

## Studies of Bio-Fertilizers on the Performance of Cabbage (*Brassica oleracea var. Capitata L.*) Cv. Golden GS 455

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### ABSTRACT

The experiment was conducted at the agriculture research farm of Department of Horticulture, Raja Balwant Singh College, Bichpuri, Agra, U.P. (India) during the winter season of 2017-2018 to find out the response of bio-fertilizer viz. *Azotobacter* and *Azospirillum* alongwith NPK on the performance of Cabbage (*brassica oleracea var. capitata L.*) cv. Golden GS 455. The investigation was laid out under Randomized Block Design having 8 treatment combinations T<sub>1</sub>(control), T<sub>2</sub>(100%RDF), T<sub>3</sub> (60% RDF +*Azotobacter*), T<sub>4</sub>(60%RDF +*Azospirillum*), T<sub>5</sub>(80% RDF+ *Azotobacter*), T<sub>6</sub> (80%RDF+*Azospirillum*), T<sub>7</sub> (60%RDF + *Azotobacter* + *Azospirillum* ) and T<sub>8</sub> (80%RDF + *Azotobacter* + *Azospirillum* )which was replicated thrice. According to statistical analysis of various aspects of the study concluded that the treatment combination T<sub>7</sub>(60%RDF + *Azotobacter* + *Azospirillum* ) was found significantly superior to improved the growth, yield and quality of cabbage.

**KEY WORDS:** *Azotobacter*, *Azospirillum*, RDF, Cabbage, Bio-fertilizer.

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### INTRODUCTION

Cabbage (*Brassica oleracea var. CapitataL.*) belongs to the family Brassicaceae, is an herbaceous biennial plant that produces "heads" [3] and it has short stem upon which is crowned with a mass of green leaves [5]. It is commonly known as Band Gobhi or PattaGobhi and varieties of the plant include the red, white and Savoy cabbages. Its heads are used as salad, boiled vegetable and dehydrated vegetable as well as in cooked curries and pickles.

Cabbages are packed with elements which are useful to the human body. It has high medicinal value because of its rich content in vitamins C, E and K as well as its antioxidants components which suppressed cancerous cell growth [9].Cabbage have a variety of health benefits including treatment of constipation, stomach ulcers, headache, excess weight, skin disorders, eczema, jaundice, scurvy, rheumatism, arthritis, gout, eye disorders, heart diseases, ageing, and Alzheimer's disease. [4].

Bio-fertilizers are also living cells of different types of micro-organisms (bacteria-algae and fungi) which are capable of mobilizing nutritive elements from non-usable from. Therefore, the current trend is of organic farming using organic fertilizers like bio-fertilizers of microbial origin with limited use of chemical fertilizers.

*Azotobacter* represents the main group of heterotrophic, non-symbiotic free living nitrogen-fixing bacteria, regarded as Plant Growth Promoting Rhizobacteria(PGPR) synthesize growth substances that greatly enhance plant growth and development and inhibit phytopathogenic growth by secreting inhibitors. There is a great importance of A.

*chroococcum* in plant nutrition and its contribution to soil fertility. It is thus an important component of integrated nutrient management system. [10]. It fixes nearly 20 to 40 kg N ha<sup>-1</sup>.

The genus *Azospirillum* also comprises PGPB, which have been broadly studied. The benefits to plants by inoculation with *Azospirillum* have been primarily attributed to its capacity to fix atmospheric nitrogen, but also to its capacity to synthesize phytohormones, in particular indole-3-acetic acid (Fukami et al. 2018). It is chemo heterotrophic and associative in nature, and has the capacity to fix 20-40 kg N ha<sup>-1</sup>. Application of this bio-fertilizers result in increased mineral and water uptake, root development, vegetative growth and 15 to 30 percent increase in crop yield. It is recommended for vegetable crops and other crops.

Keeping these facts in mind the present experiment was conducted at R.B.S.College, Agricultural Research farm, Bichpuri, Agra during winter season of 2017-2018 to assess the effect of *Azotobacter* and *Azospirillum* on the performance of cabbage.

