

## **Effect of Biocapsule and Nano micronutrients on Growth, Quality and Yield of Lettuce (*Lactuca sativa*).**

### **Abstract :**

The present experiment was carried out during 2021-22 in Central Horticulture Research Farm of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in Randomized Block Design with 10 treatment replicated thrice. The treatments were T<sub>0</sub> (Control), T<sub>1</sub> (NPK (RDF) 15:5:20), T<sub>2</sub> (Biocapsule 500ppm (Soil drenching)), T<sub>3</sub> (NPK (RDF) 15:5:20 + Biocapsule 500ppm (Soil drenching)), T<sub>4</sub> (NPK (RDF) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)), T<sub>5</sub> (Biocapsule 500ppm (Soil drenching) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)), T<sub>6</sub> (NPK (RDF) 15:5:20 + Biocapsule 500ppm (Soil drenching) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)), T<sub>7</sub> (NPK (RDF) 15:5:20 + Biocapsule 250ppm (Soil drenching)), T<sub>8</sub> (Biocapsule 250ppm (Soil drenching) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)), T<sub>9</sub> (NPK (RDF) 15:5:20 + Biocapsule 250ppm (Soil drenching) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)). From our experiment it was concluded that the treatment T<sub>5</sub> (Biocapsule 500ppm (Soil drenching) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)) was found to be best in the terms of germination percentage, vegetative growth, yield parameters, quality parameters and economics with B:C ratio 2.67.

**Keywords:** Biocapsule, Zinc, Iron, Growth, Development.

## Introduction

Lettuce (*Lactuca sativa*) is an annual plant of the daisy family, Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches and wraps; it can also be grilled. One variety, the celtuce (*asparagus lettuce*), is grown for its stems, which are eaten either raw or cooked. In addition to its main use as a leafy green, it has also gathered religious and medicinal significance over centuries of human consumption.

Lettuce was originally farmed by the ancient Egyptians, who transformed it from a plant whose seeds were used to obtain oil into an important food crop raised for its succulent leaves and oil-rich seeds. In world, lettuce and chicory is cultivated over an area of 1.27 million hectare with the production of 27.25 million tonnes. In India, production of lettuce and chicory is around 1.22 million tonnes over an area of 0.19 million hectare (FAO, 2018).

Lettuce is a rich source of vitamin K and vitamin A, and a moderate source of folate and iron. In India, it is gaining popularity with the change in food habit and health

increasing consciousness among the people .

There is an increasing demand by consumers for safe and nutritious foods that improves the physical performance, reduces the risk of diseases and increases the life span (Ogden *et al.*, 2007).The nutritional content varies with the degree of leaf colour, green outer leaves having more nutritional value than whitish inner leaves. The regular intake of lettuce helps in lowering cholesterol level, thereby avoiding cardiovascular diseases. Extracts from *Lactuca virosa* are used sleep inducers and cough suppressants in Europe (Ryder, 1929).

It is a native of Europe and Asia and introduced in India by the Britishers. Lettuce is an annual and belongs to family composite. The leaves and heads are used as salad. There are about 150 varieties of Lettuce.

**Role of Biocapsule:** Recently, ICAR (Indian Council of Agricultural Research) scientists have developed the technology to pack bio-fertilizers in tiny capsules. This eliminates the need for farmers to carry the sacks of biofertilizers. It consists of a carrier medium rich in live microorganisms. When applied to seed, soil or living plants, it increases soil nutrients or makes them biologically available.

**Role of ZnO:** Zinc oxide nanoparticles (ZnO-NPs) are considered a 'biosafe material' for stimulation of seed germination and plant growth as well as disease suppression and plant protection by virtue of their antimicrobial activity. Uptake, translocation and accumulation of ZnO-NPs by plants depend upon the distinct features of the NPs as well as on the physiology of the host plant. Zinc plays an important role in the formation of chlorophyll and some carbohydrates, conversion of starch to sugars and its presence in plant tissue helps the plant to withstand cold temperatures.

**Role of FeO:** Iron is an essential micronutrient for almost all living organisms because of its critical role in metabolic processes such as DNA synthesis, respiration, and photosynthesis. In plants, iron is involved in the synthesis of chlorophyll, and it is essential for the maintenance of chloroplast structure and function.

