



Effect of commercial bio-stimulating organic formulation on cabbage (*Brassica oleracea* L. var. *capitata*)

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ABSTRACT

Cabbage is an essential crop widely distributed and cultivated all around the year in temperate, subtropical as well as tropical regions. The experiment was carried out to analyze the effect of bio-stimulating organic formulation on vegetative parameters and yield attributes of cabbage in Horticulture Farm, Sriniketan from November 2020 to March 2021. Seven treatments were tested in Randomized Block Design with three replications on cabbage cv. Rare Ball (F_1 hybrid). The analysis of variance (ANOVA) revealed that there exists significant variation among different treatments. Maximum stem length was recorded with RDF(NPK @ 60- 30-30 Kg ha⁻¹) + manures @ (5 t ha⁻¹) + 1 foliar spray with Krish-Tee @ (2 ml l⁻¹). Maximum leaf length was registered in RDF(NPK @ 60- 30-30 Kg ha⁻¹) + KR Organic Manure (375 Kg ha⁻¹), which was noted statistically at par with T₆ [RDF (NPK @ 60- 30-30 Kg ha⁻¹) + KR Organic Manure (375 Kg ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹)] Application of RDF (NPK @ 60- 30-30 Kg ha⁻¹) + manures (5 t ha⁻¹) + seed soaking with Krish-Tee + 2 foliar sprays with Krish-Tee (2 ml l⁻¹) encouraged head polar periphery and head equatorial periphery, plant weight and head weight and thus can be suggested to local cabbage growers of Red and Laterite Zone of West Bengal.

Keywords: Cabbage, bio-stimulant, Krish-Tee, organic manure, yield.

Cabbage (*Brassica oleracea* L. var. *capitata*), a popular leafy vegetable and one of the important cole crops falls under family Cruciferae (Brassicaceae). It is a dicotyledonous biennial, although grown as an annual. It contains essential vitamins, minerals and small amount of protein with good caloric value. Globally, India is the second largest producer of cabbage next to China, covering 4% of total area under vegetables in this country. In 2020-21, India's cabbage production was 9567 MT from an area of 415 thousand ha (NHB, 2021).

Plant bio-stimulants derived from natural materials have gained considerable attention from both the scientific community as well as commercial enterprises especially in past twenty-five years (Yakhin *et al.*, 2017). Bio-stimulants necessarily defined as plant botanicals are plant products devoid of any harmful pesticides and nutrients, in the form of specific formulations when applied to plant parts, possess the innate capability to modify or change physiological processes in plants in a manner providing potential benefits to growth, development or stress response (Halpern *et al.*, 2015). Bio-stimulants could be applied in all the stages of agricultural production, as seed treatment, foliar sprays during growth and on harvested products too. Foliar spray of bio-stimulants has been found effective in enhancing enzymatic activities of antioxidants as well

as reducing physiological damage conclusively building stress tolerance in Kimchi cabbage (Lee *et al.*, 2019). In cabbage, bio-stimulants application has been proved to boost photosynthetic pigments (chlorophyll and carotenoids) but a decline is observed in polyphenols content (Godlewska *et al.*, 2019). Information on effectiveness of bio-stimulant on vegetative and yield attributes is lacking in cabbage. Considering the former, present investigation was laid out with the objective to study the effect of bio-stimulating organic formulation on growth and production of cabbage under Red and Laterite Zone of West Bengal.

MATERIALS AND METHODS

Present experiment was conducted at Horticulture Farm, Sriniketan during *rabi* season (2020-21). Cabbage var. Rare Ball (F_1 hybrid) was taken for this study. The experiment was laid out in Randomised Block Design comprising seven treatments [T₁ (RDF + manures @ 5 t ha⁻¹), T₂ (RDF + manures @ 5 t ha⁻¹ + seed soaking with Krish-Tee), T₃ (RDF + manures @ 5 t ha⁻¹ + seed soaking with Krish-Tee + 1 foliar spray with Krish-Tee @ 2 ml l⁻¹), T₄ (RDF + manures @ 5 t ha⁻¹ + 2 foliar sprays with Krish-Tee @ 2 ml l⁻¹), T₅ (RDF + KR Organic Manures [KROM] @ 375 Kg ha⁻¹), T₆ (RDF + KR Organic Manures @ 375 Kg ha⁻¹ + 2 foliar sprays

