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Effect of Rhizobium Inoculation, Farmyard Manure and Some Bio-Stimulants on Vegetative Growth Characteristics and Pod Yield of Broad Bean

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ABSTRACT

Two field experiments were carried out in a special farm at Shieba, Zagazig Center, Sharkia Governorate , Egypt during two successive winter seasons of 2023 – 2024 and 2024 – 2025 to study effect of rhizobium inoculation, organic fertilizer (farmyard manure) and bio-stimulants such as dry yeast and seaweed extract on the vegetative growth characteristics and pod yield of broad bean cv. El Kobrosy .

The experiment included 9 treatments where 3 main plot (control, rhizobium and farmyard manure) and 3 sub plot (control , dry yeast and seaweed extract)

The layout of the experiment was laid out in split plot design with three replicates**.**

Results indicated that FYM treatment gave the highest values of vegetative growth of broad bean , i.e. plant height , number of leaves , number of branches , plant fresh weight and plant dry weight , as well as, on pod yield and its components , i.e. pod length , pod diameter , pod weight , number of pods / plant , number of seeds / pod , seed weight / pod and pod yield (ton / fed) . This treatment followed by the treatment of *Rhizobium inoculation* compared to control treatment .

Moreover, dry yeast extracts , being the most effective on growth parameters and pod yield and its components of broad bean , followed by the treatment of seaweed extract compared to the control treatment . These results are true in both growing seasons .In addition, regarding to the interaction effect between FYM and dry yeast extract , being the most effective treatment in most cases , followed by *Rhizobium inoculation* with dry yeast extract compared to the other treatments .

Conclusion: It could be concluded that using Rhizobium inoculation , organic fertilizer (farmyard) and bio-stimulants such as dry yeast and seaweed extract , which they are eco- friendly without pollution.to improve the vegetative growth characteristics and pod yield of broad bean cv. El Kobrosy.

Key words: Rhizobium inoculation - farmyard manure -dry yeast = seaweed extract - broad bean.

NTRODUCTION

Broad bean (*Vicia faba* L.) is one of the most important of Fabaceae family . It is the fourth of legume crops after peas , beans and cowpea**. (Hanoon et al ., 2020)** .

The legume seeds are a highly nutritious source of protein particularly lysine . vitamins like thiamin , riboflavin and ascorbic acid , amino acids , sugars and carbohydrates **(El-Fiki, 2017)**. The legume plants are consider as an organic green fertilizer . By fixing soil nitrogen , legumes play a significant role in enhancing soil fertility and translocate carbohydrates to plants **(Al-Khaqani et al ., 2022)** .

Various microorganisms found in bio-fertilizers have the capacity to use biological processes to change nutritionally significant components from unavailable to available form. Therefore, bio-fertilization plays a

crucial role in reducing environmental pollution and natural degradation in the development and application of sustainable agricultural systems. **(Mekki 2016).** Effective bio-fertilizers include *rhizobium leguminosarum bv. Viciae* and rhizobacteria **(Mansour et al., 2021)**. It have a symbiotic relationship for nitrogen fixation **(Dashadi et al., 2011**). Plant development and yield can be enhanced by *rhizobium leguminosarum ,* which also plays a fundamental role in N2 fixation **(Noufal et al., 2018)**.

Argaw and Mnalku (2017) concluded that *rhizobium inoculation* of seeds is known to improve the nodulation , N uptake , growth and yield characteristics of legume crops .

Bio-stimulants like as plant extracts are healthy for the limiting of environmental pollution because they contain numerous nutrients including yeast and seaweed extracts , as well as natural growth regulators **(Adam et al., 2022)** . Bio-stimulants are any material or microbes that are applied to plants independent of their nutrient content with the goal of improving food efficiency , resistance to abiotic stress , and crop quality characteristics **(Kocira et al., 2020)** .

