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Influence of bioenzymes on yield and quality parameters of cabbage (*Brassica oleracea* var. *capitata* L.) var. golden acre

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Abstract
The experiment was conducted during 2007-2008, on the experimental field of Horticulture Research Scheme (Vegetable), V.N. M. K.V., Parbhani. The experiment was laid out in randomized block design with ten treatments and three replications, on Cabbage var. Golden acre. The result revealed that, the control treatment (water spray) against all other treatments not performs well in increasing yield and quality of cabbage var. golden acre. Among the various concentrations of bioenzymes sprayed at different intervals and recorded observations at regular intervals of 15, 30, 45, and 60 days after transplanting. The treatment T_6 (Synzyme 3ml. /l) spray of bioenzyme performed well in overall characters of yield and quality parameters over other treatments.

Keywords: bioenzymes, synzyme, cabbage, rbd, biozyme, golden acre, zymegold

1. Introduction
Vegetables are high yielding and provide nutritional security, employment, cash, and more foreign exchange. India is the second largest producer (next to china) of vegetable in year 2002-2003 area 5.9 million hectares and production 84.8 million tones, in year 2003-04 area 6.7 million hectares and production 101.4 million tons in 2004-05 area 7.1 million hectares and production 108.2 million tones and in year 2005-06 7.2 million hectares area and production 113.5 million tones. During the year 2006-07 vegetables have 108.00 million tones production (Anonymous 2008) [2]. Per capita consumption has also increased from 95 g to 175 g per day as against 280 g, recommended dietary requirement per day.

In Maharashtra area under vegetable 4.05 lakh hectares with production of 47.69 lakh tone with productivity of 11.8 tone /hectares (Anonymous 2007) [1] With improved varieties and hybrids, improved production technologies, better infrastructure, ensured genuine seed production, supply policy and participation of all entrepreneurs, India is poised achieve a revolution in vegetable production to fulfill the largest of 220 million tones by7 the end of 2020 AD (Som Dutt, 2001) [6].

Among different vegetables cabbage (*Brassica oleracea var. capitata*) is one of the most important winter vegetable among the Cole crops which belongs to the genus Brassica of the family, Cruciferae, Cabbage is essentiality a cold weathers hardy crop and thrives best in cool and moist climate. Cabbage having cross pollination system.

The group Cole crops is said to be derived from the wild cabbage Cole warts Coastal region of England, Southern and Western Europe are native place. Cabbage was introduced in our country much earlier than cauliflower. Though exact date of introduction is not available but it was reported to be grown during Mughal period. It appears to have been introduced by Portuguese through the crop became popular during British rule.

This was originated from Cyprus and the first crop of cabbage was introduced in India in 6th century A.D and India occupies third position in cabbage production of world. In India area 3.34 lakh hectares with annual production of 53.92 lakh tones and productivity of 23.1 t/ha.

Area under cabbage in Maharashtra for the year 2004 is estimated around 13.125 (thousand hectare) with production of 328.13 (thousand tones) with productivity of 25 tons /hectare (Anonymous 2007) [1] Cabbage is the fifth most important vegetable crop of the country primarily grown in winter season. In India among vegetable cabbage having an area of 0.28 million hectares with production of 4.80 million tons during the year 2002-03.

Cabbage grown for its thickened main bud called head. It contains adequate quantity of vitamins like A, B, C and minerals like phosphorus potassium calcium sodium iron It is used as salad boiled vegetables cooked in curried, pickles as well as dehydrated vegetables.

During the last two or three decades there is rapid increase in the population which increased the heavy demand for vegetable production, Efforts have been made to increase the vegetable production by developing large number of high yielding quality and disease resistant varieties and hybrids and production and protection technologies. However there is need to achieve over target to meet the requirements of 1 billion Population reached by 2000 A.D. All these are tried and there appears to be limit in application of these technologies for increasing yield. Moreover excessive use of fertilizers reduces quality of crop and now a day people are demanding fruit and vegetables. Without the use of pesticides or in other words vegetables produced with use of organic manures and biopesticides.

Plant growth regulators play an important role in modifying various parameters in horticultural crops. Recently bio enzymes are extensively which are the products containing enzymes Auxins and hydrolyzed proteins.