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with Krish-Tee @ 2 ml l⁻¹), T₇ (RDF (70%) + KR Organic Manures @ 750 Kg ha⁻¹ + 2 foliar sprays with Krish-Tee @ 2 ml l⁻¹) with three replications. Four weeks old nursery grown uniform and healthy seedlings were transplanted on 11th December 2020 at a spacing of 50 cm x 50 cm in main field. A basal dose of manure (Farm Yard Manure) @ 5 t ha⁻¹ or Krishi Rasayan Organic Manure (KROM) (375 or 750 Kg ha⁻¹) and (100 or 70%) NPK @ 120 Kg N ha⁻¹, 60 Kg P₂O₅ ha⁻¹ and 60 Kg K₂O ha⁻¹ application has been done as per treatment. Organic bio-stimulant Krish-Tee (KT) was applied by seed soaking or by 2% foliar spray (once or twice) as per treatment. Sources of NPK nutrients were Urea, SSP and MOP, respectively. Full doses of Phosphorus and Potassium were incorporated at the time of final land preparation and total amount of nitrogen were applied in three instalments with one-third dose application before transplanting while remaining two-third of Nitrogen was applied in two equal splits at thirty and fifty DAT (Days After Transplanting). Regular irrigation was given, along with necessary cultural operations i.e., weeding and crop protection methods were adopted. Ten plants were randomly selected and tagged leaving the border rows for recording observations. Different attributes such as number of leaves per plant, leaf length and width, stem length and periphery, head polar and equatorial periphery, whole plant weight, and head weight has been recorded. The data recorded for various parameters were analysed further for statistical analysis. F test was taken for testing significance (at 5% level of significance) of total variation recorded under different treatment combinations using analysis of variance technique.

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) study revealed significant statistical variation for leaf length, stem length, head polar and equatorial periphery, whole plant weight and head weight for different treatment combinations. However, no significant effect was noted among treatment combinations for number of leaves, leaf width and stem periphery in cabbage (Table 1). The average number of leaves per plant, leaf width and stem periphery were noted 15.3, 26.05 cm and 2.6 cm respectively. Leaf length varied significantly from 26.65 to 29.43 cm with an average of 28.05 cm. RDF (Recommended Dose of Fertilizers) + KROM (375) gave maximum leaf length (29.43 cm), which was noted statistically similar to RDF + KROM (375 Kg ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹) and RDF + manure (5 t ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹). Difference was spotted among varying treatment combinations for

cabbage stem length. Highest stem length (2.90 cm) was recorded with the application of RDF + manure (5 t ha⁻¹) + seed soaking with KT + 1 foliar spray with KT (2 ml l⁻¹), which was noted statistically at par with RDF + manure (5 t ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹). Similar variation has been observed with the application of organic amalgamated with 50% inorganic fertilizers. The experimental result revealed that head polar periphery was significantly influenced by various treatments. Head polar periphery was varied from 46.63 to 50.93 cm, with mean 48.69 cm. Maximum polar periphery was recorded in RDF + manure (5 t ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹) followed by RDF + KR Organic Manure (375 Kg ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹) and RDF + KR Organic Manure (375 Kg ha⁻¹) treatments, which were statistically similar to each other. It was noted that different treatments also influenced the head equatorial periphery of cabbage. Minimum head equatorial periphery was recorded in RDF (70%) + KROM (750 Kg ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹). While maximum equatorial periphery was observed in RDF + Manure (5 t ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹) followed by RDF + KR Organic manure (375 Kg ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹), RDF + manure (5 t ha⁻¹) + seed soaking with KT + 1 foliar spray with KT (2 ml l⁻¹) and RDF + manure (5 t ha⁻¹) + seed soaking with KT treatments.

The whole plant weight and head weight were significantly influenced by different treatment combinations. Average head weight is a non-negotiating yield contributing trait, that directly influences marketability of heads. The whole plant weight was varied from 2.46 to 1.94 kg with mean of 2.20 kg. On the other hand, cabbage head weight was varied from 1.67 to 1.18 kg with mean of 1.44 kg. Maximum whole plant weight was registered with the application of RDF + manure (5 t ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹), closely followed by RDF + manure (5 t ha⁻¹) + seed soaking with KT + 1 foliar spray with KT (2 ml l⁻¹), RDF + KR Organic manure (375 Kg ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹) and RDF + KR Organic manure (375 Kg ha⁻¹) treatments. Similarly, maximum head weight was noted in RDF + manure (5 t ha⁻¹) + 2 foliar sprays with KT (2 ml l⁻¹) and RDF + manure (5 t ha⁻¹) + seed soaking with KT + 1 foliar spray with KT (2 ml l⁻¹) treatments.