They have a high natural auxin and cytokinin content and ability to enhance the accumulation of carbohydrates, as mentioned by **Muhammed et al., 2020. Y**east is fungi has been played a beneficial role during vegetative and reproductive growths by improving flower formation and their set in certain plants (**Mageed and Ali , 2024).**

Seaweed extracts are the natural sources of riboflavin , niacine , pantothenic acid , folic acid and vitamins A , B1 , B12 , C and D which increased plant growth and pods yield (**EL-Gamal et al., 2020) .** Furthermore , **El Metwally (2016)** observed that using seaweed extract improved the broad beans yield responses **(ElMetwally and Dawood , 2017) .**

Organic manure like as FYM is a process that turns agricultural waste into environmentally acceptable fertilizers **(El-Ghamry et al., 2017)** . Large volumes of organic matter in FYM raise the soils organic carbon content . FYM also provides minerals which lowers the need for other fertilizers and consequently the price of buying non - organic fertilizers **(Zendejas et al., 2015)** . Broad bean components and overall pod production were superior when organic manure was used **(Mohamed and Gomaa , 2005) .**

Therefore the goal of this study was to evaluate growth , and pod yield of broad bean by using *rhizobium inoculation* and some bio-stimulants , i.e , dry yeast , seaweed extracts and organic manure .

MATERIALS AND METHODS

Experimental sites and soil analysis :

Two field experiments were carried out in a special farm at Shieba , Zagazig Center , Sharkia Governorate , Egypt during two successive winter seasons of 2023 – 2024 and 2024 – 2025 to study effect of rhizobium inoculation, organic fertilizer (farmyard) and biostimulants such as dry yeast and seaweed extract on the vegetative growth characteristics and pod yield of broad bean cv. El Kobrosy .

The physical and chemical properties of the soil are presented in Table (1) .

Table (1) : The physical and chemical properties of the experimental soil

Analysis	2023/2024	2024/2025
Particle size distribution ($g.kg^{-1}$)		
Coarse sand	21	23
Fine sand	10	11
Silt	23	22
Clay	45	46
Mixture soil	Clay	Clay
Bulk density ($g.cm^{-3}$)	1.32	1.40

EC ($dS.m^{-1}$) in soil paste extract	2.76	2.77
pH (in 1 soil:2.5 water suspension)	8.2	8.3
Organic Matter (%)	1.66	1.67
Plant nutrients –available ($mg.kg^{-1}$)		
N	27.18	27.20
P	18.23	18.25
K	177.12	178.12
Si	27.02	28.02

EC = Electric conductivity

Treatments and Experimental design :

The layout of the experiment was laid out in split plot design with three replicates . The seeds were inoculated by okadin which contains on *Rhizobium leguminosarum* var. vicia, bring from ministry of agriculture , agricultural research center , Giza , Egypt , microbiology unit .

Farmyard manure 5 m^3 / fed the compound was optained from lab in plant production department for Faculty of Technology and Development , Zagazig University , Egypt .

Dry yeast were prepared from (the market) brewers yeast (*Saccharomyces cerevisiae*) **(El-Shafey et al ., 2016)** . It was dissolved in water 4 gm / L followed by adding sugar at a ratio of 1 : 1 kept for 12 hours in a warm place for reproduction according to the methods of **Morsi et al . (2008)** in early morning .

Seaweed extract the compound was obtained from El Hdba Company for agriculture and development , Cairo , Egypt . It was applied at 4 g / L (powder form) dissolved in 1 Liter of water.

The plot area was 9.6 m^2 (4 rows , 4 m length and 0.6 m width) .

Seeds were sown with 2 seeds per hole at 10 th and 12 th October 2023 and 2024 , respectively, the distance between plants on one line was 20 cm and the distance between lines was 60 cm . Number of plants in one line were 20 and the number of lines were 4 . The agricultural practices for broad bean production were followed according to the Egyptian ministry of agricultural recommendations.

