

## Growth, Yield and Seed Quality of Soybean (*Glycine max L.*) As Affected by Organic, Biofertilizer and Yeast Application

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**Abstract:** During two summer seasons in Egypt, pots experiments were carried out at 2004 and 2005 seasons in order to investigate the effect of application of organic manure, biofertilizer and yeast (*Candida tropicalis*) on growth, yield and seed quality of soybean (*Glycine max L.*). The results indicated that application of organic manure at a rate of 20 ton / acre as a sole treatment and also when it associated with biofertilizer as one treatment had more plant height and dry weight / plant. On contrast plant height was reduced at the treatment had a sole biofertilizer and also when it associated with yeast, also number of branches / plant was decreased at the treatment received bio. or yeast singly. Seed yield (g. / plant), pods weight (g. / plant), as well as, number of pods / plant, seeds / pod and 1000-seed weight were decreased by adding biofertilizer singly, but when it associated with organic manure showed the highest seeds and pods weights. Application of organic manure+yeast as one treatment resulting in an increase in yield and yield attributes of soybean plants. Seed oil % was increased at the plants that treated by biofertilizer singly and also at the treatment received organic manure+yeast as one treatment, whereas protein % was increased at the treatment had organic singly or when it associated with biofertilizer, then this increase in protein percentage due to the increase in N% at the same treatments. P concentration was only increased at the plants received yeast only and also when yeast associated with biofertilizer. Zn concentration tended to increase at the plants treated by bio.+organic manure+yeast followed by bio.+organic as one treatment. Mn concentration was high when plants received yeast singly or when it associated with biofertilizer, while Fe concentration tended to increase due to adding bio.+organic manure+yeast followed by bio.+organic as one treatment.

**Key words:** Soybean, organic manure, biofertilizer, yeast, yield

### INTRODUCTION

Most countries have traditionally utilized various kinds of organic materials to maintain or improve fertility and productivity of their agricultural soils. However, several decades ago organic recycling practices in some countries were largely replaced with chemical fertilizers that were applied to high yielding cereal grains that responded best to high level of fertility. Compost utilization as manure is becoming wider spread during recent years as a consequence of the rise in price of conventional fertilizers. Beneficial effects of organic fertilizers applications of growth and yield of some field crops were shown by Radwan *et al*<sup>[1]</sup>, Mekki *et al*<sup>[2]</sup> and El-Kholy and Gomaa<sup>[3]</sup>. Nowadays emphasis has already been placed on research and development activities that led to the concept of multistrain biofertilizers i.e. the application of gathered groups of soil microorganisms, having a definite beneficial well-known role in supporting

plant growth in developing sustainable soil fertility and in bio-controlling soil born disease<sup>[4]</sup>. Bread yeast (*Candida*) as a natural bio-stimulant was appeared to reduce an astonished influence on growth and yield of millit crop<sup>[3]</sup>. The objective of this work was mainly to investigate the response of growth, yield and seed quality of soybean crop to application of organic, biofertilizer and yeast.

### MATERIALS AND METHODS

Pots experiments were carried out at the greenhouse of the National Research Center, Dokki, Cairo, Egypt during two summer seasons 2004 and 2005 in order to investigate the response of growth, yield and seed quality of soybean (*Glycine max L.*) to application of organic, biofertilizer and yeast. Earthenware pots 40 cm diameter and 40 cm in height were filled by 15 kg sandy soil which mainly taken from South El-Tahrir region, El-Behaira Governorate. The physical and chemical analysis of soil site is shown in Table (1).

**Table 1:** Physical and chemical analysis of soil site.

Properties	0-30
<b>Mechanical analysis</b>	
Coarse sand %	65.0
Fine sand %	31.0
Silt %	3.3
Clay %	0.7
Soil texture	Sandy
<b>Chemical analysis</b>	
p <sup>H</sup>	7.6
EC mmohs /cm	0.12
Organic matter %	0.60
Calcium carbonate %	3.5
Total N ppm	72.0
Available P ppm	4.0
<b>Micrnutrients (ppm)</b>	
Fe <sup>++</sup>	3.9
Zn <sup>++</sup>	1.3
Mn <sup>++</sup>	0.5

Pots were arranged in complete randomize design with 6 replications. Fresh farmer yard Manure or composted (FYM) has been added during before sowing at a rate of 20 ton / acre.

Bread yeast (*Candida tropicalis*) was applied twice at a rate of 1 g / L as foliar application after 45 and 60 days from sowing.