## METHODS AND MATERIALS

The present experiment was conducted at the agriculture research farm of Department of Horticulture, Raja Balwant Singh College, Bichpuri, Agra during the winter season of 2017-2018. The farm is situated at 27.10 °N latitude and 78.50 °E longitudes at a height of 163.4 m above the mean sea level (MSL). The farm is well equipped with all necessary facilities for cultivation vegetable crops. Research Farm has semi arid, sub tropical climate with extremes of temperature both in winter temperature at 2°C and during summers temperature often goes up to 46 to 48 °C accompanied with hot and desiccating winds. The mean annual precipitation around 670 mm and most of it received during July to September.

The soil of experimental field was gangetic alluvial with calcareous layer at the depth of about 1.5 m to 2.0 meter. It was slightly alkaline in reaction (pH 7.9) and was well drained. To determine the fertility status and other physico-chemical properties of soil of experimental area a composite soil sample from 30 cm depth was taken just before layout and was subjected to mechanical and analysis. On the basis of data obtained from chemical analysis of the soil, it is clear that the soil was sufficient in potash content but low in available nitrogen and organic carbon and medium in available phosphorus content.

The investigation was laid out under Randomized Block Design having 8 treatment combinations T<sub>1</sub>(control), T<sub>2</sub>(100%RDF), T<sub>3</sub> (60% RDF + *Azotobacter*), T<sub>4</sub>(60%RDF + *Azospirillum*), T<sub>5</sub>(80% RDF+ *Azotobacter*), T<sub>6</sub> (80%RDF+*Azospirillum*), T<sub>7</sub> (60%RDF + *Azotobacter* + *Azospirillum* ) and T<sub>8</sub> (80%RDF + *Azotobacter* + *Azospirillum* ) which was replicated thrice. The seeds of cabbage cv. Golden GS-455 variety were obtained from National Seeds Corporation, Agra. The seeds were sown in nursery bed at the rate of 50 g bed<sup>-1</sup> on 12<sup>th</sup> September, 2017 and covered with a thin layer of well decomposed leaf mould. Irrigation, weeding and other agronomic practices were applied whenever required till the seedlings were ready for transplanting. The bio-fertilizers *Azotobacter* and *Azospirillum* were applied before planting as per treatments each at the rate of 2.4 kg ha<sup>-1</sup> and NPK were applied at the rate of 180 kg, 50 kg and 50 kg ha<sup>-1</sup> respectively. The seedlings of about 33 days in age were lifted carefully and planted healthy vigorous seedlings, in well prepared field at the distance of 45X30 cm in the evening hours followed by light irrigation.

## RESULTS AND DISCUSSION

The results of various observations recorded during experiment were statistically analyzed in order to find out the significance of different treatments. The recorded data regarding growth, yield and quality were presented in Table-1, 2 and graphically represented in Fig. 1, 2 and 3. It is evident from Table-1 that different treatment combinations showed significant effect on different vegetative observations except length of longest leaves (cm) of cabbage.

The significantly maximum height of cabbage (31.59cm) was observed under T<sub>7</sub>(60% RDF + *Azospirillum* + *Azotobacter*) followed by T<sub>8</sub>(30.99cm) and T<sub>2</sub>(30.32cm). The significantly maximum number of fully opened leaves per plant (15.96) were found with T<sub>7</sub>(60%RDF + *Azospirillum* + *Azotobacter*) closely followed by T<sub>2</sub>(15.95) and T<sub>5</sub>(15.90) which were found at par to each other. The maximum width of longest leaves (15.97cm.) and maximum diameter of stem(1.36cm) were measured with T<sub>7</sub>(60% RDF + *Azospirillum* + *Azotobacter*). The non

significant response was found in the length of longest leaves, where maximum length of longest leaf (21.90 cm) was measured in T<sub>7</sub> (60% RDF + *Azospirillum* + *Azotobacter*). The findings are in consonance with the earlier results of Akbar *et al.* [1], Kumar *et al.* [7] and Yadav *et al.* [11].

The examination of data presented in Table-2 showed that all the treatments have significant effect on diameter of head in two directions, fresh weight of whole plant, fresh weight of trimmed head, fresh weight of fully open leaves, fresh weight of stem, dry matter in chopped leaves as compared to control.