The experiment included 9 treatments where 3 main plot (control , rhizobium and farmyard manure) and 3 sub plot (control , dry yeast and seaweed extract) as the following **:**

I- Main plots :

1 – Control

2 – Rhizobium 3 – Farmyard manure

II – Sub plots :

1 – Control

2 – Dry yeast

3 – Seaweed extract

Foliar treatments were sprayed directly on the leaves in early morning 3 times by using hand operator compressed air sprayer . The first spray was conducted at 3 true leaves stage after 30 days of sowing . The second and third spray were performed 15 days intervals (30 , 45 and 60 days from sowing days) . The chemical analysis of dry yeast, farmyard manure and Seaweed extract are shown in tables (2 , 3 and 4)

Table (2) : The chemical analysis of dry yeast

Amino acid %		Vitamins (mg /100 g DW)		Minerals	
Alanine	1.69	Vit.B1	23.33	Nitogen %	6.88
Arginine	1.49	Vit.B2	21.04	Phosphorus %	0.66
Aspartic acid	2.32	Vit.B6	20.67	Potassium %	0.95
Cystine	0.63	Vit.B12	19.17	Magnesium %	0.19
Glutamic acid	3.76	Thimain	23.21	Calcium %	0.17
Glycine	1.45	Riboflavin	27.29	Sulfur %	0.48
Histidine	0.71	Insitol	20.43	Iron (ppm)	107
Isoleucine	0.85	Biotin	20.04	Zinc (ppm)	77
Leucine	1.91	Nicotinic acid	73.92	Copper (ppm)	5
Lysine	1.13	Panthothenic acid	38.43	Others	
Phenyl alanine	1.18	P amino benzoic acid	29.49	Manganese (ppm)	43
Proline	1.29	Folic acid	26.22	Crude protein %	2.2
Serine	1.98	Pyridoxine	22.09	Crude fat %	33.21
Threonine	1.54			Carbohydrates %	7.2
Tryptophan	0.25			Crude fiber %	3.8
Tyrosine	0.99				
Valine	1.4				
Methionine	0.4				

Table (3). Analysis of farmyard manure used in the experiment

Ph (su) 1 / 10	EC (su) 1 / 10	P %		K %	Moisture %
8.14	**833**	**1.51**		**0.52**	**37.23**
Ca %	**Cu (ppm)**	**Fe (ppm)**	**Mg %**	**Mn (ppm)**	**Zn (ppm)**
2.63	**88.93**	**14761.8**	**0.43**	**894.5**	**410 .8**

Table (4) : The chemical analysis of seaweed extract (Al Gatun 80 %)

Organic matter	Growth regulators	Macro and micro elements
Amino acid …… 6 % Carbohydrates ……. 35 % Alginicacid …….. 10 % Manitol …… 4 % Betaines ……0.04 %	IAA …… 0.03 % Cytokinins …… 0.02 %	Organic (N) …… 3.12 % P_2O_5 ……. 2.61 % K_2O …… …… 4.71 % Ca …… 0.25 % S ……. 3.56 % Mg ……. 0.58 % Fe ……. 150 ppm Zn …… 70 ppm Mn …… 13 ppm B ….. 60 ppm I …… 30 ppm

Data recorded :

a – **Vegetative growth characters**

Three plants were randomly chosen from every treatment in 3 replicates at flowering stage and beginning fruiting stage at 60 days after sowing to determine as follows :

1 - Plant height (cm)

2- Number of leaves / plants

3- Number of branches / plants

4 - Plant fresh weight (g)

5 - Plant dry weight (g).

d – Pod yield and its components :

At the proper maturity stage (60 - 90) days after sowing , green pods of each treatment were harvested , counted and weighed in each harvest and the following parameters were assigned **;** no. of seeds / pod , pod length (cm) , pod diameter (cm) , average weight of pod (g) , average seeds weight / plant and total green pod yield (ton / fed $^{-1}$) .

Statistical analysis :

All obtained data were subjected to the statistical analysis of variance and treatment means were compared using least significant difference (LSD) method described by **Snedecor and Cochran (1989)** at 5 % significance level . The statistical analysis were performed using SAS computer software program **(SAS 2007)** .

RESULTS AND DISSCUSSION

Vegetative growth of broad bean :

Effect of *Rhizobium inoculation* and FYM :

Data in Table (5) investigated the effect of *Rhizobium inoculation* and farmyard manure (FYM) on vegetative growth of broad bean . Results indicated that FYM treatment gave the highest values of vegetative growth of broad bean , i.e. plant height , number of leaves , number of branches , plant fresh weight and plant dry weight. This treatment followed by the treatment of *Rhizobium inoculation* compared to control treatment . These results are true in both growing seasons .

