The Effect of The Dates of Application of Biohealth Fertilizer and Levels of Mineral Fertilization on The Yield and Components of The Legume Crop (Vicia Faba L.)

Wissam Abood Rebeh¹, Safaa Abd AL-hassan AL-Zubaidy² and Riyadh Jabbar Mansoor Al-Maliki ³

¹²Department of Field Crops, College of Agriculture, Al-Qasim Green University, Iraq.
³Department of Field Crops, College of Agriculture, Waist University, Iraq.

Email : wissam009@Gmail.com

Abstract

A field experiment was conducted during the winter semester 2020-2021 in Wasit Governorate - University of Wasit - College of Agriculture, Iraq. In loamy sandy soils to study the effect of dates application for Biohealth biological fertilizer in (growth stage, elongation stage and growth and elongation stage) + with (0%, 25%, 50%, 75%, 100%) from the mineral fertilizer recommendation for some plant traits in Broad bean (Vicia Faba L.). The experiment was Indicated according to a split-plots system using a randomized complete block design by three replications. A results of the study showed significant superiority in adding biological fertilizer in growth and elongation stage with highest mean of the yield and its components, Amount to (plant pods number 15.45 pod plant⁻¹ and the number of seeds per pods 5.02 seed pod⁻¹ and 100 seed weights 119.17 g and green pods yield 14.29 t ha⁻¹ and seed yield 4.45 t ha⁻¹ and biological yield 11.00 t ha⁻¹). It also significantly outpered the addition of biological fertilizer + with 75% of the recommendation for mineral fertilizer with highest mean of yield and its components, Amount to (plant pods number17.75 pod plant⁻¹ and number of seeds per pods 5.71 seed pod⁻¹ and 100 seed weights 122.72 g and green pods yield 16.21 t ha⁻¹ and seed yield 4.72 t ha⁻¹ and biological yield 11.57 t ha⁻¹). The interactions showed a significant effect on yield characteristics and its studied components, as the interaction treatment exceeded date of adding biological fertilizer + with 75% of fertilizer recommendation at growth and elongation stage highest mean of studied characteristics.

Keywords: Broad bean, Bio-fertilization, Biohealth, Mineral Fertilizer.

1. Introduction

As considered Broad bean (Vicia faba L.) a fall leguminous crop. It is a main food for millions of people in poor countries because of its high protein content from 25 to 45% and it contains amino acids, including (Lysine, Lucin, Arginine). In addition to carbohydrates 48-54%, minerals and vitamins [1]. Mineral fertilizers applictions in cereal and leguminous crops may be increase productivity up to 50% [2]. However, unexamined additions of mineral fertilizers have direct negative effects represented by damaging living components of the ecosystem, human health, animal and plant health itself. In addition to indirect effects that effect the components of the system, water, air, and soil, causing an imbalance in composition of its elements and their natural balance [3]. Bio-fertilizers are additives of microbial origin that contain bacterial or fungal cells or both, which added to seeds, plants or soil directly, and work to increase the readiness of plant nutrients and thus increase growth and production. Bio-fertilizers are of great importance in plant fertility and its surround , as they work to provide one or more nutrients necessary for plant growth by which mineral fertilizers can be reduced, in addition to encouraging plant to secrete some hormones and beneficial stimulants for growth [4], [5], indicated when using dates of adding biological fertilizer (flowering stage and seed formation) showed a significant differences of yield characteristics and components, addition at stage of fruit formation had a significant effect by giving highest mean in the characteristic of the weight the pods, pods number, the number seeds pod, 100 seed weights and seed yield. [6], showed the addition of biological fertilizer + with 50 and 75% of fertilizer recommendation led to increase seed yield, A fertilizer contributed to the phosphorous processing of plant, thus contributed in improve production of crop. [7], noted the biohealth fertilizer stimulated leguminous plants to grow and achieve an increase in wet weight of plant and green pods yield measured by the no-addition treatment. In the study by [8], it was found a biological fertilizer reduced level of mineral fertilizers which is added to Broad
bean to 50% of a fertilizer recommendation in plant yield character which gave 173.22 g plant while the comparison treatment was 82.7 g plant.