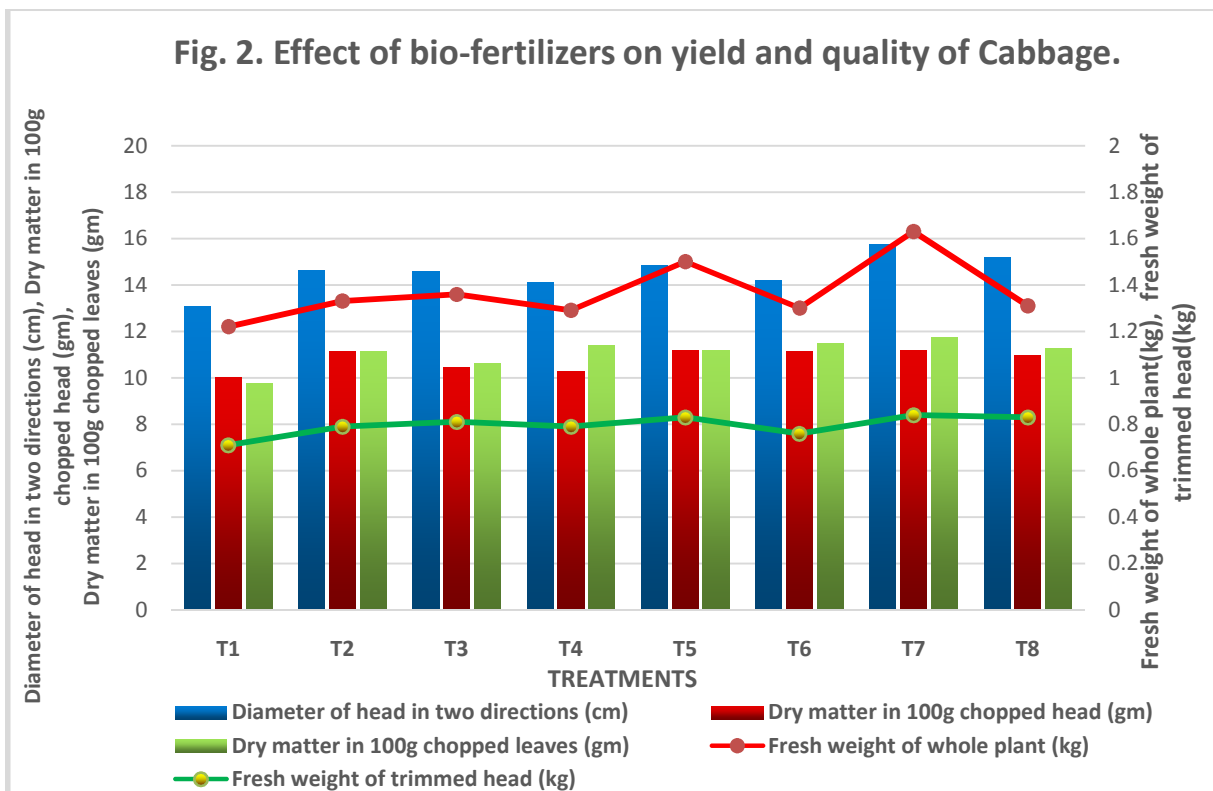
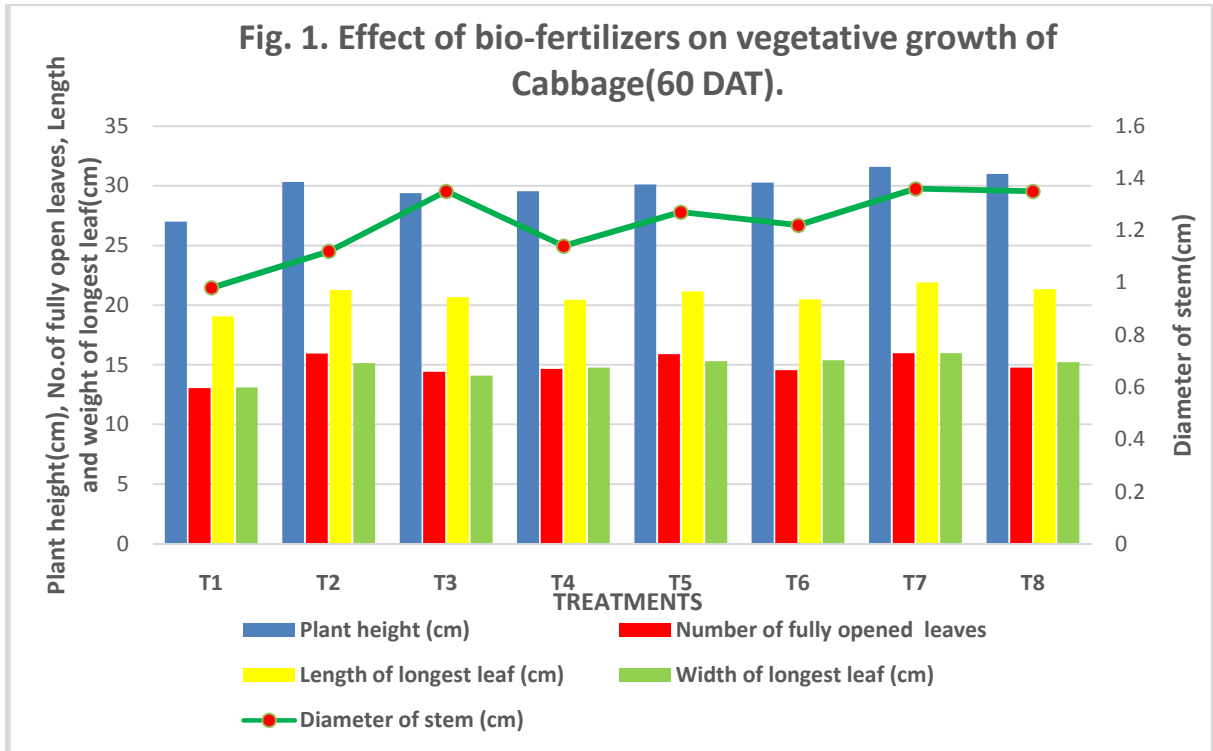
The significantly maximum yield of total cabbage plant (652.40 q ha<sup>-1</sup>) was noted with T<sub>7</sub> (60% RDF + *Azospirillum* + *Azotobacter*) followed by T<sub>5</sub> and T<sub>8</sub>. The increase in the yield with the treatment T<sub>7</sub>, T<sub>5</sub> and T<sub>8</sub> were to the tune of 49.38 %, 43.80% and 34.34% when compared with T<sub>1</sub> (control). The significantly maximum fresh weight of total cabbage plant (1.63 kg) was noted with T<sub>7</sub> (60% RDF + *Azospirillum* + *Azotobacter*) followed by T<sub>5</sub>. The significantly maximum fresh weight of trimmed head (0.84 kg), maximum fresh weight of leaves (485.76 gm), maximum fresh weight of stem (76.44 gm) were noted with T<sub>7</sub> (60% RDF + *Azospirillum* + *Azotobacter*) followed by T<sub>8</sub> (80% RDF + *Azospirillum* + *Azotobacter*) and T<sub>5</sub> (80% RDF + *Azotobacter*). The treatment T<sub>7</sub> (60% RDF + *Azospirillum* + *Azotobacter*) produce plants of cabbage with maximum diameter of head (15.76 cm) in two directions closely followed by T<sub>8</sub> and T<sub>5</sub>. The significantly maximum dry matter in 100 gm chopped leaves (11.76 gm) was obtained under T<sub>7</sub> (60% RDF + *Azospirillum* + *Azotobacter*). The non significant response was found in the dry matter in chopped head where maximum dry matter in 100 gm chopped head (11.20 gm) was measured in T<sub>7</sub> (60% RDF + *Azospirillum* + *Azotobacter*) and minimum (10.03 gm) was found in control (T<sub>8</sub>). It may be due to balance application of NPK and bio-fertilizer which makes the availability of almost all the major nutrients in available form and improve the physio-chemical properties of soil. The findings are in consonance with the earlier results of Khare and Singh [8] and Mankar *et al.* [6].

