on 30, 45 and 60 DAT

Symbols	Treatments	At day to head maturity
T ₁	Control	99.77
T ₂	GA ₃ (25ppm)	97.90
T ₃	GA ₃ (50ppm)	97.16
T ₄	GA ₃ (75ppm)	96.30
T ₅	GA ₃ (100ppm)	95.30
T ₆	NAA (30ppm)	94.40
T ₇	NAA (60ppm)	93.60
T ₈	NAA (90ppm)	92.80
T ₉	NAA (120ppm)	90.40
S.Em ±	-	0.59
CD (0.05)	-	0.65

Conclusion

The current investigation's conclusions might go as follows: "Impact of Various Growth Regulators Applied through Foliar Application on the Development and Productivity of Cabbage (*Brassica oleracea* var. *capitata* L.)" is the title of the study. Research conducted in the rabi season of 2023–24 at the Agriculture Research Farm, Rama University, Mandhana, Kanpur, verified the application of growth controllers to improve the growth and production of cabbage. The current study's findings showed that growth regulators were generally effective in raising the yield of cabbage. NAA (120 ppm) foliar spray at 30, 45, and 60 DAT records high results in terms of plant height, number of days to 50% head maturity, and greater outcome at the moment of maturity per hectare under control among the numerous plant growth regulators.

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