



IMPACT OF GLYCINE APPLICATION METHODS ON QUALITY PARAMETERS OF CAULIFLOWER (*BRASSICA OLERACEA* VAR. *BOTRYTIS* L.) UNDER SUBTROPICAL CONDITIONS OF GARHWAL HIMALAYA

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ABSTRACT

Cauliflower (*Brassica oleracea* var. *botrytis* L.) is an important commercial cole vegetable crop belongs to family Brassicaceae with chromosome number $2n = 18$. It is native of Western Europe and Northern shore of Mediterranean region. The experiment was conducted during winter season, 2023-24 at Horticultural Research Centre, Department of Horticulture, Chauras Campus, Hemvati Nandan Bahuguna Garhwal University, Srinagar, Uttarakhand (India). The experiment was laid out having 7 treatments viz., T₀ (Control), T₁ (Glycine @ 250 mg SA), T₂ (Glycine @ 500 mg SA), T₃ (Glycine @ 1000 mg SA), T₄ (Glycine @ 250 ppm FA), T₅ (Glycine @ 500 ppm FA), T₆ (Glycine @ 1000 ppm FA). The quality parameters total soluble solid (°Brix) and ascorbic acid (mg/100g) were found to be maximum under T₂ (Glycine @ 500 mg SA) and dry weight of curd and Chlorophyll of leaves (SPAD⁰C) were found to be maximum under T₅ (Glycine @ 500 ppm FA). Hence, it may be suggested that glycine could use for enhancing the quality of cauliflower cv. Pusa Himjyoti under subtropical condition of Garhwal Himalaya.

Key words: Cauliflower, Glycine, Soil, Foliar application, Quality, Amino acid.

Introduction

Cole crops belonging to the family *Brassicaceae* in this group includes cauliflower, cabbage, knol-khol, broccoli, Brussels sprouts, kale, and Chinese cabbage. Cole crops are nutritionally superior, being rich sources of vitamins A and C and containing appreciable amounts of essential minerals such as phosphorus, potassium, calcium, sodium, and iron. All cole crops originated from *Brassica oleracea* var. *sylvestris*, commonly known as wild cabbage, from which the term “cole crops” is derived (Dhaliwal, 2017). Cauliflower (*Brassica oleracea* var. *botrytis* L.) is one of the most popular and economically important cole crops. Originating from the Mediterranean region, it has a long history of cultivation in Europe and was introduced to India from England in 1822 (Peter *et al.*, 2010). At present, cauliflower is grown across all

continents, with Asia being the leading producer. China and India together contribute about 72 percent of global cauliflower production, while other major producers include France, Italy, the United Kingdom, the United States, Spain, Poland, Germany, and Pakistan (Sharma *et al.*, 2005; FAO, 2020). In India, cauliflower occupies a significant area, with major producing states being West Bengal, Odisha, and Gujarat (Joseph, 2022).

The edible portion of cauliflower is the curd, which consists of compact, undeveloped flower buds. Cauliflower is a rich source of proteins, carbohydrates, vitamins, and minerals and also possesses medicinal properties. It contains bioactive compounds such as glucosinolates and indole-3-carbinol, which are known for their anti-inflammatory and anti-carcinogenic effects (Bana *et al.*, 2012; Basnet and Shakya, 2016). Its high

nutritional value makes it an important vegetable for improving dietary quality (Neupane *et al.*, 2020).

Cauliflower cultivars grown in India are classified into early, mid-early, mid-late, and late groups based on curd maturity. The crop is thermo-sensitive, with an optimum temperature range of 15–21°C required for proper curd formation. It grows best in fertile, well-drained soils rich in organic matter, with an optimum soil pH of 5.5–6.5 (Swarup and Chatterjee, 1972; Thamburaj and Singh, 2015). Amino acids are fundamental building blocks of proteins and act as bio-activators in plants, enhancing physiological processes such as root and shoot growth. Among them, glycine, the simplest proteinogenic amino acid, plays a vital role in protein synthesis and nutrient chelation, thereby improving nutrient uptake and translocation in plants (AL-Modhafer, 2009; Abd-EL-Hafez *et al.*, 2011; Souri and Hatamian, 2019).