### **Materials and Methods**

The present investigation entitled "**Effect of Biocapsule and Nano micronutrients on Growth, Quality and Yield of Lettuce (*Lactuca sativa*)**." was conducted at the central research farm of Department of Horticulture, Sam Higginbottom University

of Agriculture, Technology and Sciences Prayagraj during 2022.

### **Climatic condition**

The area of Prayagraj district comes under subtropical belt in the south east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46° C-48° C and seldom falls as low as 4°C- 5°C. The relative humidity ranges between 20 to 94 %. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

The experiment was conducted in Randomized Block Design with 10 treatment replicated thrice. The treatments were **T<sub>0</sub>** (Control), **T<sub>1</sub>** (NPK (RDF) 15:5:20), **T<sub>2</sub>** (Biocapsule 500ppm (Soil drenching)), **T<sub>3</sub>** (NPK (RDF) 15:5:20 + Biocapsule 500ppm (Soil drenching)), **T<sub>4</sub>** (NPK (RDF) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)), **T<sub>5</sub>** (Biocapsule 500ppm (Soil drenching) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)), **T<sub>6</sub>** (NPK (RDF) 15:5:20 + Biocapsule 500ppm (Soil drenching) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)), **T<sub>7</sub>** (NPK (RDF) 15:5:20 + Biocapsule

250ppm (Soil drenching)), T<sub>8</sub> (Biocapsule 250ppm (Soil drenching) + Foliar application of Zn (12%) and Fe (12%) Nano particles (NPs)), T<sub>9</sub> (NPK (RDF) 15:5:20 + Biocapsule 250ppm (Soil drenching) + Foliar application of Zn (12%) and Fe (12%) Nano particles (NPs)).

## Result and Discussion

The maximum germination % was observed in the Treatment T<sub>5</sub> with (90.56) % followed by T<sub>8</sub> with (90.26) % and the minimum was observed in the T<sub>0</sub> with (82.56) %.

The maximum plant height was observed in the Treatment T<sub>5</sub> with (20.92) cm followed by T<sub>8</sub> with (20.82) cm and the minimum was observed in the T<sub>0</sub> with (18.85) cm.

The maximum plant height was observed in the Treatment T<sub>5</sub> with (20.92) cm followed by T<sub>8</sub> with (20.82) cm and the minimum was observed in the T<sub>0</sub> with (18.85) cm.

The maximum number of leaves was observed in the Treatment T<sub>5</sub> with 9.79 followed by T<sub>8</sub> with 9.64 and the minimum was observed in the T<sub>0</sub> with 6.59.

The maximum length of leaves was observed in the Treatment T<sub>5</sub> with (18.39) cm followed by T<sub>8</sub> with (18.23) cm and the

minimum was observed in the T<sub>0</sub> with (15.36) cm.

The plant spread was observed in the Treatment T<sub>5</sub> with (16.30) cm followed by T<sub>8</sub> with (16.06)cm and the minimum was observed in the T<sub>0</sub> with (13.35) cm.

The maximum width of leaf was observed in the Treatment T<sub>5</sub> with (7.35) cm followed by T<sub>8</sub> with (6.67) cm and the minimum was observed in the T<sub>0</sub> with (5.02) cm.

The maximum leaf area was observed in the Treatment T<sub>5</sub> with (126.34) cm<sup>2</sup> followed by T<sub>8</sub> with (125.36) cm<sup>2</sup> and the minimum was observed in the T<sub>0</sub> with (75.26) cm<sup>2</sup>.

The maximum Average Fresh Weight (g) was observed in the Treatment T<sub>5</sub> with (119.69) g followed by T<sub>8</sub> with (117.49) g and the minimum was observed in the T<sub>0</sub> with (90.26) g.

The maximum Yield/plot was observed in the Treatment T<sub>5</sub> with (8.65) kg followed by T<sub>8</sub> with (8.02) kg and the minimum was observed in the T<sub>0</sub> with (6.92) kg.

The maximum yield per hectare was observed in the Treatment T<sub>5</sub> with (23.84) t/ha followed by T<sub>8</sub> with (23.05) t/ha and the minimum was observed in the T<sub>0</sub> with (17.56) t/ha.

The maximum dry matter was observed in the Treatment T<sub>5</sub> with (10.56) % followed by T<sub>8</sub> with (10.56) % and the minimum was observed in the T<sub>0</sub> with (7.59) %.

The maximum ascorbic acid was observed in the Treatment T<sub>5</sub> with (14.89) mg/100 g followed by T<sub>8</sub> with (14.12) mg/100 g and the minimum was observed in the T<sub>0</sub> with (10.35) mg/100 g.