2. Materials and Methods

A field experiment was conducted during the fall season 2020-2021 in Wasit Governorate - University of Wasit - College of Agriculture, Iraq. In sandy loamy soils (Table 1), to study the effect of dates application for a Biohealth biological fertilizer in growth stage and elongation stage and growth and elongation stage + with (0, 25%, 50%, 75%, 100%) from the mineral fertilizer recommendation the yield and its components in Broad bean (Vicia Faba L.). The experiment was carried out according to a split plots arrangement in randomized complete design with three replicates, each with 45 experimental units. The experiment included two factors: the first factor included three dates for adding the biological fertilizer (the growth stage (D1), elongation stage (D2), growth and elongation stage (D3)). The second factor included the combination of biological fertilizer and levels mineral fertilizer. Random samples were taken at a depth of 0-30 cm before planting for the experiment land and for different sites and analyzed in the laboratory of the Soil Department at the College of Agriculture - University of Wasit, the results of which are shown in Table (1).

| Character       | Value  | Character       | Value  |
|-----------------|--------|-----------------|--------|
| PH              | 7.4    | Bulk density mg.m⁻³ | 1.19   |
| Ec dS.m⁻¹       | 3.35   | Organic matter %  | 0.61   |
| Available N mg.kg⁻¹ | 36.4   | Sand (g.kg⁻¹)    | 524    |
| Available P mg.kg⁻¹ | 12.29  | Silt (g.kg⁻¹)    | 362    |
| Available K mg.kg⁻¹ | 137.55 | Clay (g.kg⁻¹)    | 114    |
| Soil texture:   | Alluvial sandy soil |

Broad bean seed cultivated in the field on October 12, 2020 in ridges, two meters long, 0.75 meters wide and two ridges for the experimental unit. Phosphate fertilizer was added in the form of triple superphosphate 120 kg P₂O₅.h⁻¹ as one batch when plowing. Whereas, nitrogen fertilizer was added in the form of urea fertilizer (46% N) at 100 kg. h⁻¹ in two batches, the first after 30 days of germination and the second after 30 days from first batch [9]. When green pods were ripened following traits were calculated:

2.1. Plant pods number

The total number of pods produced from five plants were taken randomly and divided by the number of plants and the mean was recorded for all experimental units.

2.2. The number of seeds per pods

it was taken 10 pods randomly from the pods yield for each experimental unit and calculated the number of seeds in pods and estimated their averages.

2.3. 100 seed weights (g)

A random sample of 100 seeds were taken, after collecting and mixing seeds for each experimental unit and weighed with a sensitive scale [10].

2.4. Green pods yield (ton. h⁻¹)

The mean of plant yield was calculated on a basis of plant density by multiplying the pod yield on one plant in a plant density then conversion was to (ton. h⁻¹).

2.5. Seeds yield (ton. h⁻¹)

After calculating mean seed yield per plant then calculating total seed yield based on plant density and converting it into (ton. h⁻¹).
2.6. Biological yield (ton.h⁻¹)

All parts of plant were harvested above soil surface for five plants randomly from each experimental unit, firstly, it is dried, after it is dried by using an electric oven at a temperature of (65) degrees (72) hours, weighed until a stability of weight then conversion was to (ton. h⁻¹) on a basis of plant density [11].

The results of the experiment were analyzed statistically according to method of analysis of variance using the randomized complete block design (R.C.B.D), a significant differences between coefficients were calculated at 0.05 significance level for the least significant difference LSD, by Genstat program of statistical analysis.

3. Results and Discussions

3.1. Yield components

The results of table (2) showed that there is a significant difference between dates of adding the bio-fertilizer as date (D3), which it achieved highest values for mean number of pods per plant amount to 15.45 pod, number of seeds per pods 5.02 seed pod⁻¹ and 100 seed weights 119.17 g, while the date (D1) was showed lowest averages of the traits: number of pods per in plant amount to 12.37 pod plant⁻¹, number of seeds per pods 4.02 seed pod⁻¹ and 100 seed weights 114.11 g. This attributed to addition of biological fertilizer at different stages of growth may be encourage plant vegetative growth and thus increase the rate of photosynthesis which in turn increases production of organic materials necessary for flowers, hence may be lead to increase number of pods, number of seeds in pods and weight of seeds, these results are consistent with results [10].

