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Research article

EFFECT OF FERTILIZER APPLICATION ON VEGETATIVE GROWTH CHARACTERS OF BROAD BEAN (*VICIA FABA* L.)

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ABSTRACT: The investigation was conducted at the field crops department, Faculty of Agricultural Sciences, to study the effect of different application of Chemical and natural manures on the growth and development of broad bean as a module legume crops. The experiment was run, in the pots of 10L size, with 3 replicates in CRD for 6 levels of chemicals and natural manures, including the control (normal soil). The results indicated the significant different between all the treatment means with LSD comparison. Manure fertilization for 50% and 30% were the best applications for all characteristics studied especially the root growth and the *Rizobium* bacterial nodulation. The applications of higher performance for this experiment were recommended as a good substitution for chemical fertilizer to reduce the agricultural production input and better corporation of Nitrogen fixation with the less pollution and higher yield.

Key words: Fertilizer, Vegetative growth, Broad bean

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INTRODUCTION

The broad bean or faba bean (*Vicia faba*) is a member of the vetch family and grows in temperate regions. Archaeological evidence suggests that it was one of the first foods cultivated by man. It remained an important part of the diet throughout the middle Ages, being able to be dried for storage over long periods, until it was superseded by the potato in the 16th century. Nutritionally, it is a good source of vitamins A and C, as well as potassium and iron [1]. Fababean Family (Fabaceae) is consumed worldwide as an important source of plant protein for humans and animals [2]. Fababean seeds contain 51-68% total carbohydrates [3] 28-30% protein [4]. Broad bean (*Vicia faba* L.) is a famous winter leguminous crops in Iraq. It is considered as good source of vegetarian protein for human consumption, and it is cultivated in crop rotations to improve soil properties [5]. Shifting from biological to industrial sources of nitrogen (N) from 20th century in agricultural production is one of most important steps in raising the agriculture section toward higher level of production and profound transformations in agriculture. [6]. Faba beans are among the best legume crops to increase and restore organic matter in the soil, in developing countries and arid zones [7]. The low nutrient and degraded status of many soils is a particular problem for small landholders, as many cannot afford to use artificial fertilizers. Legume yields are less dependent upon an external supply of nitrogen fertilizer (although most do respond to additional nitrogen) and the ability of most of them to grow in poor soils has favored their cultivation [8]. Faba bean (Vicia fabae) is ranked first among cool season food legumes based on area of production and foreign exchange earnings [9]. Besides to strain inoculation, application of chemical fertilizer, particularly nitrogen and phosphorus, are needed to improve the production of the crop [10]. Effect of rhizobia inoculation, farm yard manure and nitrogen fertilizer on nodulation and yield of food grain legumes. The same author indicated that nitrogen is required as starter fertilizer at the early growth stage since there is no nodule formation where atmospheric nitrogen is fixed. Phosphorus deficiency is also another significant factor that reduces the nodulation since both effective rhzobium bacteria and the crop require in larger quantity [11].

The world will not be able to meet its food production goals without biotechnology and improved genetics, and without fertilizer. Commercial fertilizer is responsible for 40 to 60% of the world's food production. Thus, the world has to depend on the Fertilizer application to meet the food demand [12]. It is recognized that nitrogen is one of the key elements of soil fertility. Most of the developed countries are harvesting high yields and maintaining the soil nitrogen level by the application of chemical nitrogenous fertilizer [13]. Chemical and organic fertilizers are an essential process in plant management. Adequate fertilizers led to increase the crop yields, improves the nutrient element concentration in plant tissue and soil macro and micro nutrient status. Chemical fertilizers are expensive and harmful effects on the environment [14]. They are an important part of subsistence agriculture as in addition to providing a protein-rich food they also improve the soil structure [15].
Therefore recommended the addition of organic matter (animals manure, humic acid and seaweed extract) as an alternative to chemical fertilizers [16]. The objective of the current study was to estimate the effect of different levels of chemical and manure fertilizer on the vegetative growth characters especially the nodulation activity of legume crop. Broad bean as a model legume plant was the plant materials in this investigation. Optimization for the suitable soil condition was estimated from different levels of fertilizer sources, to emphasize the optimum activity of atmospheric N_2 fixation in broad bean.