The treatments used as follows:

1. Biofertilizer (Soybean seeds were mixed by the multi Strains biofertilizer (Microbein) devoted by Saber<sup>[5]</sup> and commercially produced by Ministry of Agriculture, Egypt.
2. Organic manure at a rate of 20 ton/ acre
3. Yeast (foliar application 1g / L).
4. Biofertilizer+Organic
5. Biofertilizer +Yeast
6. Organic+Yeast
7. Biofertilizer+Organic+Yeast

At 90 days plant age, a random sample was taken from each treatment to determine some growth characters as follows:

- C Plant height (cm).
- C Number of branches / plant
- C Dry weight / plant (g)
- C Root / Shoot ratio

At harvesting time the yield and yield components were estimated as follows:

- C Pods weight / plant (g)
- C Seeds weight / plant (g)
- C Number of pods / plant
- C Number of seeds / pod
- C 1000-seed weight (g)

Seed oil percentage was estimated according to A.O.C.S<sup>[6]</sup>, nitrogen (%) was estimated by using Micro-Kjeldhl, then the protein (%) was also calculated, Phosphorus (%) by using Spectrocolorimeter and micronutrients elements such as Fe, Zn and Mn by using Atomic Absorption.

The obtained data were statistically analyses according to Snedecor and Cochran<sup>[7]</sup> and combined analysis was done according to Steel and Torrie<sup>[8]</sup>, the treatments means were compared by using LSD test at 5% of probability.

## RESULTS AND DISCUSSION

**Growth:** Some growth characters of soybean plants are shown in Table 2. Application of biofertilizer plus organic fertilizer as one treatment showed more plant height and dry weight/plant in comparison to the treatments received bio. or organic fertilizer soly and also to the treatments sprayed by the yeast only and /or when it combination with organic and bio. as one treatment. The increase of plant height and dry weight of soybean plants that received bio.+organic as one treatment mainly attributed to the beneficial effect of bio.+organic application to the soil that organic manure improved not only soil physical and biological properties , but also chemical characteristics resulting in more release of available nutrients to plant root. This may be true under the same condition, particularly in sand soil lacks enough nutrients (Table 2). Also application of biofertilizer is suggested as a sustainable way for increasing crop yields, in general El-Kholy and Gomaa<sup>[3]</sup> stated that the biofertilizer could replace 50% of the chemical fertilizer recommended for millet plants without decreasing the green and dry fodder, this could be attributed to the plant growth promoting substances produced by the biofertilizer, in addition to the reasonable quantity of atmospheric nitrogen fixed by *Azotobacter chroococcum*<sup>[9,10]</sup>. These reaction saved more available nutrients for enzymes required to building up the different organs compounds and consequently for better growing soybean plants. The general physiological status of the plants as indicated by the dry weight always exhibited positive response to use biofertilizer addition<sup>[11]</sup>. On contrast, the lowest value of plant height was recorded at the treatment that received bio. soly or bio.+ yeast as one treatment, however the lowest dry weight

**Table 2:** Some growth characters of soybean plants as affected by bio, organic and yeast application.

Treatments	Plant height cm.	Dry weight (g./ plant)	No.of branches/ plant	Root/shoot ratio
Biofertilizer	62.75	10.83	10.25	0.04
Organic	93.25	16.64	15.75	0.07
Yeast	83.13	12.49	11.38	0.06
Bio. + Org.	113.50	22.48	14.00	0.08
Bio. + Yeast	67.25	15.86	12.38	0.11
Org. + Yeast	87.50	19.66	13.25	0.07
Bio. + Org. + Yeast	89.50	21.75	14.50	0.09
LSD 5%	6.47	4.02	4.71	-

**Table 3:** Yield and it components of soybean as affected by bio., organic manure and yeast.

Treatments	Seed weight/plant (g)	Pods weight/plant (g)	Number of pods/plant	Number of seeds/pod	1000-seed weight (g)
Biofertilizer	3.62	12.50	15.25	1.83	12.98
Organic	8.88	20.44	29.50	2.09	14.65
Yeast	6.74	16.11	20.50	2.30	13.78
Bio. + Org.	13.64	30.38	43.25	2.32	14.09
Bio. + Yeast	10.67	23.11	33.13	2.06	14.97
Org. + Yeast	10.66	24.35	36.75	2.50	13.55
Bio.+Org. + Yeast	10.43	23.89	36.38	2.22	13.16
LSD 5%	1.37	8.24	4.28	0.36	1.09

was recorded at the treatment had bio. or yeast as a sole treatment.

Number of branches/plant was also decreased due to application of bio. or yeast singly, whereas it increased when organic was applied as a sole treatment and also at bio.+organic+yeast as one treatment. Data also show that the value of root/shoot ratio was increased at the treatment received bio.+yeast and the lowest was at the treatment had biofertilizer only. The smaller root / shoot ratios are often associated with improved plant nutrition and some studies reported that smaller root / shoot ratios associated with arbuscular mycorrhizal fungi<sup>[12,13]</sup>

**Yield and yield components:** Data presented in Table 3 show that yield and yield attributes were significantly affected by the treatments used .In general, the plants that treated by biofertilizer singly showed the lowest values of seeds and pods weights as well as number of pods/plant, seeds/pod and also 1000 seeds weight in comparison to the other treatments. However, the plants that treated by bio.+organic manure recorded the highest values in these traits. The increase in pods and seeds weights/plant estimated by 14.88 and 10.02 g., respectively in comparison to the treatment had biofertilizer only. This increases mainly due to the increase of number of pods

and also seeds/pod at the same treatment. Badaruddin *et al*<sup>[14]</sup> reported that application of FYM resulted in a significant increase (21%) in final grain yield of wheat, whereas Schmidt *et al*<sup>[15]</sup> indicated that application of manure to nodulation soybean offers a production the increase that maximum yield. Also, Ahmed *et al*<sup>[16]</sup> on groundnut stated that application of bio.associated with organic manure resulted in an increase in yield and its components.