The combination of biohealth bio-fertilizer and levels of mineral fertilizer exhibited a significantly different in the mean traits of Broad bean plant. The treatment (A3) showed highest mean of number of pods per in plant 17.75 pod, the number of seeds per pods 5.71 seed and 100 seed weights 122.72 g. Whereas, the control treatment gave lowest mean number of pods per in plant 10.17 pod, number of seeds per pods 3.44 seed and weight of 100 seed 110.48 g.

Availability of nutrients such as nitrogen and phosphorus could be increases strength of growth and photosynthesis, which leads to an increase in a yield and its components to the plant. Also, the availability of phosphorus component element works to development root system, this leads to encouraging vegetative growth and increasing the leaf area and number of branches for a plant this is reflected of increasing a number of pods for a plant. This is consistent with [8,9].

The interaction between dates of addition and a combination of a bio-fertilizer biohealth and mineral fertilizer the yield components of a plant significantly affected, the interaction treatment (D3*A3) gave a highest mean number of pods in plant amount to 20.33 pod, the number of seeds per pods 6.50 seed and 100 seed weights 127.11 g compared with interfering treatment (D1*A0) which showed a lowest mean for these components were 9.83 pod, 3.25 pod seeds and 109.27 g per in plant.

The results of Table (3) showed a significances difference between dates of adding the biological fertilizer, the date (D3) gave the highest mean for green pods yield 14.29 ton. h⁻¹ and seed yield 4.45 t h⁻¹ and the biological yield 11.00 ton. h⁻¹, while the date (D1) gave a lowest mean the green pods yield 11.55 ton. h⁻¹, the seed yield 3.25 ton. h⁻¹ and the biological yield 8.95 ton. h⁻¹. The addition of biological fertilizer at different dates had achieved significant for all studied characteristics, due to it is in line with stages of plant growth according to the actual need of growth stage, subsequently a yield is a real reflection of increasing in, its components.

The combination of biological fertilizer (Biohealth) and levels of mineral fertilizer had a significant effects, the treatment (A3) showed a highest mean for a green pods yield 16.21 ton. h⁻¹, seed yield 4.72 ton. h⁻¹ and a biological yield 11.57 ton. h⁻¹, whereas control treatment exhibited a lowest mean for a green pods yield t 8.68 ton. h⁻¹, the seed yield 2.94 ton. h⁻¹ and the biological yield 7.96 ton. h⁻¹. The increase in yield due to an addition of biological fertilizers is to fact that a biological fertilizers may be increased number of pods, number of seeds in the pod and the weight 100 seeds, thus increase the yield of seed and pods and the biological yield, this agree with [9]. Furthermore, the presence of fertilized organisms in the soil may be lead to an increase in production of green pods by increasing the production of growth regulators, hence encouraging vegetative growth and having a greater number of root nodes, which results increasing atmospheric nitrogen and delaying an aging of plants, subsequently increasing a duration of seed filling, which it leads to an increase in their weight and this In turn, increases the yield and its components.

The interaction between dates of addition and a combination of the bio-fertilizer biohealth and mineral fertilizer the characteristics the yield of pods and seeds and biological yield showed significantly different. The interaction treatment (D3*A3) gave a highest mean for adjectives compared with the interaction treatment (D1*A0) which gave a lowest mean on adjectives the yields pods and seeds and biological yield.
Table 2. Effect of dates of adding and fertilizer of combination on plant pods number, The number of seeds per pods, weights (100) seed Yield.