MATERIALS AND METHODS

This study was conducted at the University of Sulaimani - Faculty of agricultural Sciences, Field crops department for the academic year 2013 – 2014. It was started in 19^{th} January 2014. The experiment was run in the pots, three levels of natural manure and there levels of nitrogen fertilizer (Urea) with the control were the experiment treatments, in Complete Randomized Design with three replications. The treatments applied in this study were: zero level (control), 10% manure (Patmos), 30% manure, 50% manure, 80 kg urea/ha, 140 kg urea/ha and 200 kg urea/ha. The pot size used was 10 L each. The percents of natural manure were conducted depends on the total volume of the soil used in the pots. The levels of chemical fertilizer were counted depends on amount of fertilizer per unit area of the land and then converted to the areas occupied by the plants in the pot. Ten seeds were planted in each pot to guarantee the availability of plant for all replicates. Passing three weeks of planting the number of seedling inside all pots were thinned to two plants. Urea as a chemical fertilizer and Peat moss (compost) were utilized for the different application treatments. Data was recorded for the plant characteristic until the flowering stage. The measurements were recording at the beginning of flowering stage 27^{th} – 28^{th} April 2015 for the following traits: Plant height (cm), branch number/plant, leaf number/ plant, flower number/ plant, pod length (cm), shoot dry weight (g), root length (cm), root nodule/ plant, nodule diameter (cm) and Root dry weight (g). Data collected from the experiment was analyzed with the CDR Design using XLSTAT analyzer software.

RESULTS AND DISCUSSION

The result of all traits studied were indicated the significant differences between the treatments for most of the traits studied, however leaf and branch number/ plant with the shoot weight trait were not significant in the CRD analysis (Table 1 and 2).

Table-1: Mean Square of Variance Analysis of some Characters

S.O.V	d.f	Mean squares				
		Leaf number/plant	Branch number/plant	Flower number/plant	Plant height (cm)	Pod length(cm)
Treatment	6	$32.761^{N.S}$	$0.317^{N.S}$	3.270*	847.936*	18.539*
Exp. Error	14	14.333	0.238	0.524	48.666	4.571

Table-2: Mean Square of Variance Analysis of root measurements and biomass

S.O.V	d.f	Mean squares				
		Root Length (cm)	Nodule Length (mm)	Root Nodule/plant	Root Weight (g/plant)	Shoot Weight (g/plant)
Treatment	6	54.714*	14.984*	3673.492*	0.647*	$19.014^{N.S}$
Exp. Error	14	11.619	3.523	54.523	0.057	9.722

Leaf number/plant

Although the mean square of statistical analysis for this trait indicated non-significant differences ($P \leq 0.05$) between the treatments, the comparison test revealed that both the treatments of 50% and 30% manure were significantly different from 10% manure. These two treatments were no significantly different with others (Table3). The highest value was 23.00 cm achieved by the % 50 manure and the lowest value was 12.667 cm recorded with 10% manure. Non significant indication for this trait might be came from the miscounting of the significant level for different treatments which thought to be resulted in increasing the experiment error, enabling the significant of the trait to be hindered due to this reason.

Table-3: Effect of chemical and organic fertilizer upon some growth characters

Treatment	Leaf number/plant	Branch number/ plant	Flower number/plant	Plant Height (cm)	Pod Length (cm)
Control	16.667 ab	2.667 ab	4.333 bc	41.667 b	3.667 c
10% manure	12.667 b	2.333 ab	5.667 a	75.667 b	5.000 bc
30% manure	19.000 a	2.667 ab	6.333 a	65.667 a	7.333 bc
50% manure	23.000 a	3.000 a	6.000 a	83.000 a	11.333 a
80 kg urea /ha	14.667 b	2.333 ab	5.333 ab	79.000 ab	5.333 bc
140 kg urea /ha	18.000 ab	2.000 b	4.000 c	82.333 ab	7.667 ab
200 kg urea /ha	18.333 ab	2.667 ab	3.667 c	48.333 ab	7.333 bc
L.S.D (P≤0.05)	6.631	0.855	1.268	12.218	3.745

Branch number/plant

The LSD comparison of the treatments means shows that Branch number was significantly ($P \leq 0.05$) influenced due to application of manure and chemical fertilizer (Table1). The highest branch number (3) recorded with 50% manure was significantly different from 145 Kg. Urea/ha, which had the lowest branch number (2).

Flower number/plant

Table (1) and Appendix (1) show that flower number was significantly ($P \leq 0.05$) influenced due to application of organic and chemical fertilizer. The highest value was 83.00 cm achieved by the 50% manure fertilizer and the lowest value was 41.66 cm recorded with the control.

Table-4: Effect of chemical and organic fertilizer upon root diameters and biomass

Treatment	Root Length (cm)	Nodule diameter (mm)	Root Nodule/ plant	Root Weight (g/plant)	Shoot Weight (g/plant)
Control	12.667 c	8.667 a	25.667 bc	1.633 b	9.550 b
10% manure	17.333 bc	7.333 ab	79.333 a	1.433 b	10.100 b
30% manure	22.667 ab	6.333 abc	92.667 a	2.467 a	14.733 ab
50% manure	25.333 a	5.333 bc	81.000 a	2.367 a	16.600 a
80 kg urea /ha	17.333 bc	3.667 cd	11.667 d	1.483 b	11.610 ab
140 kg urea /ha	17.667 bc	2.000 d	15.000 cd	1.670 b	12.533 ab
200 kg urea /ha	15.667 c	5.000 bcd	28.667 b	1.290 b	11.453 ab
L.S.D (P≤0.05)	5.970	3.288	12.932	0.421	5.461

Plant height (cm)

Table 1 and Appendix 1 shows that plant height was significantly ($P \leq 0.05$) influenced due to application of fertilizer. The highest value 83.00 cm was obtained by the treatment of 50% manure fertilizer; while the lowest value of 41.66 cm was recorded for the control**.**

Pod length (cm)

Pod length was significantly ($P \leq 0.05$) influenced due to application of organic and chemical fertilizer (Table 1 and Appendix 1). The highest value was 11.333 cm achieved by the 50% manure treatment and the lowest value was 3.667 cm recorded without any addition (control).

