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# Effect of bioregulators and boron on growth attributes of cabbage (*Brassica oleracea var. capitata* L.) cv. golden acre

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**Abstract**
In order to study the effect of bioregulators and boron on growth attributes of cabbage. The experiment consisting 15 treatments combination with two factors *i.e.* bioregulators with five levels (control, $GA_3$ @ 50 ppm, $GA_3$ @ 100 ppm, NAA @ 50 ppm and NAA @ 100 ppm) and boron with three levels (control, boric acid @ 0.1 per cent and boric acid 0.2 @ per cent) in Factorial Randomized Block Design with three replications each.

The individual application of bioregulators treatment $B_2$ ($GA_3$ @ 50 ppm) recorded maximum plant height (23.87 cm), plant spread (43.45 cm), open numbers of leaves per plant (16.18), stem length (5.03 cm), stem diameter (1.83 cm), days required for head initiation (44.50) and maximum chlorophyll content in leaves at 45 DAT (0.43 mg/g). Similarly, the individual application boron treatment $M_2$ (boric acid @ 0.2 per cent) found maximum plant height (23.50 cm), plant spread (41.57 cm), number of open leaves per plant (15.55), length of stem (4.65 cm), stem diameter (1.70 cm) days required for head initiation (44.31) and maximum chlorophyll content in leaves at 45 DAT (0.42 mg/g) compared to control.

**Keywords:** Cabbage, bioregulators, boron and growth attributes

## 1. Introduction
Cabbage (*Brassica oleracea* L. var. *capitata*) is the most important member of genus Brassica grown in the world. The cabbage belongs to cruciferae (Brassicaceae) family. It is a slow growing biennial crop of temperate region. The word 'Cabbage' is derived from the French word 'coboche' which means head. It is grown in kitchen and truck gardens It is one of the important leafy vegetable crop and used as salad, cooked, pickling as well as dehydrated vegetable. The particular flavor in the cabbage head is due to the glycoside 'sinigrin' which contains sulphur. However, its cultivation is equally successful in tropical and sub-tropical regions. It is the most common vegetable crop available during winter season but now a day it is grown round the year in all over India. Among several growth regulators, NAA and $GA_3$ are very popular and being used in commercial scale in several crops including cauliflower. They help in the synthesis of metabolites as well as translocation of nutrients and assimilation in different parts, which ultimately results in higher yields (Kotecha *et al.* 2011) [11]. Boron is an essential micronutrient required for normal plant growth and development. It performs a wide range of functions in cabbage plants. It is important in pollination and seed reproduction. It is necessary for normal cell division, nitrogen metabolism, and protein formation. It is essential for proper cell wall formation. Boron plays an important role in the proper function of cell membranes and the transport of K to guard cells for the proper control of internal water balance and Breakdown at head formation. The physiological disorders browning and hollow stem causes by boron deficiency ultimately resulting in lower yield having inferior quality. Boron deficiency affects the growing points of roots and youngest leaves. The leaves become wrinkled and curled with light green colour. Its deficiency affects translocation of sugar, starches, nitrogen and phosphorus, synthesis of amino acids and proteins. Adequate boron supply is essential for proper nucleic acid metabolism and influences the incorporation of phosphorus into RNA and DNA (Basavarajeswari *et al.* 2008) [2].

## 2. Materials and Methods

A field experiment to study the "Effect of bioregulators and boron on growth, yield and quality of cabbage (*Brassica oleracea* var. *capitata* L.) cv. Golden Acre'' was conducted at Protected Cultivation Unit, Department of Vegetable Science, College of Horticulture & Forestry, Jhalrapatan city, Jhalawar during *Rabi*, 2017-18.

The experiment consisting 15 treatments combinations with two factors *i.e.* bioregulators with five levels (control, $GA_3$ @ 50 ppm, $GA_3$ @ 100 ppm, NAA @ 50 ppm and NAA @ 100 ppm) and boron with three levels (control, boric acid @ 0.1 per cent and boric acid @ 0.2 per cent) in Factorial Randomized Block Design with three replications each. The treatment combinations are $T_0$ - Control, $T_1$ – Boric acid @ 0.1 %, $T_2$ – Boric acid @ 0.2 %, $T_3$ - $GA_3$ @ 50 ppm, $T_4$ - $GA_3$ @ 50 ppm + Boric acid @ 0.1 %, $T_5$ - $GA_3$ @ 50 ppm + Boric acid @ 0.2 %, $T_6$ - $GA_3$ @ 100 ppm, $T_7$ - $GA_3$ @ 100 ppm + Boric acid @ 0.1 %, $T_8$ $GA_3$ @ 100 ppm + Boric acid @ 0.2 %, $T_9$ - NAA @ 50 ppm, $T_{10}$ - NAA @ 50 ppm + Boric acid @ 0.1 %, $T_{11}$ - NAA @ 50 ppm + Boric acid @ 0.2 %, $T_{12}$ - NAA @ 100 ppm, $T_{13}$ NAA @ 100 ppm + Boric acid @ 0.1 % , $T_{14}$ - NAA @ 100 ppm + Boric acid @ 0.2 %. The treatment application was given as foliar spray of bioregulators and boric acid at 15 and 30 DAT.