| Treatments          | Plant pods number | The number of seeds per pods | Weights (100) Seed (g) |
|---------------------|-------------------|------------------------------|------------------------|
| dates of application|                   |                              |                        |
| D1                  | 12.37             | 4.02                         | 114.11                 |
| D2                  | 13.80             | 4.50                         | 116.48                 |
| D3                  | 15.45             | 5.02                         | 119.17                 |
| LSD(0.05)           |                   |                              |                        |
| fertilizer of combination|               |                              |                        |
| Control             | 10.17             | 3.44                         | 110.48                 |
| A1                  | 11.61             | 3.87                         | 114.14                 |
| A2                  | 15.06             | 4.69                         | 118.01                 |
| A3                  | 17.75             | 5.71                         | 122.72                 |
| A4                  | 14.78             | 4.87                         | 117.57                 |
| LSD(0.05)           |                   |                              |                        |
| Interaction         |                   |                              |                        |
| D1× Control         |                   |                              |                        |
| D1× A1              | 9.83              | 3.25                         | 109.27                 |
| D1× A2              | 10.17             | 3.50                         | 111.89                 |
| D1× A3              | 13.00             | 4.11                         | 115.42                 |
| D1× A4              | 16.00             | 5.03                         | 118.80                 |
| D2× Control         | 12.83             | 4.23                         | 115.17                 |
| D2× A1              | 10.10             | 3.58                         | 110.45                 |
| D2× A2              | 12.50             | 4.00                         | 114.00                 |
| D2× A3              | 15.00             | 4.63                         | 118.45                 |
| D2× A4              | 16.92             | 5.61                         | 122.25                 |
| D2× A4              | 14.50             | 4.71                         | 117.24                 |
| D3× Control         | 10.58             | 3.50                         | 111.73                 |
| D3× A1              | 12.17             | 4.13                         | 116.53                 |
| D3× A2              | 17.17             | 5.33                         | 120.17                 |
| D3× A3              | 20.33             | 6.50                         | 127.11                 |
| D3× A4              | 17.00             | 5.66                         | 120.30                 |
| D3× A4              | 1.90              | 0.51                         | 1.84                   |
| LSD(0.05)           |                   |                              |                        |
Table 3. Effect of dates of adding and fertilizer of combination on green pods yield, seed yield, biological yield.

| Treatments dates of application | Green pods yield (ton/h) | Seed yield (ton/h) | Biological yield (ton/h) |
|--------------------------------|--------------------------|--------------------|-------------------------|
| D1                             | 11.55                    | 3.25               | 8.95                    |
| D2                             | 12.75                    | 3.81               | 9.76                    |
| D3                             | 14.29                    | 4.45               | 11.00                   |
| LSD(0.05)                      | 0.64                     | 0.20               | 0.58                    |
| fertilizer of combination      |                          |                    |                         |
| Control                        | 8.68                     | 2.94               | 7.96                    |
| A1                             | 11.12                    | 3.38               | 9.08                    |
| A2                             | 14.22                    | 4.12               | 10.50                   |
| A3                             | 16.21                    | 4.72               | 11.57                   |
| A4                             | 14.09                    | 4.03               | 10.41                   |
| LSD(0.05)                      | 0.59                     | 0.18               | 0.62                    |
| Interaction                    |                          |                    |                         |
| D1 x Control                   | 8.03                     | 2.61               | 7.76                    |
| D1 x A1                        | 10.13                    | 2.84               | 8.34                    |
| D1 x A2                        | 12.25                    | 3.49               | 9.25                    |
| D1 x A3                        | 14.81                    | 3.91               | 10.31                   |
| D1 x A4                        | 12.53                    | 3.42               | 9.09                    |
| D2 x Control                   | 8.93                     | 3.05               | 8.04                    |
| D2 x A1                        | 10.66                    | 3.44               | 9.02                    |
| D2 x A2                        | 14.25                    | 4.07               | 10.20                   |
| D2 x A3                        | 16.05                    | 4.53               | 11.24                   |
| D2 x A4                        | 13.88                    | 3.97               | 10.30                   |
| D3 x Control                   | 9.10                     | 3.15               | 8.09                    |
| D3 x A1                        | 12.56                    | 3.87               | 9.86                    |
| D3 x A2                        | 16.16                    | 4.80               | 12.06                   |
| D3 x A3                        | 17.78                    | 5.71               | 13.15                   |
| D3 x A4                        | 15.86                    | 4.72               | 11.86                   |
| LSD(0.05)                      | 1.03                     | 0.32               | 1.62                    |

Conclusions

An addition of a biological fertilizer Biohealth had a significant effect to increase the yield and its components of Broad bean crop. The dates of adding biological fertilizer in growth and elongation stages superiority in all the attributes studied the yield and its components. It also significantly outpered when addition of bio-fertilizer Biohealth with 75% mineral fertilizer recommended for all the yield and its components studied.

