Res. on Crops **21** (1) : 59-64 (2020) DOI : 10.31830/2348-7542.2020.009
Printed in India

Response of broad bean (*Vicia faba* L.) to different depths of tillage and spraying with yeast extract

KADHIM H. HUTHILY[1,*], ABDUL KADHM N. AL-SHOAILY[2] AND MURTADHA A. A. ALFARIS[3]

[1]*Department of Field Crops Sciences*
College of Agriculture, University of Basra, Iraq
**(e-mail : aalnidawi@yahoo.com)*

(Received : November 21, 2019/Accepted : December 27, 2019)

ABSTRACT

Field experiment was conducted during the growing season of 2017-18 in Basra governorate to study the effect of three tillage depth "TD" (30, 40 and 50 cm), and spraying with three activated yeast extract "AYE" concentrations (zero, 4 and 8 g/l) on growth and yield of broad bean (*Vicia faba* L.) var. loz de onito. The experiment was carried out in a split-plot arranged with randomized complete block design with three replicates. The results showed that TD of 50 cm led to an increase in plant height, number of branches in plant, also led to a significant increase in the number of pods and number of seeds in pod by 26 and 21%, respectively, compared to the TD of 30 cm, also held green pods yield of 327.2 g/plant at TD of 30 cm increased to 547.5 g/plant at 50 cm depth. Spraying AYE at 8 g/l resulted in a significant increase for all traits that have been studied, among these traits number of pods/plant and number of seeds/pod by 16 and 22%, respectively, compared to control. The interaction gave a significant increase for plant height and green pods yield per plant, so the TD at 50 cm and 8 g/l AYE gave the highest values.

Key words : Green pods yield, tillage depth, *Vicia faba* L., yeast

INTRODUCTION

Broad bean (*Vicia faba* L.) is one of Fabaceae crops which is globally the third most important feed grain legume and produced in 58 countries on large scale (Singh *et al.*, 2013). The pods are consumed fresh or dry. It is a staple for millions of people in poor countries because it contains a high percentage of protein up to 28-36% (El-Kotb, 2013), as well to its importance as a good source for a number of vitamins such as thiamin, riboflavin and vitamin C. It contains a significant proportion of sugar and carbohydrates, amino acids as well as for use as feed for animals (Singh *et al.*, 2013). It is used as green manure and a best bio factory of nitrogen by fixing 130 to 160 kg N/ha (Hoffmann *et al.*, 2007). It can also be grown on residual soil moisture and relatively more tolerant to biotic and abiotic stresses, with minimum input (Singh and Bhatt, 2012).

The production of broad bean is affected by many agronomical (Al-Khafaji *et al.,* 2018) and environmental factors such as the tillage depth or tillage system, which improves physical, chemical and biological soil properties as well as improves the environment (Kumar *et al.*, 2012). Proper tillage management under semi-arid conditions preserves soil fertility and moisture, which increase yields (Demjanová *et al.*, 2009). The appropriateness of the depth of tillage affects production costs, emergence of seedling, bulk density, evaporation, competition of weeds and root system (Govaerts *et al.*, 2005). Sometime plough is used under the soil surface for cracking hard layers formed in the soil and improves some physical properties of the soil like porosity and bulk density to increase availability of some nutrients, increase infiltration, and then the efficiency of drainage and leaching of the soil (Adday *et al.*, 2008).

Another factor affecting and stimulating crop growth and productivity is the application of nutrients (Hassan and Lehmood, 2019) from

[2]Department of Horticulture and Landscape, College of Agriculture, University of Basra, Iraq.
[3]Department of Agricultural Mechanization, College of Agriculture, University of Basra, Iraq.

different sources like yeast extract. The yeast (*Saccharomyces cerevisiae*) are microorganisms with a single real cell nucleus (eukaryotic) contains a lot of essential minerals and trace elements, namely iron, calcium, cobalt, etc. In addition, it is a best source for some vitamins, high quality protein, auxins, cytokinins, enzymes and other bio-constituents (Amer, 2004; Mahmoud *et al*, 2013).

Studies tended recently to the possibility of using AYE as a kind of foliar fertilization. Nassar *et al*. (2011) noticed that spraying of beans (*Phaseolus vulgaris* L.) with AYE at concentration : 25, 50, 100 and 150 ml/l led to outweigh the sprayed plants with 100 and 150 ml/l compared to the less concentration, especially the vegetative growth characters, green pods and total weight of seeds.

Also, Neama *et al*. (2014) showed that the highest values of the growth traits and seed yield for broad bean as well as the percentage of protein were recorded when the plants sprayed with AYE of 6 ml/l. A number of researchers observed the improving of growth, yield and quality as a result of spraying the AYE (El-Tohamy and El-Greadly, 2007; Kamal and Ghanem, 2012; Mahmoud *et al.*, 2013).

To improve productivity and quality of broad bean and because of the scarcity of research studying the effect of the depth of soil tillage as a service factor, as well as spraying with yeast extract in the productivity of the green pods; this research was conducted.

MATERIALS AND METHODS

A field experiment was carried out during the winter season of 2016-17 in clay loam soil with salinity 6.7 dS/m using sub-soiler plow provided with shallow wings manufactured in the College of Agriculture, University of Basrah. A factorial experiment (3× 3) was implemented using a split-plot arranged with randomized complete block design, with three replicates. The field was divided into three blocks, and each block into three main plots, plowed every main plot with one of the depth studied (30 or 40 or 50 cm) by length of 15 m for each depth and then divided every main plot manually to three secondary (sub-plot), and distributed with the three levels of the second factor (spray by AYE : zero or 4 or 8 g yeast/liter water). Four rows were opened in each experimental unit 4 meters long and a distance of 60 cm between rows. The seeds of broad bean (var. loz de onito) planted in 28 October 2016 using three seeds in a hill (25 cm distance between) and two weeks after germination, the plants were thinned to two plants in a hill. One month after germination, the plants were sprayed by the studied levels of yeast extract (which was the chemical composition shown in Table 1).