According to the vital role of farmyard manure on growth of legumes plants , **Goldan et al. (2023)** illustrated that FYM can significantly improve soil structure , microorganisms activity and encourage the growth of plants. These results are supported by those of **singh and singh (2018) , Seif El-yazal (2020) , Gomaa and Afifi (2021) , Priya et al. (2023) and Agegnehu et al. (2025) .**

In addition , regarding the important role of *Rhizobium inoculation* on growth characters of legumes plants, **Allito et al . (2020)** demonstrated that rhizobium inoculation on seeds enhanced nitrogen fixation , soil nitrogen balance , nitrogen uptake and phosphorus uptake of faba bean. Moreover , **Yousief et al. (2021)** stated that *rhizobium inoculation* significantly enhanced the nodulation and growth parameters of faba bean .

The obtained results are in accordance with those mentioned by **Arafa et al. (2018) , Jasim and Khudair (2018) , Mowafy et al. (2022) , Geleta and Bakele (2022) and Lishan et al. (2022) .**

Effect of bio-stimulants extracts (Seaweed and dry yeast) :

Data in table (5) revealed that biostimulants significantly increased the vegetative growth of broad bean plants , i.e . plant height, number of leaves , number of branches , plant fresh weight and plant dry weight. These results showed that dry yeast extracts , being the most effective on growth parameters of broad bean, followed by the treatment of seaweed extract compared to the control treatment. These results are true in both growing seasons .

Regarding the important role of dry yeast on legumes plants, **Abdel Rahman et al (2020)** indicated that dry yeast extract significantly increased soil microorganisms activation to improve the plant growth of faba bean. In addition, **Hamza et al. (2020)** suggested that spray faba bean plants with dry yeast extract significantly increased plant growth .

These results are accordance with those reported by **Abed Nasser et al. (2019) , Abu Khouder et al. (2019) and Hassan and El-Faraikh (2025)** .

Moreover , according to the vital role of seaweed extract on legumes plants, **El-Gamal et al. (2020)** concluded that seaweed products improved plant growth of faba bean , which it contains growth hormones , vitamins , amino acids , trace elements , auxin , gibberellin and then improved plant growth . Moreover, **Fahmy et al. (2022)** demonstrated that seaweed foliar spray improved vegetative growth of snap bean , i.e. plant height and number of leaves / plant .

Similar findings are obtained by **Osman et al. (2020) , Fahmy et al. (2022) , Sulieman et al. (2023) and Doklega et al. (2024)** .

The interaction effect of *rhizobium inoculation* and FYM application with bio-stimulants of seaweed and dry yeast extracts :

Results in Table (6) clearly demonstrated that FYM with dry yeast extract , being the most effective treatment in most cases, followed by *Rhizobium inoculation* with dry yeast extract compared to the other treatments , but not reach to the significant level.(0.05).

Pod yield and its components :

Effect of *Rhizobium inoculation* and farmyard manure :

Data in Tables (7a , 7b and 7c) revealed that Farmyard manure (FYM) , being the most effective on pod yield and its components , i.e. pod length , pod diameter , pod weight , number of pods / plant , number of seeds

/ pod, seed weight / pod and pod yield (ton / fed), followed by *Rhizobium inoculation* , respectively , compared to the control treatment .

Regarding the important role of (FYM) on legume plants , **Heinze et al . (2010)** concluded that farmyard manure is a storage of organic matter that is beneficial to the soil. It is used to improve soil and plant fertility. It provides the soil with significant amount of nitrogen , phosphorus and potassium , as well as other minerals , which improved soil and increased the physiological processes in legume plants like broad bean and then increased the pod yield and its components .

Moreover, **Maruf (2021)** illustrated that manure is a valuable and renewable resource that can be used as a fertilizer in crop production .

Respecting the vital role of *Rhizobium* inoculation on broad bean , **Furkan et al . (2022)** concluded that *Rhizobium bacteria* is one of the most important issuses four country and farmers, taking into account the needs of not only the plant , but also the soil and plants. The broad bean plant is the most nitrogen - fixing plant among the edible legumes .