Materials and Methods

The present investigation, entitled “Impact of Glycine Application Methods on Quality Parameters of Cauliflower (*Brassica oleracea* var. *botrytis* L.) under Subtropical Conditions of Garhwal Himalaya,” was carried out at the Horticultural Research Centre, Department of Horticulture, H.N.B. Garhwal University, Srinagar, Uttarakhand, during the winter season of 2023–24. The experimental site is situated in a valley region characterized by a humid subtropical climate, marked by dry summers and severe winters. The area frequently experiences dense fog from mid-November to mid-February, which significantly influences crop development and quality.

The experiment was laid out in a Randomized Block Design (RBD) comprising seven treatments with three replications to assess the effect of soil and foliar application of L-glycine on cauliflower quality parameters. The treatments included a control (T_0) and six glycine treatments: soil application of glycine at 250 mg (T_1), 500 mg (T_2), and 1000 mg per plant (T_3), and foliar application of glycine at 250 ppm (T_4), 500 ppm (T_5), and 1000 ppm (T_6). Healthy and uniform seedlings of cauliflower variety ‘Pusa Himjyoti’ were raised on raised nursery beds under polyhouse conditions.

The experimental field was prepared and divided into three equal blocks, with each block consisting of seven plots of equal size measuring 3.0 m × 2.25 m. Four-week-old, healthy, and uniform seedlings were selected for transplanting. Prior to uprooting, a light irrigation was applied in the nursery to minimize root damage. Transplanting was carried out at a spacing of 60 cm between rows and 45 cm between plants to ensure

proper growth and development. Foliar application of glycine at different concentrations (250, 500, and 1000 ppm) was applied four times during the crop growth period. The first foliar spray was given two weeks after transplanting, followed by three subsequent sprays at 15-day intervals. Soil application of glycine was carried out as soil drenching in three split doses to achieve the final required concentration (250, 500 or 1000 mg per plant). For this purpose, the total quantity of glycine was dissolved in distilled water, and the first application (83 mg or 167 mg per plant) was given two weeks after transplanting, followed by two more applications at two-week intervals. This systematic approach enabled the evaluation of different glycine application methods on the quality attributes of cauliflower under subtropical Himalayan conditions. During the experiment different observations pertaining to growth and yield parameter were recorded. Five plants from each treatment per replication were tagged randomly for recording the data. The quality parameters: Dry weight of curd (g) the freshly harvested curd from five selected plants of each treatment per replication were cut and composited into 100 g in electronic weighing balance (cap. max. 400g). After weighing, the head were chopped into small pieces and put into paper envelop and kept in the dehydrator at 65°C for 72 hours for drying. Then, the dried material was weighed on electronic weight balance for recording the dry weight and further average was calculated. Moisture percentage of curd (%) for five randomly selected plants from each treatment per replication was calculated by using the formula given below:

$$\text{Moisture Percentage (\%)} = \frac{\text{Fresh Weight} - \text{Dry Weight}}{\text{Dry Weight}} \times 100$$

Total soluble solids (°Brix) of cauliflower was estimated with the help of hand refractometer. A composite sample (10 g) of five curd from each treatment was taken. The curd juice was extracted by crushing the curd with the help of mortar pestle in the laboratory. A few drops of the extract were placed on a hand refractometer’s prism and the readings were recorded and the mean calculated. Ascorbic acid (mg/100g) content in cauliflower was estimated by using the method given by Ranganna (1977).

$$\text{Ascorbic acid} \left(\frac{\text{mg}}{100\text{gm}} \right) = \frac{\text{Titre value (ml)} \times \text{Dry factor} \times \text{Volume made up (ml)} \times 100}{\text{Aliquote of extract taken for estimation (ml)} \times \text{weight of sample (g)}}$$

Chlorophyll content was recorded by SPAD-502 meter at the time of harvest, then mean values for each treatment was calculated.

Table 1: Effect of application methods and among level of glycine on quality attributes in cauliflower.