The addition of bio-fertilizer reduced a quantities of the added mineral fertilizer to half, as the results of adding the Biohealth + 50% of the mineral fertilizer recommendation did not significantly different with the addition treatment Biohealth + 100% of the mineral fertilizer recommendation In most the attributes the yield and its components the studied.
References

[1] A.O.A.C. 1975. Official method of analysis. 10th Edn. Association of Official Analytical Chemists. Washington, D. C. P.115.

[2] Abd-Al-Hadi, A.; A. S. Mahmoud and B. A. Kanaan. 2018. The role of the biofertilizer of local isolates rhizobium and pseudomonas strains in reducing the level of the fertilizer recommendation of the plant. Anbar Journal of Agricultural Sciences, 16(1): 705 - 719.

[3] Al-Taey DKA, Mijwel AK, and Al-Azawy SS. 2018. Study efficiency of poultry litter and kinetin in reduced effects of saline water in Vicia faba. Research J. Pharm. and Tech. 2018; 11(1): 294-300.

[4] Al-Khafajy RA, Al-Taey DKA and Al-Mohammed MHS. 2020. The impact of Water Quality, Bio fertilizers and Selenium Spraying on some Vegetative and Flowering Growth Parameters of Calendula Officinalis L. under Salinity Stress. Int. J. Agricult. Stat. Sci., 16, Supplement 1: 1175-1180. https://connectjournals.com/03899.2020.16.1175

[5] Al-Tawaha ARM, Al-Tawaha A, Sirajuddin SN, McNeil D, Othman YA , Al-Rawashdeh IM, Amanullah, Imran, Qais AM, Jahan N, Shah MA, Khalid S, Sami R, Rauf A, Thangadurai D, Sangeetha J, Fahad S, Yousef RA, Al-Taian WA, Al-Taey DKA. 2020. Ecology and adaptation of legumes crops. IOP Conf. Series: Earth and Environmental Science 492. doi:10.1088/1755-1315/492/1/012085

[6] Attia, Hayawi, Yeh, Evan Abdel-Hassan Muhammad Ali, and Solaf Hamid Temoz. 2018. The Effect of Integration by Bio-fertilization, Organic and Metallic in the Growth of the Product and the Output of Luz-be-otono and Absorption of Some Nutrients. J. Babylon Uni, Pure and Applied and Engineering Sci. 26(2): 107-118.

[7] Bashour, E.; M. Al-Fouly, A. Al-Sayegh, D. Anak, H. Abu Al-Haq, N. Baba Doblus and N. Ahmed. 2007. A guide to the use of fertilizers in the Near East. FAO. Rome. P.9.

[8] Dongare, D. M.; G. R. Pawar., S. B. Murumkar, and D. A. Chavan. (2016). To study the effect of different fertilizer and biofertilizer levels on growth and yield of summer greengram. Internat. J. agric. Sci., 12 (2) : 151-157.

[9] JASIM, A. H. and D. S. KHUDAIR. 2018. Effect of bio- and chemical fertilizers on some vegetative growth of broad bean cultivars. Annals of West University of Timişoara, ser. Biology, 21(2) : 207 - 216.

[10] Mouhanna, Ahmad. 2016. The Effect of Rates and Times of Spraying Bio-fertilizer on Growth and Yield of Peanut crop in Tartous. Al-Baath University Journal. 38(23): 33-59.

[11] Sahuki, Medhat Majeed. 1990. Yellow Maize Production and Improvement. Ministry of Higher Education and Scientific Research, University of Baghdad.