

was found that 100 g of the green edible portion of the cabbage is present with 92 %water, 18 mg sodium, 170 mg potassium, 1.28 g protein, 5.8 g carbohydrate, 4 % calcium, and 2 % mg iron (Dev et al., 2020). It is also rich in indole-3-carbinol which helps in improving the capability of DNA repair in cells and seems to hinder the formation of cancer cells (Moniruzzaman et al., 2019). The seed production in cabbage can be done by seed to seed and head to seed method. In head to seed method, head intact method is especially practiced where a cross cut is made to facilitate the emergence of the flower stalk (Singh et al., 2018). Despite its importance, cabbage seed production occupies a relatively small portion of the vegetable seed importance sector. It accounts for about 0.5% of the vegetable seed-producing land (Aryal et al., 2022). Seed yield and quality are critical factors influencing cabbage productivity. However, cabbage seed production is often constrained by climatic conditions, particularly in cold and high-altitude environments where low temperatures and short growing seasons can adversely affect flowering, seed set and maturation. The application of plant growth regulators has therefore been studied as a method of enhancing cabbage and reproductive performance.

Gibberellic acid (GA₃) and naphthalene acetic acid (NAA) are widely used plant growth hormones which exhibited beneficial effect in several crops such as cell elongation and floral induction (Chaurasiy et al., 2014). Similarly, application of plant growth regulator is also better to enhance the yield of vegetable without compromising with their quality (Singh and Verma, 2021). Previous studies have reported that GA₃ application can enhance plant height, leaf number, flowering and seed yield in cabbage and other Brassicaceae crops (Moniruzzaman et al., 2019; Dev et al., 2020). Similarly, NAA has been shown to enhance flower retention, pod development and seed maturation by influencing auxin-related physiological mechanisms. However, the majority of these investigations have been carried out in lowland or moderate climatic conditions.

Systemic studies evaluating the combined and comparative effects of GA₃ and NAA on cabbage seed production under high-altitude, cold climate conditions remain limited. Specifically, data regarding ideal hormone levels for improving seed yield in areas like Mustang, Nepal is limited. Therefore, this study was conducted to evaluate the effects of different concentrations of GA₃ and NAA on the growth and seed yield of cabbage in high altitude environments, with the goal of producing location-specific recommendations for cabbage seed production in colder areas.

2 Materials and Methods

2.1 Experimental site and climate

The experiment was conducted at Temperate Horticulture Development Center (THDC) located at Gharapjhong Rural Municipality-2, Marpha, Mustang district, coordinated at 28 °20' to 29 °05' N and 83 °30' to 84 °15' E with an altitude of 2,650 masl. The area is characterized by a cold, high altitude climate with cool summers and cold winters. The average annual minimum and maximum temperature range reported during the research period were 4.9 °C-20.7 °C. The average annual rainfall of the study site was recorded to be about 36.875 mm. The soil in the experimental area was sandy loam to sandy in texture, well-drained and was prepared by ploughing and leveling before transplanting.

2.2 Plant material and experimental design

The experiment was conducted using cabbage (*Brassica oleraceae* var. *capitata*) plants of Copenhagen market variety. The head of the matured cabbage was transplanted at the first week of Bhadra. Transplanting was done at a spacing of 60 × 75 cm and plot size was maintained 2.40 × 3.00 m. The experiment was laid out in a single-factor Randomized Complete Block Design (RCBD) with 7 treatments and 3 replications. The treatments namely T₁, T₂, T₃, T₄, T₅, T₆ and T₇ consisted of different concentrations of GA₃ and NAA including a control which is shown in (Table 1).