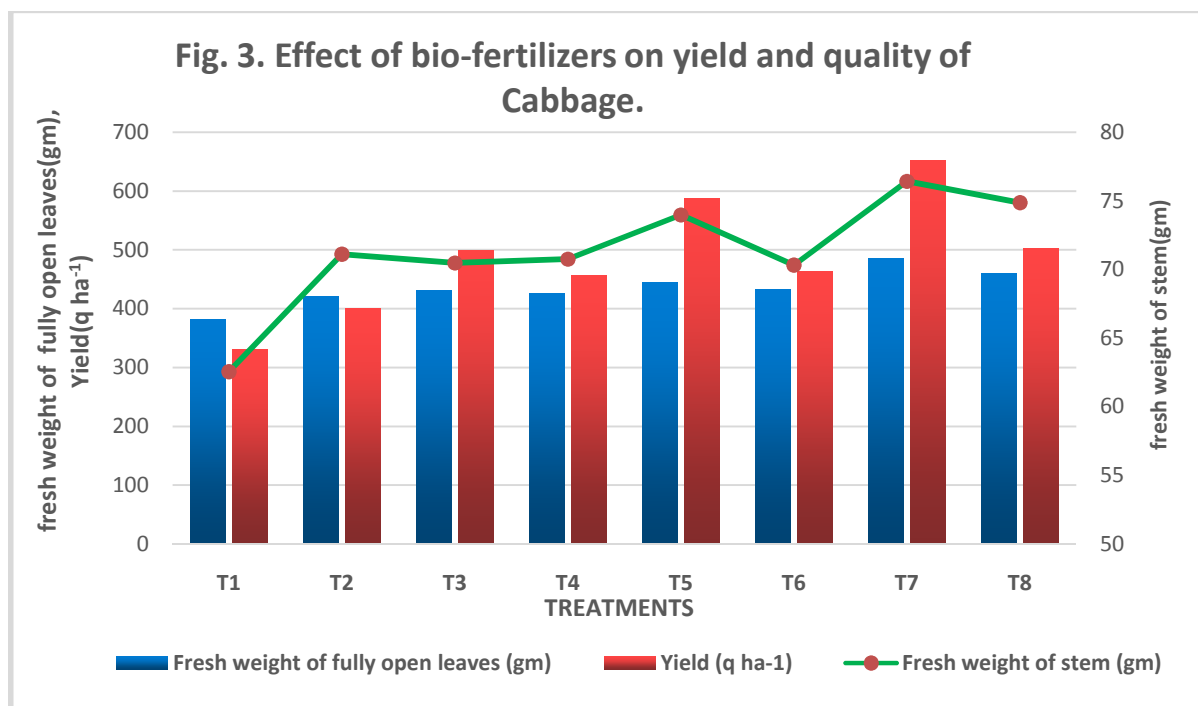
**Table No. 1:- Effect of bio-fertilizers on vegetative growth of Cabbage (60 DAT).**