A diverse range of bio-stimulants have been identified so far to escalate plant productivity by augmenting growth of plant as a result of supplementing metabolic activities, promoting germination rate, enhancing photosynthesis as well as enforcing nutrient

Table 1: Effect of bio-stimulants on growth parameters of cabbage

Treatments	Number of leaves plant ⁻¹	Leaf length (cm)	Leaf width (cm)	Stem length (cm)	Stem periphery (cm)
T ₁	15.1	26.82	25.53	2.49	2.60
T ₂	15.2	27.95	25.22	2.45	2.74
T ₃	15.7	27.77	25.99	2.90	2.77
T ₄	15.5	28.69	27.22	2.79	2.45
T ₅	14.9	29.43	27.02	2.53	2.60
T ₆	14.7	29.03	25.83	2.58	2.48
T ₇	15.5	26.65	25.53	2.49	2.53
Mean	15.3	28.05	26.05	2.61	2.60
LSD(0.05)	NS	1.47	NS	0.19	NS

(T₁-RDF + manure(5 t ha⁻¹), T₂-RDF + manure (5 t ha⁻¹) + seed soaking with KT, T₃-RDF + manure (5 t ha⁻¹) + seed soaking with KT + 1 foliar spray with KT (2 ml L⁻¹), T₄-RDF + manure (5 t ha⁻¹) + 2 foliar sprays with KT (2 ml L⁻¹), T₅-RDF + KR Organic Manure (375 Kg ha⁻¹), T₆-RDF + KR Organic Manure (375 Kg ha⁻¹) + 2 foliar sprays with KT (2 ml L⁻¹), T₇-RDF (70%) + KROM (750 Kg ha⁻¹) +2 foliar sprays with KT (2 ml L⁻¹))

Table 2: Effect of bio-stimulants on yield parameters of cabbage

Treatments	Head polar periphery (cm)	Head equatorial periphery (cm)	Whole plant weight (kg)	Head weight (kg)
T ₁	47.67	54.27	2.06	1.22
T ₂	48.37	55.13	2.12	1.38
T ₃	46.63	55.37	2.39	1.60
T ₄	50.93	56.40	2.46	1.67
T ₅	49.33	54.57	2.35	1.49
T ₆	50.30	55.53	2.37	1.50
T ₇	47.60	53.17	1.94	1.18
SEm(±)	48.69	54.92	2.20	1.44
LSD(0.05)	1.90	1.50	0.12	0.13

(T₁-RDF + manure (5 t ha⁻¹), T₂-RDF + manure (5 t ha⁻¹) + seed soaking with KT, T₃-RDF + manure (5 t ha⁻¹) + seed soaking with KT + 1 foliar spray with KT (2 ml L⁻¹), T₄-RDF + manure (5 t ha⁻¹) + 2 foliar sprays with KT (2 ml L⁻¹), T₅-RDF + KR Organic Manure (375 Kg ha⁻¹), T₆-RDF + KR Organic Manure (375 Kg ha⁻¹) + 2 foliar sprays with KT (2 ml L⁻¹), T₇-RDF (70%) + KROM (750 Kg ha⁻¹) +2 foliar sprays with KT (2 ml L⁻¹))

absorption from the soil (Yakhin *et al.*, 2017). The plant bio-stimulant significantly improved the length of stem and head size of carnation (Niyokuri *et al.*, 2017). Mahmoud *et al.* (2019) reported that a brown seaweed, commonly known as gulfweed i.e., *Sargassum vulgare* when applied as a foliar spray prior to pre-sowing seed soaking as a natural plant growth stimulant resulted in improved vegetative growth and nutritional quality alongwith increased production in red radish plantings. Sherinlincy *et al.* (2020) recorded highest plant height, leaf length, leaf width, branches per plant, fresh weight of leaves and yield per plant in *Amaranthus* sp. with the application of humic-fulvic acid mixture. Application of seaweed extract was noted best for plant height, leaf

number, leaf area, head diameter, fewest days to 50% head maturity, highest number of secondary heads, and highest per cent of nitrogen and potassium in broccoli (Manea and Abbas, 2018). From the obtained result it was found that application of NPK @ 120-60-60) + manures (5 t ha⁻¹) + seed soaking with Krish-Tee + 1 or 2 foliar sprays with Krish-Tee @ 2 ml L⁻¹ had significant and encouraging effect on leaf and stem length, head polar and equatorial periphery, whole plant weight as well as head weight. Considering these responses, this treatment combination can be suggested to the farmers for commercial cultivation of cabbage under Red and Laterite Zone of West Bengal.

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