The obtained results are in accordance with those mentioned by **Buraka et al . (2016)** , **Singh and Singh (2018)** , **Gomaa and Afifi (2021) , Aboseif et al . (2022) , Priya et al. (2023) and Suleymanoglu and Sumer (2025)** who worked with FYM (farmyard manure) .

As well as , **Arafa et al. (2018) , ucar (2021) , Chimdi et al. (2022) and Furkan et al . (2022)** who worked with *Rhizobium inoculation* .

Effect of seaweed and dry yeast extracts :

Data in Tables (7a , 7b and 7c) explain that seaweed and dry yeast extracts gave the highest values of pod yield and its components above mentioned . These results showed that dry yeast extracts, being the most effective on pod yield and its components , followed by the seaweed extract treatment compared to the control treatment .

Regarding the vital role of dry yeast extract on yield of legumes plants, specially broad bean, **Abbas (2013)** illustrated that dry yeast plays a key role in boosting enzyme activity and improving nutrient uptake , which helps to promote overall plant growth and then increased yield of plant . Furthermore , yeast contributes to increased photosynthetic production by releasing co_2 **(Khalil and Ismael , 2010)** and also contained on some hormones (cytokinin and GA3) which promote elongation and activate the bio processes in plant , consequently increased the pod yield and its components , moreover , it provides essential and trace nutrients , growth regulators such as auxins , sugar and certain vitamins , particularly vitamin B **(Abou El - yazied and mady, 2012)** .

In addition , seaweed extract plays an important role in increasing pod yield of legume plants , **Jasim and Mhanna (2014)** demonstrated that seaweed extract provides an excellent source of bioactive compounds , such as carotenoids, protein , essential fatty acids, vitamins , aminoacids , minerals and growth promoting substances which promote and increase plant growth and yield of plants .

These results supported by those recorded by **Ibrahim and El-Fiki (2019) , Jasim and Khudair (2018) and Mageed and Ali (2024)** , who worked with dry yeast extract , as well as , **Abdulraheem and Ibraheem (2020) , Karewish et al. (2020) and Osman et al. (2020)** , who worked with seaweed extract on legume plants .

The interaction effect between *Rhizobium* and FYM , with dry yeast and seaweed extracts :

Data presented in Tables (8a ,8b and 8c) show that the interaction between the both of FYM and *Rhizobium inoculation* with dry yeast and seaweed extracts significantly increased the pod yield and its components of broad bean in most cases .

These results were true in both growing seasons of this study . In this concern , the interaction effect between FYM as organic fertilizer and dry yeast extract gave the highest values of pod yield and its components of broad bean plants . When FYM and dry yeast together , this treatment improved the pod yield of broad bean , which had an important active compounds and many benefits microorganisms in the soil which promote the nutrients to absorbed by plant and then increases the biophysiological processes for increasing the plant growth and then increased the pod yield of plant (farmyard manure) .

As well as , dry yeast plays an important role in increasing pod yield of broad bean , which contains many vitamins and growth hormones that increases the biochemical and physiological processes in different parts of plant for increased pod yield of plant .

Conclusion:

In most cases , *Rhizobium inoculation* or FYM application , dry yeast or seaweed extracts as foliar spray caused an increases in plant vegetative growth parameters , and pod yield of broad bean cv . El Kobrosy .

Table (5) : Effect of rhizobium inoculation , FYM and some bio-stimulants extracts on vegetative growth characters of the broad bean during 2023/2024 and 2024/2025 seasons

