

# **YIELD AND QUALITY OF VEGETABLE AS AFFECTED BY EFFECTIVE MICROORGANISMS**

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## **Abstract.**

According to treatment of EM and EM-fermented compost in greenhouse, the yields of spinach and costmary were increased by 10.4 – 24.8 % and 19.4 - 32.9 %. And the yields of Chinese cabbage and radish in field in Autumn were increased to 23.5 - 57.9 % 38.8 - 47.2 %, respectively. Improvement of taste and nutrient value by increasing of vitamins, sugar, protein and amino acid was found with Elf treatment in vegetable crops.

## **Introduction**

Various effective microorganisms and physiological active substances are contained in EM. Therefore, it must be effective to improvement of the quality and productivity of soil and to increase the vegetable production (Higa, 1991).

In general, the vegetable crops require much nutrients for short period of cultivation. It seems that EM is a good supply source of nutrients in vegetable crops, because EM can make a favourable condition for the growth of crops, promoting the mobilization of non-soluble and activating the beneficial microorganisms in soil (Higa, 1991).

Effect of EM on the yield and quality of some vegetable crops were investigated in this paper.

## **Material and Methods**

These experiment were conducted at Institute of Agrobiolgy, Pyongyang DPRK.

Experiment in greenhouse : spinach (variety :<Dungunip>) were seeded on Dec.5, 1994 and harvested on March 1, 1995. Costmary (variety:<Chobunip>) were seeded on Dec,13, 1994. and harvested on Feb. 22, 1995.

Chemical fertilizers (N-P-K) were applied at a dose of 8-10-4 kg per 10 are in all plots. Farmyard manure was applied at 2000 kg per 10 are for the plot C. EM stock solution was diluted 1:1000 with water and applied three times during the growth period at a dose of 2,000 liters per 10 are for the plot T<sub>1</sub>. EM-fermented compost at 100 kg per 10 are for the plot T<sub>2</sub>. The plot area was 10m<sup>2</sup>. Each of the three treatments was replicated 4 times.

Vitamin, saccharide, protein and amino acid were determined to decide the improvement degree of quality of spinach and tomato.

Experiment in Autumn vegetables: Chinese cabbage seeds were immersed in EM stock

solution (diluted 1:1000) for 30 minutes and seeded in nutrient jar nursery after drying in the shade. They were treated one time with EM (diluted 1:1000) during the growth period of seedlings, After transplanting, the amounts and method of treatment of farm yard manure for the plot C, EM for the plot T<sub>1</sub> and EM-fermented compost for the plot T<sub>2</sub> were the same as for the greenhouse vegetables.

Chemical fertilizers (N – P - K) were applied at a dose of 4 – 5 - 2 kg per 10 are in all plots. The plot area was 10 m<sup>2</sup>. Each of three treatment was replicated 4 times; the variety of the Chinese cabbage was Pyongyaner-88 and Punjap-77.

In case of radish, the amount and method of treatment of farm yard manure. EM and EM-fermented compost were the same as for the greenhouse vegetables, too. But chemical fertilizers (N-P-K) were applied at a dose of 8 – 10 – 4 kg per 10 are in all plots. The plot area was 10m<sup>2</sup>. Each of three treatment was replicated 4 times; the variety of radish Chongsu-1.

## Results and Discuss ion

1. Effect of EM and EM3-fermented compost on growth and yield of spinach and costmary in greenhouse.

High temperature and sufficient moisture in greenhouse is a favorable situation for the multiplication of microorganisms. The growth and yield of spinach and costmary we re remarkably increased by the treatments of EM-fermented compost (Table 1 and Table 2)

**Table 1. Effect of Treatment of EM and EM-fermented Compost on Growth and Yield of Spinach.**

Treatment	Plant Height (cm)	Leaf (No./plant)	Yield (kg/ha)	Yield Increase (kg/ha)	Yield Index (%)
C	27.5	9.7	18,000	-	100.0
T <sub>1</sub>	35.5	10.9	20,952	2,952	116.4
T <sub>2</sub>	38.5	12.9	22,464	4,464	124.8

\*LSD 0.05 = 2,850kg 1995

Variety: Dungunip.

Treatments included : C, chemical fertilizer (N–P-K). 8-10-4 kg per 10 are plus farm yard manure, 100kg per 10 ares: T<sub>1</sub>, C plus EM (diluted 1:1000), 2000 L per 10 are three times: T<sub>2</sub>, T<sub>1</sub> plus EM-fermented compost 100 kg per 10 are.

**Table 2. Effect of EM-fermented Compost on Growth and Yield of Costmary**

Treatment	Plant Height (cm)	Leaf (No./plant)	Yield (kg/ha)	Yield Increase (kg/ha)	Yield Index (%)
C	45.4	17.6	19,400	-	100.0
T <sub>1</sub>	49.6	18.5	23,164	3,764	119.4
T <sub>2</sub>	51.4	19.5	25,783	6,383	132.9

\*LSD 0.05 = 3,750kg 1995

Variety : Chobunip

Application of chemical fertilizer, EM and EM-fermented compost are the same as Table 1.

As shown in Table 1 and Table 2, the yields of spinach and costmary were increased by 16.4 to 24.8 % and 19.4 to 32.9 %. respectively.

Because of high content of hums and continuous accumulation of salts. there is a strong tendency of yield decrease and insect increase year after year in greenhouse soil. However, EM: affected to the growth and yield of vegetables in greenhouse to the growth and yield of vegetables in greenhouse. It is appeared that. if the leaf vegetable is sprayed with El. the physiologically active substance is absorbed through stoma so to promote growth and comes to have a strong resistance to the disease so to contribute to the yield growth after all.