Data in Table 3 also show that application of organic manure+bio.+ yeast as one treatment resulted in an increase of yield and other yield traits , this increases mainly attributed to the effect of microorganisms which can play a very significant role in making available nutrients elements for plants. It is essential by bring about some microbial transformation of both inorganic and organic compounds in the soil to make available of these elements to soybean plants. These findings were also supported by Molla *et al*<sup>[17]</sup> stated that about 22-29 % of organic phosphate mineralized at the 45th day of incubation. Other study reported that a highly significant increase in fresh and dry cuttings of millet due to application of bio.+yeast<sup>[3]</sup>.

**Seed quality:** Seed oil and protein percentages as well as

**Table 4:** Seed oil and protein percentages, as well as, some macro and micronutrients elements in soybean seeds in response to bio., organic manure and yeast application.

Treatments	Oil	Protein	N	P	Zn	Mn	Fe
	%		Ppm				
Biofertilizer	26.41	46.31	7.41	0.45	127.8	59.7	217.0
Organic	24.86	49.69	7.95	0.41	124.5	52.6	205.0
Yeast	25.77	44.88	7.18	0.57	127.4	72.4	189.5
Bio. + Org.	25.56	49.69	7.95	0.52	135.3	55.2	211.0
Bio. + Yeast	24.76	46.56	7.45	0.57	121.8	66.6	171.5
Org. + Yeast	26.62	42.50	6.80	0.49	124.3	57.5	140.0
Bio. + Org. + Yeast	25.05	41.88	6.70	0.56	143.8	50.7	254.5

some macro and micronutrients in soybean seeds are shown in Table 4. The plants that treated by biofertilizer singly and/or received organic manure+yeast surpassed in the seed oil content compared to other treatments. However, the lowest seed oil content (24.76%) was recorded at the treatment had bio.+yeast as on treatment. In this concern that Saber *et al*<sup>[18]</sup> reported that application of biofertilizer increased oil and protein contents as well as nutrients elements in soybean seeds. Protein % was only increased due to application of organic manure alone and when it combination with biofertilizer as one treatment. The highest protein content (49.69%) was obtained at the same previous treatments. The increase in protein % mainly due to the increase of N% at the same treatments (Table 4), This means that both bio. or organic manure can provide plants with essential nutrients elements required for oil and protein formation These results are in line with those obtained by El-Kholy and Gomaa<sup>[3]</sup> and Schmidt *et al*<sup>[15]</sup>.

Phosphorous concentration was only increased at the plants received yeast soly and or when it combination with biofertilizer and organic manure. The sole treatment of yeast had the same value (0.57%) of the treatment that treated by yeast+bio. and approximately the same value of bio.+organic+yeast. These results were supported by the findings of Molla *et al*<sup>[17]</sup> and El-Kholy and Gomaa<sup>[3]</sup>. In general, microorganism can play a very significant role in making available phosphorous to plants. Bacterial organic acids after which free phosphate may sometimes be liberated by hydrolysis can dissolve organic phosphate<sup>[19]</sup>. It is essential to bring about some microbial transformations of both inorganic and organic compounds in soil to make available of this element to plant. Results obtained by Molla *et al*<sup>[17]</sup> indicated that about of 22-29 % of organic phosphate was mineralized at the 45th day of incubation. Also the results of Khalil *et al*<sup>[13]</sup> showed that in soy mycorrhizal plants had greater shoot P uptake than unmycorrhizal plants.

Data in Table 4 also cleared that the micronutrient elements such as Zn, Mn and Fe were also affected by the treatments used. Zn concentration was only increased when plants treated by bio.+organic+yeast followed by bio.+organic as one treatment. At the same time, Mn concentration was increased at the treatment had yeast singly and also when it combination with biofertilizer as on treatment. Badaruddin *et al*<sup>[14]</sup> and Mekki *et al*<sup>[2]</sup> reported that Zn and Mn concentrations were increased due to adding organic manure when associated with biofertilizer in line with those obtain these results.

Fe concentration in soybean seeds recorded the highest value when plants treated by bio.+organic+yeast followed by bio.+organic. Saber and Kabesh<sup>[11]</sup> supported these results. Also Mekki *et al*<sup>[3]</sup> reported that organic manure either soly or when it associated with biofertilizer increased Fe concentration in millet cuttings. This increase in Fe is mainly due to the action of biofertilizer that rendered phosphorous and most micronutrients in the available form.

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