Treatments	No. of leaves / plant		No . of branches / plant		Plant height (cm)		Plant fresh weight (g)		Plant dry weight (g)	
A	2023/ 2024	2024/ 2025	2023/ 2024	2024/ 2025	2023/ 2024	2024/ 2025	2023/ 2024	2024/ 2025	2023/ 2024	2024/ 2025
Control	136.666	145.888	5.222	6.333	55.444	42.222	208.000	169.667	16.200	15.511
Rhizobium	141.000	148.666	7.778	6.666	56.666	62.111	229.000	175.778	17.566	16.101
FYM	167.777	191.111	8.000	7.333	64.555	62.444	238.777	206.222	20.400	18.100
LSD 0.05	0.197	0.739	2.288	1.966	1.218	0.419	1.885	8.495	1.534	2.504
B foliar spray										
Control	121.444	147.111	6.444	5.666	52.555	50.888	176.222	164.111	16.700	15.146
Seaweed	157.333	160.333	7.222	5.888	60.444	55.333	231.000	177.444	18.377	15.756
Dry yeast	166.666	178.222	7.333	8.777	63.666	60.555	268.555	210.111	19.088	18.811
LSD 0.05	0.197	0.739	2.288	1.966	1.218	0.419	1.885	8.495	1.534	2.504

Table (6) : The interaction effect of rhizobium inoculation and FYM with some bio-stimulants extracts on vegetative growth characters of the broad bean during 2023/2024 and 2024/2025 seasons

Interaction A B	No. of leaves / plant		No . of branches / plant		Plant height (cm)		Plant fresh weight (g)		Plant dry weight (g)	
	2023/ 2024	2024/ 2025	2023/ 2024	2024/ 2025	2023/ 2024	2024/ 2025	2023/ 2024	2024/ 2025	2023/ 2024	2024/ 2025
Control × Control										
Seaweed	107.000	113.000	6.333	4.666	41.000	32.000	167.000	171.666	15.300	14.200
Dry yeast	144.000	151.000	6.666	5.000	60.333	42.333	186.000	193.000	16.233	14.500
	172.000	182.000	10.333	10.333	65.000	52.333	271.000	254.000	17.066	17.833
Rhizobium × Control	97.000	103.666	2.666	4.000	48.000	52.666	164.000	141.666	16.233	17.000
Seaweed	107.0000	117.000	5.666	5.000	58.333	62.000	170.333	152.666	16.733	17.266
Dry yeast	206.000	217.000	7.333	9.000	63.666	71.666	352.666	214.666	19.733	20.033

FYM × Control	113.333	135.666	6.000	6.000	62.333	52.000	172.333	146.666	18.066	13.936
Seaweed	122.000	213.000	7.666	7.000	62.666	58.666	182.000	161.666	20.466	15.800
Dry yeast	268.000	224.666	10.333	10.000	68.666	76.666	362.000	219.000	22.666	18.566
LSD 0.05	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Table (7a) : Effect of soil fertilizers and some bio-stimulants extracts on the yield and its components of broad bean during 2023/2024 and 2024/2025 seasons

Treatments	**No. of pods / plant**		**No. of seeds / pod**	
A	2023/2024	2024/2025	2023/2024	2024/2025
Control	6.555	8.222	4.555	4.000
Rhizobium	7.666	9.000	4.555	4.777
FYM	9.333	9.555	5.000	6.000
LSD 0.05	1.226	1.288	0.948	1.126
B foliar spray				
Control	6.222	7.444	4.222	4.555
Seaweed	7.888	8.333	4.444	4.555
Dry yeast	9.444	11.000	5.444	4.666
LSD 0.05	1.226	1.288	0.948	1.126

Table (7b) : Effect of soil fertilizers and some bio-stimulants extracts on the yield and its components of broad bean during 2023/2024 and 2024/2025 seasons

Treatments	**Pod fresh weight (g)**		**Pod dry weight (g)**		**Pod length (cm)**		**Pod diameter (cm)**	
A	2023/ 2024	2024/\ 2025	2023/ 2024	2024/ 2025	2023/ 2024	2024/\ 2025	2023/ 2024	2024/ 2025
Control	19.666	18.555	6.186	6.022	12.555	12.222	4.666	6.888
Rhizobium	21.000	21.444	8.269	7.311	13.555	14.333	6.333	7.444
FYM	28.444	34.444	13.458	9.224	14.222	15.555	8.666	10.888
LSD 0.05	2.020	1.452	2.315	1.305	0.082	0.683	1.472	1.511
B foliar spray								
Control	18.666	18.555	4.869	6.171	12.555	13.111	5.444	6.000
Seaweed	24.555	25.777	9.566	7.644	13.333	14.444	6.555	9.444
Dry yeast	25.888	30.111	13.478	8.742	14.444	15555	7.666	9.777
LSD 0.05	2.0	1.45	2.3	1.30	0.07	0.55	1.47	1.51