2. Effect of EM and EM-fermented Compost on Growth and Yield of Autumn vegetables. These experiments compared the effect of EM and EM-fermented compost on growth and yield of Chines cabbage and radish under field condition with the application of chemical fertilizer. Chinese cabbage and radish are planted in August every year in our country. These are the most important materials for <Kiuchi>. pickles. <Cimchi> is one of the main subsidiary food for our Korean people. Chinese cabbage were seeded in the nutrient jar made of humus soil and transplanted to the field. So they grow well. In addition, their growth is better by treatment of EM-fermented compost. The growth and yield of Chinese cabbage were remarkably increased by treatments with EM and EM-fermented compost of seed, seedling and field (Table 3).

**Table 3. Effect of Elf and EH-fermented Compost in Growth and Yield of Chinese Cabbage.**

Treatment	Plant Height (cm)	Growth of Head (cm)	Yield (t/ha)	Yield Increase (t/ha)	Yield Index (%)
C	40.6	24.5	85.60	-	100.0
T <sub>1</sub>	41.2	24.9	105.72	20.12	123.5
T <sub>2</sub>	42.6	25.4	135.16	49.56	157.9

Variety: Pumjap-77, Sowing: Aug 10, Harvesting: Nov 5, 1995

\*LSD 0.05 = 19,300 kg

Treatments included: C, chemical fertilizer plus farmyard manure; T<sub>1</sub> Plus EM sprayed three different times during the growth period; T<sub>2</sub>, plus EM- fermented compost.

As shown in Table 3, the yield of Chinese cabbage were increased by 23.5 to 57.9% with the treatments of EM and EM-fermentation compost compare to the control. The treatment frequency of EM effected the yield of Chinese cabbage (Table 4).

**Table 4. Effect of treatment frequency of EM on yield of Chinese cabbage**

Treatment	Yield (t/ha)	Yield Increase (t/ha)	Yield Index (%)
C	133.43	-	100.0
T <sub>1</sub>	135.48	2.06	101.5
T <sub>2</sub>	140.89	7.48	105.6
T <sub>3</sub>	151.45	18.03	113.5

Variety: Pyongyang - 8, Sowing: Aug.5, Harvesting: Nov.5,1995

\* LSD 0.05 = 7,350kg

Treatments included: C, chemical fertilizer(N-P-K) , 40- kg per ha plus farmyard manure 20t, per ha: T<sub>1</sub>, C plus EM (diluted 1:1000) 20,000 liters per ha two times during the growth period; T<sub>2</sub>, C plus EM (diluted 1: 1000) 20,000 L per ha three times; T<sub>3</sub>, C plus EM (diluted 1:1000) 20,000 L per ha five times. In case of Elf treatment without EM-fermented compost the numbers of EM treatment frequencies must be more than three times to increase the yield of cabbage. It seems that the microflora of beneficial microorganisms depends on the EM treatment (Higa, 1991).

On the other hand, the effect of EM treatment was related to the dressing levels of chemical fertilizer. The more the dressing amounts of chemical fertilizer is, the smaller the effect of EM treatment becomes. (Table 5).

**Table 5. Effect of EM on yield of Chinese cabbage according to the levels of chemical fertilizer.**

Treatment	Yield (t/ha)	Yield Increase (t/ha)	Yield Index (%)
C	133.43	-	100.0
T <sub>1</sub>	151.45	18.02	113.5
C <sub>2</sub>	140.88	-	100.0
T <sub>2</sub>	145.25	4.37	103.1
C <sub>3</sub>	146.00	-	100.0
T <sub>3</sub>	146.50	0.50	100.3

Variety: Pyongyang - 8, Sowing: Aug.5, Harvesting: Nov.5,1995

\*LSD 0.05 = 16,530 kg

The growth and yield of radish are closely related to the soil microflora because it is one kind of root vegetables. The yield of radish was remarkably increased by the treatments of EM and EM-fermented compost.

**Table 6. Effect of EM and EM-fermented compost on yield of radish.**

Treatment	Yield (t/ha)	Yield Increase (t/ha)	Yield Index (%)
C	58.60	-	100.0
T <sub>1</sub>	81.34	22.74	138.8
T <sub>2</sub>	86.26	27.66	147.2

Variety: Chongsu-1, Sowing: Aug.3, Harvesting :Oct, 25, 1995

\*LSD 005=19.620 kg.

Treatments included: C, chemical fertilizer (N-P-K, 80 kg per ha plus farmyard manure 20 ton per ha; T<sub>1</sub>, C plus EM (diluted 1:1000) 20,000 liters per ha three times during the growth period; T<sub>2</sub>, T<sub>1</sub> plus EM-fermented compost 20 ton per ha.

### 3. Effect of EM on Quality of Vegetables

The quality as well as the yield of vegetables were increased by EM treatment.

**Table 7. Effect of EM on Vitamin Content of Spinach (mg/100g -sample)**

Treatment	Vitamin B	Vitamin C
C	0.68	381.0
T	1.85	477.5

Variety: Dungunip. 1995

**Table 8. Effect of EM on Quality of Tomato (g/kg -sample)**

Treatment	Saccharide	Protein	Amino acid
C	13.9	21.6	12.0
T <sub>3</sub>	16.2	22.6	15.3

### Conclusion

In this experiment. the effect of EM-fermented compost was tested on the condition that applied the chemical fertilizer at the control and treatment. It is considered that the period of EM applied is short and the fertility of our country's vegetable field is low relatively.

However, since 1996, the effect of EM is tested while decreasing the dressing level of chemical fertilizer to below 50 %, so to have a good tendency. Therefore, we are going to study more about the method to increase the effect of EM from now on.

### Reference

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