## 3. Results and Discussion

The result of present study clearly indicate that plant height, plant spread, number of open leaves per plant, stem length, stem diameter, days required for head initiation as well as chlorophyll content in leaves (mg/g) at 45 DAT were significantly increased by individual application of different bioregulator and boron as compare to control.

The application of bioregulator $B_1$ ($GA_3$ @ 50 ppm) had maximum plant height (23.87 cm), plant spread (43.45 cm), numbers of open leaves per plant (16.18), stem length (5.03 cm), stem diameter (1.83 cm), minimum days required for head initiation (44.50) and maximum chlorophyll content in leaves at 45 DAT (0.43 mg/g) as compare to minimum plant height (22.40 cm), plant spread (36.11 cm), numbers of open leaves per plant (13.88), stem length (3.00 cm), stem diameter (1.28 cm), maximum days required for head initiation (46.28) and minimum chlorophyll content in leaves at 45 DAT (0.35 mg/g) as compared to control, respectively. These results were confirmed by Dhengle and Bhosale (2008) [8] in cabbage, Roy and Nasiruddin (2011) [24] in cabbage and Sitapara *et al*. (2011) [27] in cauliflower.

Plant height increased by application of bioregulators over control. It might be due to $GA_3$ which increase the cell division and cell elongation in sub apical meristem. The increase in number of leaves per plant with application of $GA_3$ may be due to the activity of $GA_3$ at the apical meristem resulting in more nucleo - protein synthesis responsible for increasing leaf initiation Dhengle and Bhosale (2007) [7]. The stem length was increased by application of $GA_3$ over control. It might be due to the foliar spray of $GA_3$ which stimulate vegetative growth and involved in initiation of the cell division in cambium (Mishra and Singh, 1986) [15]. The application of $GA_3$ decreased number of days taken for head initiation. It might be due to the more cell division and elongation with increase in photosynthetic activity and better food accumulation Yadav *et al*. (2000) [29]. The early head initiation resulting decrease the number of days required for head initiation Reddy *et al.* (1989) [23]. The increase in chlorophyll content by application of bioregulators might be due to stimulated nutrient uptake specially which have role in the assimilation of numerous amino acids that are subsequently incorporated in proteins and nucleic acid, which provides framework for chloroplast results into better chlorophyll content in leaves of plant Ramteke *et al*. (2016) [20].

The application of boron $M_2$ (Boric acid @ 0.2 %) had maximum plant height (23.50 cm), plant spread (41.57 cm), numbers of open leaves per plant (15.55), stem length (4.65 cm), stem diameter (1.70 cm), minimum days required for head initiation (44.31) and maximum chlorophyll content in leaves at 45 DAT (0.42 mg/ g) as compare to minimum plant height (23.07 cm), plant spread (40.48 cm), numbers of open leaves per plant (14.97), stem length (4.41 cm), stem diameter (1.64 cm), maximum days required for head initiation (45.84) and minimum chlorophyll content in leaves at 45 DAT (0.36 mg/g) as under control, respectively. Similar observations were recorded by Mishra and Singh (1986) [15], Mishra (1992) [16], Chaudhary and Mukherjee (1999) and Prasad and Yadav (2003) in cauliflower and (Basavarajeshwari *et al.*, (2008) in tomato.