Table (7c) Effect of rhizobium inoculation and FYM and some bio-stimulants extracts on the yield and its components of broad bean during 2023/2024 and 2024/2025 seasons

Treatments	**Seed weight / pod (g)**		**Total pod yield (ton / fed)**	
A	2023/2024	2024/2025	2023/2024	2024/2025
Control	6.140	6.155	4.155	4.173
Rhizobium	6.253	6.274	4.277	4.300
fym	6.566	6.588	4.700	4.501
LSD 0.05	0.035	0.183	0.006	0.007
B foliar spray				
Control	5.695	5.641	3.707	3.651
Seaweed	6.326	6.370	4.381	4.330
Dry yeast	6.937	7.007	5.044	4.993
LSD 0.05	0.035	0.183	0.006	0.007

Table (8a) : The interaction effect of rhizobium inoculation and FYM with some bio-stimulants extracts on the yield and its components of broad bean during 2023/2024 and 2024/2025 seasons

Interaction A B		No. of pods / plant		No. of seeds / pod	
		2023/2024	2024/2025	2023/2024	2024/2025
Control×	Control	3.666	5.000	4.0000	3.666
	Seaweed	7.666	8.666	4.333	4.000
	Dry yeast	8.333	11.000	5.333	4.333
Rhizobium ×	Control	4.333	6.000	3.333	4.444
	Seaweed	8.333	10.333	4.666	4.666
	Dry yeast	10.333	10.666	5.666	5.000
FYM ×	Control	6.666	7.000	4.666	4.333
	Seaweed	9.666	10.333	5.000	6.000
	Dry yeast	11.666	11.333	5.888	7.444
LSD 0.05		N.S	N.S	N.S	N.S

Table (8b) : The interaction effect of rhizobium inoculation and FYM **with** some bio-stimulants extracts on the yield and its components of broad bean during 2023/2024 and 2024/2025 seasons

Interaction A B	Pod fresh weight (g)		Pod dry weight (g)		Pod length (cm)		Pod diameter (cm)	
Control× Control	2023/2024	2024/2025	2023/2024	2024/2025	2023/2024	2024/2025	2023/2024	2024/2025
Seaweed	17.333	13.666	1.656	3.533	12.333	12.000	3.000	4.000
Dry yeast	18.000	17.333	1.966	6.200	14.666	13.333	4.666	7.333
	23.666	24.666	14.933	8.333	15.666	15.333	6.333	9.333
Rhizobium × Control	13.666	14.666	4.340	4.733	12.666	12.333	4.666	6.000
Seaweed	20.000	15.000	4.566	7.533	13.333	13.666	6.333	6.333
Dry yeast	29.333	31.000	15.900	9.666	15.666	15.000	8.000	10.000
FYM × Control	18.666	27.333	8.073	7.446	12.000	12.000	7.000	7.666
Seaweed	42.000	45.000	9.600	8.226	13.000	13.060	8.666	9.000
Dry yeast	24.666	34.666	22.700	12.000	15.666	14.661	10.333	16.000
LSD 0.05	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Table (8c) : The interaction effect of rhizobium inoculation and FYM with some bio-stimulants extracts on the yield and its components of broad bean during 2023/2024 and 2024/2025 seasons

Interaction A B	Seed weight / pod (g)		Total pod yield (ton / fed)	
Control×	2023/2024	2024/2025	2023/2024	2024/2025
Control	5.130	5.140	3.150	3.170
Seaweed	6.146	6.163	4.153	4.166
Dry yeast	7.143	7.163	5.163	5.183
Rhizobium×				
Control	5.240	5.210	3.220	3.286
Seaweed	6.270	6.293	4.270	4.296
Dry yeast	7.250	7.270	5.293	5.316
FYM×				
Control	5.700	5.500	3.700	3.500
Seaweed	6.600	6.700	4.700	4.503
Dry yeast	7.400	7.566	5.700	5.500
LSD 0.05	0.011	0.012	0.05	0.06

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