Treatment	Plant height (cm)	Number of fully opened leaves	Diameter of stem (cm)	Length of longest leaf (cm)	Width of longest leaf (cm)
T <sub>1</sub>	27.00	13.05	0.98	19.05	13.11
T <sub>2</sub>	30.32	15.95	1.12	21.25	15.14
T <sub>3</sub>	29.38	14.41	1.35	20.67	14.08
T <sub>4</sub>	29.56	14.66	1.14	20.45	14.77
T <sub>5</sub>	30.11	15.90	1.27	21.15	15.29
T <sub>6</sub>	30.27	14.55	1.22	20.48	15.39
T <sub>7</sub>	31.59	15.96	1.36	21.90	15.97
T <sub>8</sub>	30.99	14.76	1.35	21.33	15.21
CD ('t' 5%)	2.335	1.802	0.194	NS	1.595

**Table No. 2:- Effect of bio-fertilizers on yield and quality of Cabbage.**

Treatment	Diameter of head in two directions (cm)	Fresh weight of whole plant (kg)	Fresh weight of trimmed head (kg)	Fresh weight of fully open leaves (gm)	Fresh weight of stem (gm)	Dry matter in 100g chopped head (gm)	Dry matter in 100g chopped leaves (gm)	Yield (q ha <sup>-1</sup> )
T <sub>1</sub>	13.08	1.22	0.71	381.33	62.55	10.03	9.78	330.47
T <sub>2</sub>	14.62	1.33	0.79	421.33	71.11	11.13	11.12	399.89
T <sub>3</sub>	14.59	1.36	0.81	431.33	70.49	10.46	10.63	499.34
T <sub>4</sub>	14.11	1.29	0.79	426.00	70.77	10.30	11.40	456.32
T <sub>5</sub>	14.83	1.50	0.83	444.66	73.99	11.18	11.18	588.11
T <sub>6</sub>	14.18	1.30	0.76	433.33	70.31	11.13	11.47	462.96
T <sub>7</sub>	15.76	1.63	0.84	485.76	76.44	11.20	11.76	652.40
T <sub>8</sub>	15.18	1.31	0.83	461.00	74.86	10.96	11.27	503.37
CD('t'5)	1.326	0.204	0.073	55.220	6.82	NS	1.072	99.033





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