Treatments	Dry weight of curd (g)	Moisture percentage of curd (%)	Total soluble solid (°Brix)	Ascorbic acid (mg/100g)	Chlorophyll of leaves (SPAD/°C)
T ₀ (control)	7.73	92.27	6.35	45.52	49.81
T ₁ (Gly@ 250mg SA)	8.63	91.37	6.48	46.67	51.70
T ₂ (Gly@ 500mg SA)	8.72	91.28	7.42	50.04	55.82
T ₃ (Gly@ 1000mg SA)	9.26	90.74	7.36	47.37	57.69
T ₄ (Gly@ 250ppm FA)	8.04	91.96	6.75	47.50	52.92
T ₅ (Gly@ 500 ppm FA)	9.41	90.59	7.06	49.44	57.85
T ₆ (Gly@ 1000 ppm FA)	9.25	90.75	6.94	48.05	55.13
CD (5%)	0.62	0.63	0.51	0.59	3.87
S.E (m)±	0.20	0.20	0.16	0.19	1.24
C.V.	3.95	0.38	4.09	0.68	3.96

The statistical analysis experiment was laid out in a randomized block design (RBD) with three replications as described by Snedecor and Cochran (1961). The collected data, which was derived from five randomly selected plants, were analysed statically involving analysis of variance (ANOVA) test at 5% level of probability. Critical differences were calculated in order to compare the treatment means. The experiment results are presented with the help of tables and Fig wherever found necessary.

Result and discussion

Dry weight of curd (g)

Dry weight of curd that, the maximum (9.41 g) dry weight of curd was recorded in T₅ (Gly @ 500 ppm FA), which was statistically at par with T₃ (9.26 g) in Gly @ 1000 mg SA and T₆ (9.25 g) in Gly @ 1000 ppm FA. On the other hand, the minimum (7.73 g) dry weight of curd was recorded in T₀ (Control). Glycine contributes to protein synthesis and cellular function, which can enhance plant growth and development, including the formation and weight of curds. Glycine may influence the production of auxins, which are crucial for cell elongation and division, potentially leading to increased biomass and dry weight. Similar result found in which a study of cauliflower by Tariq *et al.* (2016).

Moisture percentage of curd (%)

Moisture percentage of curd, the maximum (92.27%) moisture percentage of curd was recorded in T₀ (control). On the other hand, the minimum (90.59 %) moisture percentage of curd was recorded in T₅ (Gly @ 500 ppm FA), which was statistically at par with T₃ (90.74 %) in Gly @ 1000 mg SA. Glycine helps maintain cell turgor pressure and reduces the impact of water scarcity. Foliar application of Glycine can improve water use efficiency by influencing physiological processes such as transpiration and stomatal conductance. Similarly result

found Zhu Y. *et al.*, (2019) in broccoli crops

Total soluble solid (°Brix)

The effect of soil and foliar glycine application methods and levels on the total soluble solids (°Brix) content of cauliflower curd was found to be statistically significant. The highest total soluble solids value (7.42 °Brix) was observed under treatment T₂ (soil application of glycine @ 500 mg). In contrast, the lowest total soluble solids content (6.35 °Brix) was recorded in the control treatment (T₀). Soil application of glycine can improve plant tolerance to abiotic stresses such as drought and nutrient deficiency. By mitigating stress, plants can maintain higher levels of sugars and other solutes, potentially leading Glycine can enhance nutrient uptake and utilization, leading to improved overall plant health and potentially higher levels of sugars in the plant tissues, thus affecting TSS. The similarly result of amino chelate fertilizers found by Souri (2016) in the various crops.

Ascorbic acid (mg/100g)

The ascorbic acid content (mg/100 g) of cauliflower curd was significantly influenced by different glycine application methods and levels. Among the treatments, the highest ascorbic acid content (50.04 mg/100 g) was observed in T₂ (soil application of glycine @ 500 mg). In contrast, the lowest ascorbic acid content (45.52 mg/100 g) was recorded under the control treatment (T₀). Low to moderate levels of glycine had beneficial effects on ascorbic acid. Toxicity and leaf necrosis were also observed in this study under 1000 ppm spray. Based on plant species and physiological status, glycine probably acts as a proton donor resulting in cell hyper-acidification, quite similar to ammonium spray toxicity. (Souri *et al.*, 2019)

Chlorophyll content of cauliflower leaves (SPAD/°C) at harvest

The maximum (57.85) chlorophyll content of

cauliflower leaves at harvest time was recorded in treatment T₅ (Gly @ 500 ppm FA) whereas the minimum (49.81) was recorded under the treatment control (T₀). The increase in chlorophyll content with glycine application may be attributed to its role as a precursor in porphyrin synthesis, which forms an essential component of the chlorophyll molecule. Adequate availability of glycine supports porphyrin formation, thereby enhancing