In recent years bioenzyme a commercial product obtained from *Asephyllum modosum*, a seaweed algae known to rich in cytokinin and auxin precursors. Wide range of trace elements (B, M_O, Fe, Zn, Cu, Mn and Cl). Enzymes and hydrolyzed proteins foliar spray of bio enzymes at 1 to 4 ml/lit. of water have enhanced vegetative growth and fruits per plant with good quality. Thus Bioenzymes is a new tool to increase yield of vegetables (More, 2000) [3].

There are different bioenzymes reported to promote the vegetative growth increase the yield per plant and affect the quality of produce in different crops. Maxitalol and Vipul increased growth flowering and yield of okra (Pandita *et al.* 1991) [4]. In this context use of bioenzymes, which does not have any residual effect appears to be most important new tool in increasing the yield of vegetables (Rana and Vasishtha, 1985: More 2000) [3].

2. Materials and Method

The experiment was laid out in Randomized Block Design with ten treatments and three replication at Horticulture Research Scheme (Vegetables), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during 2007-2008, treatment details given in following Table.

Treatment details

S. No	Treatment No.	Treatments
1	T_1	1ml/lit Biozyme
2	T_2	2ml/lit Biozyme
3	T_3	3ml/lit Biozyme
4	T_4	1ml/lit Synzyme
5	T_5	2ml/lit Synzyme
6	T_6	3ml/lit Synzyme
7	T_7	1ml/lit Zymegold
8	T_8	2ml/lit Zymegold
9	T_9	3ml/lit Zymegold
10	T_{10}	Water sprays (control)

3. Results and Discussion

3.1 Yield

3.1.1 Weight of head (g)

Data presented in Table 1, revealed that there were significant differences in respect of mean weight of head in different levels of bioenzymes. The treatments T_6 were found (1670.00g) highest weight of head which statistically superior over all rest of the treatments. Followed by treatments T_6 synzyme 3ml/lit. Maximum weight of head found in T_9 (1608.00g) and T_3 (1496.00g). The lowest weight of head observed inT10 control (986.00g).

Table 1: Effect of bioenzymes on mean weight of head (g).

Tr. No	Treatments	Head diameter(cm)
T_1	1ml/lit Biozyme	1183
T_2	2ml/lit Biozyme	1291
T_3	3ml/lit Biozyme	1496
T_4	1ml/lit Synzyme	1193
T_5	2ml/lit Synzyme	1422
T_6	3ml/lit Synzyme	1670
T_7	1ml/lit zymegold	1191
T_8	2ml/lit zymegold	1359
T_9	3ml/lit zymegold	1608
T_{10}	Water sprays(control)	986
	S.E.+	20.21
	CD at 5%	58.04

3.1.2 Yield per plot (kg)

Perusal of data presented in Table 2 revealed that, yield per plot (kg) in different Bioenzymes. Maximum yield per plot were found in T_6 synzyme 3ml/lit. (15.03kg) followed by treatments T_3, T_5, T_8 and which were statistically at par with the treatments T_6. Whereas the minimum yield per plot was observed in treatment T_{10} control (8.54kg).

Table 2: Effect of bioenzymes on mean yield of head per plot (kg)

Tr. No.	Treatments	Head diameter(cm)
T_1	1ml/lit Biozyme	10.64
T_2	2ml/lit Biozyme	11.61
T_3	3ml/lit Biozyme	13.46
T_4	1ml/lit Synzyme	10.73
T_5	2ml/lit Synzyme	12.79
T_6	3ml/lit Synzyme	15.03
T_7	1ml/lit zymegold	10.71
T_8	2ml/lit zymegold	12.23
T_9	3ml/lit zymegold	14.47
T_{10}	Water sprays(control)	8.54
	S.E.+	1.03
	CD at 5%	3.08

3.1.3 Yield per hectare (q)

Significant differences in respect of total yield per hectare were observed in different bioenzymes as evident from the data presented in table 3.

Maximum yield per hectare was found in treatments T_6 (463.52q/ha) which is statistically over all other treatments followed by T_6 maximum yield per hectare found in treatments T_9 and T_3 respectively. The treatments T_4 (331.65q/ha) was statistically at par with treatments T_7 (330.65q/ha). The lowest yield per hectare was observed in treatment T_{10} (272.01q/ha).

Table 3: Effect of bioenzymes on yield per hectare (q).