The maximum chlorophyll content was observed in the Treatment T<sub>5</sub> with (28.62) followed by T<sub>8</sub> with (28.19) and the minimum was observed in the T<sub>0</sub> with (26.35) .

The maximum TSS was observed in the Treatment T<sub>5</sub> with (4.68) °B followed by T<sub>8</sub> with (4.60) °B and the minimum was observed in the T<sub>0</sub> with (3.32) °B.

The maximum fresh weight was observed in the Treatment T<sub>5</sub> with (140.65)g followed by T<sub>8</sub> with (135.62)g and the minimum was observed in the T<sub>0</sub> with (115.62) g.

The maximum score for Color and appearance was observed in the Treatment T<sub>5</sub> with (140.65) followed by

T<sub>8</sub> with (135.62) and the minimum was observed in the T<sub>0</sub> with (115.62) .

The maximum score for flavor was observed in the Treatment T<sub>5</sub> with (8.61)g followed by T<sub>8</sub> with (7.92) and the minimum was observed in the T<sub>0</sub> with (6.13)

The maximum score for taste was observed in the Treatment T<sub>5</sub> with (8.59) followed by T<sub>8</sub> with (8.48) and the minimum was observed in the T<sub>0</sub> with (6.45).

The maximum score for texture was observed in the Treatment T<sub>5</sub> with (8.49) followed by T<sub>8</sub> with (8.37) and the minimum was observed in the T<sub>0</sub> with (6.55).

The maximum score for overall acceptability was observed in the Treatment T<sub>5</sub> with (8.70) followed by T<sub>8</sub> with (8.49) and the minimum was observed in the T<sub>0</sub> with (6.58).

### **Conclusion**

From our experiment it was concluded that the treatment T<sub>5</sub> (Biocapsule 500ppm (Soil drenching) + Foliar application of ZnO (12%) and FeO (12%) Nano particles (NPs)) was found to be best in the terms of germination percentage, vegetative growth, yield parameters, quality parameters and economics with B:C ratio 2.67.

**Table 1 Effect of Biocapsule and Nano micro nutrients plant height, no. of leaves, length of leaves and width of leaves of lettuce.**

Treat ment	Plant Height (cm)			No. of leaves			Length of leaves (cm)			Width of leaves (cm)		
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
<b>T<sub>0</sub></b>	4.65	14.95	18.85	1.59	3.26	6.59	7.89	12.35	15.36	2.09	3.15	5.02
<b>T<sub>1</sub></b>	5.52	15.26	19.36	2.09	3.86	7.32	8.05	13.56	16.57	2.38	3.67	5.24
<b>T<sub>2</sub></b>	5.89	15.76	19.86	2.53	3.98	7.59	8.28	13.79	16.78	2.46	3.75	5.64
<b>T<sub>3</sub></b>	6.25	15.88	19.78	2.49	4.12	8.23	8.89	14.02	17.09	2.76	3.86	5.89
<b>T<sub>4</sub></b>	6.34	15.65	19.66	2.54	4.38	8.65	9.46	14.34	17.36	2.53	3.98	6.88
<b>T<sub>5</sub></b>	6.89	16.87	20.92	2.89	4.68	9.79	10.35	15.36	18.39	2.95	4.35	7.35
<b>T<sub>6</sub></b>	6.56	16.52	20.48	2.12	4.49	9.35	9.32	13.82	16.83	2.65	4.1	6.98
<b>T<sub>7</sub></b>	6.66	16.62	20.63	2.29	4.09	9.34	8.65	14.56	17.58	2.71	4.08	7.09
<b>T<sub>8</sub></b>	6.72	16.72	20.82	2.76	4.56	9.64	9.75	15.19	18.23	2.9	4.12	7.16
<b>T<sub>9</sub></b>	6.68	16.67	20.65	2.38	4.37	8.92	9.05	15.02	17.92	2.88	4.09	6.66
<b>F Test</b>	S	S	S	S	S	S	S	S	S	S	S	S
<b>C.D.<sub>@5</sub></b> %	0.86	1.265	1.568	0.562	0.628	0.759	0.86	0.85	1.02	0.39	0.49	0.56
<b>S.E.d</b>	0.412	0.561	0.726	0.247	0.324	0.351	0.412	0.413	0.514	0.153	0.215	0.251