Plant height increased by application of boron over control. It might be due to this perceptible increase in plant height may be due to an enhancement in cell multiplication and cell elongation because of boron. Singh *et al*. (2002) have opined an increase in vegetative growth in cauliflower as a result of B application, which might be due to the beneficial effect of B in the growth of metabolic tissues. These results are in agreement with those of Mishra and Singh (1986) [16], Mishra (1992) [16], Patel (2002) [17] in cauliflower and Basavarajeshwari *et al*., (2008). It produced significant improvement in growth parameters which might be due to the enhanced photosynthetic activity and metabolic activity with the application of B (Bhatt, *et al.*, 2004) [3] in tomato. The increase plant spread might be due to the enhancement in photosynthesis, deposition of photossimilates, translocation of carbohydrates, improvement in physiological and other metabolic activity which led to an increase in various plant metabolites responsible for actively cell division and elongation results improvement in growth characters Lal and Rao (1954) [12] and Rawat and Mathpal (1984) [22] Hatwar *et al.* (2003) [10]. The increase in number of open leaves per plant with application of boric acid may be due its essential role in the growth and development of new cells in the plant meristem. These findings are in consonance with the results reported by Mishra and Singh (1986) [15], Thakur *et al*. (1991) [28], Ghosh and Hasan (1997) [9] and Patel (2002) [17] in cauliflower. The increase in leaf area as a result of boron application may be due to better growth of meristematic tissues, resulting in increased vegetative growth Singh, (2003) [26] in cauliflower. The stem length and steam diameter was increased by application of boron over control. It might be due to the active participation of boron in translocation of nutrients, hormone movement, enhancement in cell division, formation of more tissues and apical meristem movement resulting an increase in above mentioned growth parameters. These results are closely in agreement with the findings of Bussler (1962) [4], Maurya and Lal (1975) [14], Mishra and Singh (1986) [15]. The application of boron decreased number of days taken to head initiation. It might be due to the particular function of boron which resulted into the precipitation of excess cation, buffer action, and maintenance of conducting tissues which ultimately might have helped in absorption of nitrogen. This finding also finds support in the works of Rao *et al.* (1990) [21] and Chaudhary and Mukherjee (1999) in cauliflower. The increase in chlorophyll content

may be Boron plays important role in physiological processes like carbohydrates metabolism, translocation and development of cell wall and translocation of sugar and carbohydrates Siddiky *et al.* (2007) [25].

## 4. Conclusion

The individual application of bioregulators $B_1$ ($GA_3$ @ 50 ppm) and boron $M_2$ (boric acid @ 0.2 %) exhibited maximum plant height (23.87 and 23.50 cm), plant spread (43.45 and 41.57 cm), numbers of open leaver per plant (16.18 and 15.55), stem length (5.03 and 4.65 cm), stem diameter (1.83 and 1.70 cm), minimum days required for head initiation (44.50 and 44.31) and maximum chlorophyll content in leaves at 45 DAT (0.43 and 0.42 mg/g), respectively.

**Table 1:** Individual effect of bioregulators and boron on growth attributes plant height, plant spread, number of open leaves per plant, stem length, stem diameter, days required for head initiation and chlorophyll content in leaves at 45 DAT.

| Treatment | Plant height (cm) | Plant spread (cm) | No. of open leaves per plant | Stem length (cm) | Stem diameter (cm) | Days required for head initiation | Chlorophyll content in leaves (mg/g) |
|---|---|---|---|---|---|---|---|
| $B_0$ | 22.40 | 36.11 | 13.88 | 3.00 | 1.28 | 46.28 | 0.35 |
| $B_1$ | 23.87 | 43.45 | 16.18 | 5.03 | 1.83 | 44.50 | 0.43 |
| $B_2$ | 23.35 | 42.02 | 15.78 | 4.85 | 1.75 | 45.03 | 0.38 |
| $B_3$ | 23.55 | 42.25 | 15.83 | 4.86 | 1.77 | 44.60 | 0.40 |
| $B_4$ | 23.20 | 41.41 | 14.49 | 4.83 | 1.72 | 45.19 | 0.37 |
| SEm ± | 0.14 | 0.29 | 0.16 | 0.06 | 0.01 | 0.58 | 0.02 |
| C.D. (p=0.05) | 0.30 | 0.61 | 0.33 | 0.13 | 0.03 | 1.19 | 0.04 |
| $M_0$ | 23.07 | 40.48 | 14.97 | 4.41 | 1.64 | 45.84 | 0.36 |
| $M_1$ | 23.26 | 41.09 | 15.17 | 4.49 | 1.67 | 45.21 | 0.38 |
| $M_2$ | 23.50 | 41.57 | 15.55 | 4.65 | 1.70 | 44.31 | 0.42 |
| SEm ± | 0.11 | 0.22 | 0.12 | 0.05 | 0.01 | 0.45 | 0.01 |
| C.D. (p=0.05) | 0.24 | 0.47 | 0.26 | 0.10 | 0.02 | 0.92 | 0.03 |

$B_0$ - control, $B_1$ – $GA_3$ @ 50 ppm, $B_2$ – $GA_3$ @ 100 ppm, $B_3$ – NAA @ 50 @ ppm, $B_4$ - NAA @ 100 ppm, $M_0$ – control, $M_1$ – Boric acid @ 0.1 %, $M_2$ – Boric acid @ 0.2 %

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