Root length (cm)
Like most other traits studied the root length recorded at flowering stage was significantly ($P \leq 0.05$) different with different treatments (Table 2 and 4). The highest value was 25.333 cm recorded by 50% manure fertilizer while control had the shortest root length (12.667 cm). The condition of soil with the highest amount of patmos caused to create the best soil structure allowing the root to be extend in such soil combination.

Nodule diameter (mm)
It is clear from Table 2 and Appendix 2 that Nodule size was significantly ($P \leq 0.05$) influenced due to fertilizer application. The highest value was 8.67 mm achieved by the % 50 manure fertilizers and the less diameter for the bacterial nodule was 2.0 mm. The result for this trait described that normal soil without any addition had the biggest influence on the activity of bacterial nodulation in this crop, followed by 10% manure and 30% manure, consequently.

Root nodule/plant
However the size of nodule without any fertilization was surpassed all other treatments, the number of nodules/ plant gave different result. Table 2 and Appendix 2 show that root node was significantly ($P \leq 0.05$) influenced due to application of organic and chemical fertilizer. The highest value of nodule number (92.6) was achieved by 30% manure, followed by 50% and 10% of manure. It is very obvious here that the number of nodule was educed by different levels of Urea applications. This result may indicate that higher doses of chemical fertilizer, particularly nitrogen, might suppress the nodulation potential of the crops [17 and 18].

Root weight (g)
Table 2 and Appendix 2 show that root weight was significantly ($P \leq 0.05$) influenced due to application of organic and chemical fertilizer. The trait values had similar pattern to the nodule number/ plant. The highest root weight was referred to the manure application by 30% (2.47 g/plant), followed by 50 of manure application. The treatment of 200 kg urea had the lowest weight of root.

Shoot weight (g)
Shoot weight was not significant statistically for the treatments of fertilizer applications (Appendix 2). While the comparison result of LSD indicated the presence of significant different between the treatments (Table 2). The highest weight of shoot system was referring to 50% manure while the lowest value was for the control.

Generally for both Tables (1 and 2) the levels of 30 and 50% of manure treatments were surpassed significantly for most of the traits compared to the chemical fertilizer levels. These result indicate that the natural manure caused to provide different necessary nutrients to the plants which gave better perform for different traits, in addition to providing better condition to (pH - 7). This also stimulated the activity of *Rizobium* bacteria to fix atmospheric nitrogen. The best ratio to give higher number of bacterial nodules at 50% of natural manure was the best approve for the above hypothesis. In addition to the Soil pH and high nutrient from 30 and 50% of natural manure the other physical properties of these two mixture ratios have made a better condition of moisture capacity and ventilation of root system. These all advantages had a clear reflex on the vegetative shoot system, as most of them were surpassed the measurements of plant for chemical fertilizer treatments.

This module can be applied for other legumes and non legumes crops to be a good substitute for chemical fertilizer, being environmentally friendly in addition to the reduction in the production input for different crops. The results will also assure practicing natural manure for the intercropping as the activity of *Rizobium* will not being affected or damped due to the nutrient providing for other companion crops.

The results recommend the manure application to different legume crops in companion to non-legume crops in the intercropping system for the following incomes. This application can contribute in the reduction of agricultural production input through substituting the application of chemical fertilizer to natural manures. In addition to the cost effectiveness the manure application will provide the best soil texture for the crop without affecting or damping the *Rizobium* activity in legume crop. Thus, the maximum benefit can be obtained from the companion legume crop.

CONCLUSIONS
The result of current investigation indicated the significant differences between the treatments for most of the traits studied. Only the mean squares of three traits (leaf number/ plant, branch number/ plant and shoot weight) were not significantly. The comparison study investigated for all traits revealed the significant different for all traits studied, including those were not significantly for their mean squares.

The treatments of 50% and 30% of manure represented the most surpassed for most of the traits especially the root properties and the nodulation of *Rizobium* bacteria. The different levels of chemical fertilizer treatments seem to have a negative effect on the activity of root and *Rizobium* nodulation. At the same time the manure application enhanced better performs of the plant activity due to provide suitable soil condition in addition to the nutrient provided through.

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