**Table 2 Effect of Biocapsule and Nano micro nutrients leaf area, leaf area index, average fresh weight, yield/plot, yield/ha, dry matter content, ascorbic acid and chlorophyll content of lettuce.**

Treatment	Leaf area cm <sup>2</sup>			Leaf area index			Average fresh weight (g)	Yield per plot (kg)	Yield per hectare (kg)	Dry matter content %	Ascorbic acid (mg/100g)	Chlorophyll content (kg)
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS						
<b>T<sub>0</sub></b>	14.72	36.26	75.26	1.02	1.85	3.08	90.26	6.92	6.92	7.59	10.35	26.35
<b>T<sub>1</sub></b>	16.15	39.35	80.32	1.31	1.92	3.45	112.64	7.12	7.12	8.09	11.95	26.56
<b>T<sub>2</sub></b>	16.46	39.56	80.56	1.26	2.03	3.52	111.89	7.35	7.35	8.37	13.64	26.78
<b>T<sub>3</sub></b>	16.58	42.05	84.36	1.38	2.12	3.78	109.56	7.05	7.05	8.19	12.82	26.91
<b>T<sub>4</sub></b>	18.35	42.35	102.35	1.51	2.35	3.64	112.38	7.89	7.89	8.65	12.65	27.62
<b>T<sub>5</sub></b>	20.89	60.35	126.34	1.72	2.86	3.95	119.69	8.65	8.65	10.56	14.89	28.62
<b>T<sub>6</sub></b>	18.65	52.65	96.59	1.46	2.45	3.8	115.68	7.38	7.38	9.46	13.08	27.59
<b>T<sub>7</sub></b>	16.71	56.95	119.26	1.55	2.64	3.71	114.82	7.52	7.52	9.64	13.28	28.05
<b>T<sub>8</sub></b>	19.24	59.32	125.36	1.68	2.78	3.83	117.49	8.02	8.02	10.51	14.12	28.19
<b>T<sub>9</sub></b>	18.32	58.62	103.75	1.6	2.71	3.76	115.37	7.65	7.65	9.85	13.76	28.1
<b>F Test</b>	S	S	S	S	S	S	S	S	S	S	S	S
<b>C.D.<sub>@5</sub>%</b>	1.851	4.235	8.659	0.59	0.62	0.82	3.68	1.235	1.235	0.65	1.12	2.91
<b>S.E.d</b>	0.921	2.231	4.319	0.312	0.312	0.0415	1.862	0.623	0.623	0.31	0.62	1.43

**Table 3 Effect of Biocapsule and Nano micro nutrients Total soluble solid, fresh weight, organoleptic evaluation (Color, Flavor, Taste, Texture, and Acceptance) and B:C ratio of lettuce.**

Treatment	Total soluble solid $^{\circ}\text{B}$	Fresh weight (g)	Organoleptic evaluation					B:C Ratio
			Color	Flavor	Taste	Texture	Acceptance	
<b>T<sub>0</sub></b>	3.32	115.62	6.57	6.13	6.45	6.55	6.58	1.97
<b>T<sub>1</sub></b>	3.98	119.64	7.95	7.18	8.17	7.9	8.33	2.20
<b>T<sub>2</sub></b>	4.25	120.38	6.89	6.59	7.09	7.35	7.59	2.33
<b>T<sub>3</sub></b>	4.35	125.43	7.26	6.79	7.19	7.26	7.43	2.28
<b>T<sub>4</sub></b>	4.42	128.64	7.62	7.09	7.4	7.64	7.7	2.42
<b>T<sub>5</sub></b>	4.68	140.65	8.95	8.61	8.59	8.49	8.7	2.67
<b>T<sub>6</sub></b>	4.51	129.46	7.64	7.38	7.19	7.91	7.82	2.48
<b>T<sub>7</sub></b>	4.59	130.26	7.08	6.6	6.85	7.09	6.83	2.55
<b>T<sub>8</sub></b>	4.6	135.62	8.43	7.92	8.48	8.37	8.49	2.58
<b>T<sub>9</sub></b>	4.55	131.52	7.6	7.17	7.57	7.44	7.63	2.39
<b>F Test</b>	S	S	S	S	S	S	S	
<b>C.D.@5 %</b>	0.94	2.369	1.01	0.989	0.89	0.866	0.177	
<b>S.E.d</b>	0.437	1.215	2.188	2.141	1.927	1.875	0.383	

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