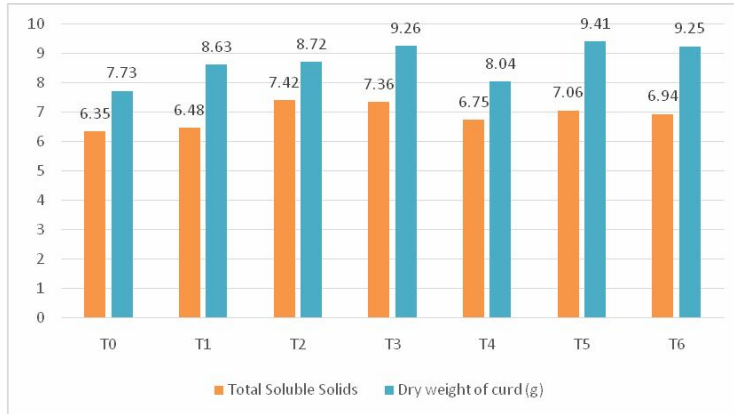


Fig. 1: Effect of application methods and among level of glycine on Total soluble solids (°Brix) and dry weight of curd (g) in cauliflower.

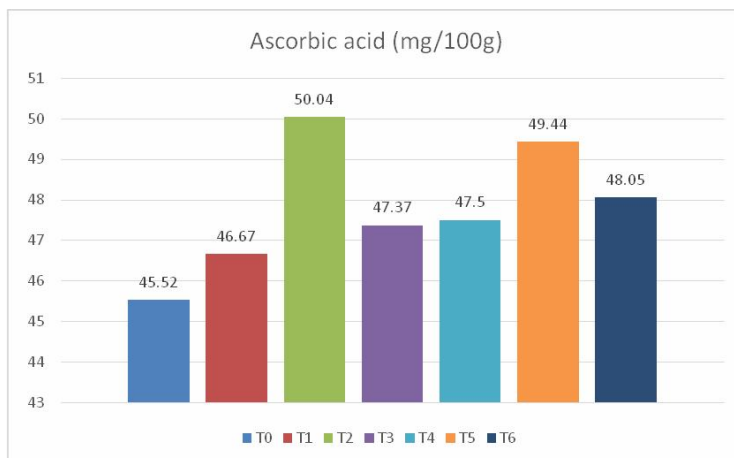


Fig. 2: Effect of application methods and among level of glycine on Ascorbic acid (mg/100g) in cauliflower

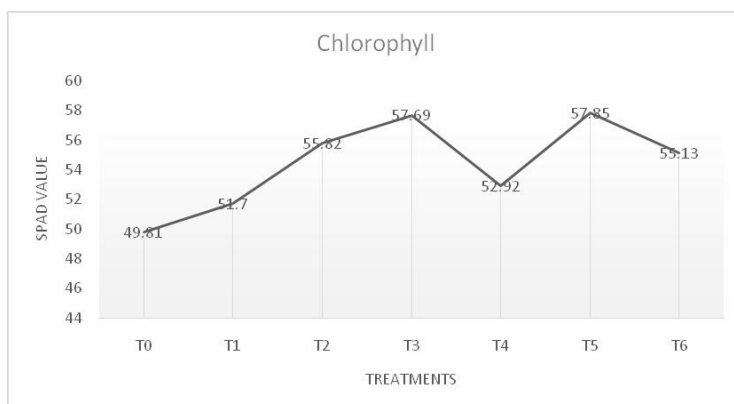


Fig. 3: Effect of application methods and among level of glycine on chlorophyll (SPAD/°C) in cauliflower.

chlorophyll biosynthesis. Similar findings were reported by Yildirim (2015), who observed that glycine supplementation positively affected chlorophyll content in lettuce plants.

Conclusion

Foliar application of glycine significantly improved the quality attributes of cauliflower as compared to the untreated control. Among the evaluated treatments, foliar application of glycine at 500 ppm exhibited superior performance over soil application at 1000 mg per plant, indicating greater efficiency of foliar delivery in enhancing plant physiological responses. This suggests that optimal foliar supplementation of glycine facilitates improved absorption and utilization, thereby positively influencing crop performance. The findings have important implications for enhancing cauliflower productivity and quality under subtropical conditions. Additionally, from the perspective of food safety and consumer health, the use of bio stimulants such as glycine amino acid as a partial or complete alternative to chemical fertilizers represents a sustainable approach. Such practices not only improve crop performance but also contribute to soil health, environmental safety, and overall human health.

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