Tr. No	Treatments	Head diameter(cm)
T_1	1ml/lit Biozyme	382.12
T_2	2ml/lit Biozyme	357.34
T_3	3ml/lit Biozyme	415.25
T_4	1ml/lit Synzyme	331.65
T_5	2ml/lit Synzyme	393.32
T_6	3ml/lit Synzyme	463.52
T_7	1ml/lit zymegold	330.65
T_8	2ml/lit zymegold	377.37
T_9	3ml/lit zymegold	446.66
T_{10}	Water sprays(control)	272.01
	S.E.+	1.29
	CD at 5%	3.85

3.2 Quality

3.2.1 Staying capacity of head (days).

The data presented in table 4 revealed that, the significant differences in respect of staying capacity in field conditions was observed due to application of bioenzymes. The treatment T_6 showed highest staying capacity (10.67 days) followed by T_9 (10.00days) and T_3(9.67days) treatment T6 was found statistically superior over T_3 and T_9 which were statistically at par with treatment T_6. Treatment T_7 (9.33) found statistically at par with treatments T_1, T_2, T_4, T_5. Treatments T_7 showed lowest staying capacity (7.67) of head except T_{10} (6.33) which was lowest among all treatments.

Table 4: Effect of bioenzymes on mean staying capacity of head

Tr. No	Treatments	Head diameter(cm)
T_1	1ml/lit Biozyme	8.67
T_2	2ml/lit Biozyme	8.00
T_3	3ml/lit Biozyme	9.67
T_4	1ml/lit Synzyme	9.00
T_5	2ml/lit Synzyme	8.67
T_6	3ml/lit Synzyme	10.67
T_7	1ml/lit zymegold	7.67
T_8	2ml/lit zymegold	9.33
T_9	3ml/lit zymegold	10.00
T_{10}	Water sprays(control)	6.33
	S.E.+	0.38
	CD at 5%	1.14

3.2.2 Keeping quality of head (days)

Keeping quality of head was judged under different treatments after harvesting. The data were statistically analyzed and same are reported in table no.5. Maximum keeping quality of heads was found in treatments T_6 (11.33) and followed by T_9 (12.33) next treatments T_3 and T_7 (11.330 were recorded equal days for keeping quality of head. Whereas treatments T_{10} (control) showed lowest (8.33) keeping quality of head.

Table 5: Effect of bioenzymes on mean keeping quality of head.

Tr. No	Treatments	Head diameter(cm)
T_1	1ml/lit Biozyme	10.67
T_2	2ml/lit Biozyme	10.33
T_3	3ml/lit Biozyme	11.33
T_4	1ml/lit Synzyme	10.33
T_5	2ml/lit Synzyme	11.00
T_6	3ml/lit Synzyme	12.67
T_7	1ml/lit zymegold	11.33
T_8	2ml/lit zymegold	10.67
T_9	3ml/lit zymegold	12.33
T_{10}	Water sprays(control)	8.33
	S.E.+	0.52
	CD at 5%	1.54

3.2.3 TSS content

Significant differences were observed in respect of mean total soluble solid content amongst different level of combination of bioenzymes spray as can be seen from the days after transplanting presented in table no. 6. Maximum TSS (5.9 ^{O}B) was observed in T_6 (synzyme 3ml/lit) which was statistically superior over all other treatments except T_3, T_5 and T_9 which were statistically at par with the treatments T_6 (synzyme 3ml/lit.) Treatment T_4 were found statistically at par with the treatments T_1, T_2, T_7 and T_8 respectively. Significantly minimum TSS (4.47B) was recorded in treatment T_{10} (control).

Table 6: Effect of bioenzymes on mean total soluble solids contents

Tr. No	Treatments	Head diameter(cm)
T_1	1ml/lit Biozyme	5.00
T_2	2ml/lit Biozyme	5.20
T_3	3ml/lit Biozyme	5.70
T_4	1ml/lit Synzyme	5.33
T_5	2ml/lit Synzyme	5.40
T_6	3ml/lit Synzyme	5.90
T_7	1ml/lit zymegold	5.10
T_8	2ml/lit zymegold	5.30
T_9	3ml/lit zymegold	5.80
T_{10}	Water sprays(control)	4.17
	S.E.+	0.17
	CD at 5%	0.53

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