The preparation of activated yeast extract done as pointed by Spencer *et al*. (1983), by melted zero or 4 or 8 g of dry pure and effective yeast in a liter of the nutrient solution (which is a 50 g of sucrose dissolved in a liter of pure distilled water) to activate the yeast, left in the solution to grow and multiply and then will produce effective components (carbohydrates, sugars, proteins, amino and fatty acids and hormones). These constituents could be released out of yeast cells in readily form by two cycles of freezing and thawing to break down yeast cells and releasing their contents. The plants were sprayed twice during the growth period (30 and 50 days after sowing) early in the morning, using a manual sprinkler of 5 liter capacity.

Before maturity, 10 plants were pointed out to take the measurements and calculations required for the yield components.

Table 1. Some components of activated yeast (mg/100 g dry yeast)*

Arginine	1.99	Serine	1.59	Inositol	0.26
Histidine	2.63	Aspartic acid	1.33	Biotin	0.09
Isoleucine	2.31	Cysteine	0.23	Nicotinic acid	39.9
Lucien	3.09	Proline	1.53	Pantothenic acid	19.6
Lysine	2.95	Tyrosine	1.49	Folic acid	4.36
Methionine	0.72	Vit. B_1	2.23	Pyridoxine	2.90
Phenylalanine	2.01	Vit. B_2	1.33	Total carbohydrates	23.2
Threonine	2.09	Vit. B_6	1.25		
Tryptophan	0.45	Vit. B_{12}	0.15	Glucose	13.3
Valine	2.19	Glutamic acid	2.00	Cobalamine	0.153

*Neama *et al.* (2014).

Data were analyzed using the SPSS (version 21) software and means were compared using the LSD test at P<0.05.

RESULTS AND DISCUSSION

Plant Height

The statistical analysis showed a significant effect of TD and the spraying of AYE in the average height of broad bean plants. The results in Table 2 indicate that the TD of 50 cm gave the highest height of the plant amounted to 65.7 cm, morally and differed from the other depths with an increase by 13% more than the height obtained in the depth 30 cm. The reason may come back here to the role of tillage in the positive impact in many physical, chemical and biological properties that leads to keep the soil in the largest amount of water and thus provided most of the nutrients that the plants need, which is reflected positively on the increase in plant height. These results are consistent with those of Haider *et al.* (2016).

Table 2. Effect of tillage depth and activated yeast extract and their interaction on plant height (cm)

Yeast concentration (g/l)	Tillage depths (cm)			Means for yeast concentration
	30	40	50	
0	55.7	56.4	61.0	57.7c
4	58.6	64.2	63.8	62.2b
8	61.1	65.8	72.3	66.4a
Means for depth	58.5c	62.1b	65.7a	
LSD (P<0.05) for interaction		4.32		

Results in Table 2 also indicate the positive role to spray AYE in increasing plant height. It was observed that the plants sprayed with 8 g/l outperformed on the plants at other levels, and recorded a height of 66.4 cm, by an increase of 17% compared to untreated plants. The reason here is due to containing of the AYE on amino acids, proteins, enzymes and some other important materials (Table 1). These components are important for the formation of nitrogenous bases and the construction of nucleic acids (RNA and DNA). They also contained vitamin B_1, B_2, which entered at the building of some co-enzymes and that had different and important roles in oxidative processes and reduction that occurred during many metabolic processes, positively reflected in increasing plant growth (Ghoname *et al.*, 2009). These results are consistent with those of Ahmed (2004) on chamomile (*Matricaria recutita* L.) when he applied AYE over the soil or sprayed on the leaves. In addition, it is consistent with that of Abou El-Yazied and Mady (2012) when sprayed AYE with concentration of 5 ml/l, compared to no spraying.

Interaction between TD and AYE showed significant effect on height of broad bean. The results in Table 2 show that the plants plowed with depth of 50 cm and sprayed with 8 g/l AYE gave the highest height of 72.3 cm compared with 55.7 cm recorded in the treatment (30 cm depth × no yeast spraying).

Number of Branches in Plants

The data presented in Table 3 show that the plowing at third depth (50 cm) significantly affected and increased the number of branches in plants by 32.8% compared with plants at the first depth (30 cm). Plowing at the third depth (50 cm) gave the highest number (7.57). Increase in the number of branches at the deeper tillage treatment may be due to increasing in soil pulverizing and cracking solid layer with high penetration resistance values, which resulted from crushing and softening of soil blocks, which facilitated root growth, increased depth and increased access to water and nutrients (Lal, 1989).

Table 3. Effect of tillage depth and yeast extract on some characters of broad bean

Tillage depths (cm)	No. of branches/ plant	Pod length (cm)	No. of pods/plant	No. of seeds/pod
30	5.70c	14.95b	19.89c	3.43b
40	6.70b	16.29a	22.75b	3.78b
50	7.57a	17.30a	25.18a	4.16a
Yeast concentration (g/l)				
0	5.95b	15.16b	20.61b	3.42b
4	6.91a	16.31ab	23.31a	3.76b
8	7.48a	17.07a	23.90a	4.19a

In case of foliar application of yeast extract, maximum number of branches in plant was produced at concentration 8 g/l (7.48) compared with 5.95 branches per plant at the control (no yeast spraying). This response to the foliar application of AYE may be attributed to its content of different nutrients like K, Mg, Ca, P, Fe, Mn and Zn and higher values of free amino acid, higher percentage of protein and vitamins. All these contents and others may play an important role in improving some of growth parameters. Also because AYE contains cytokinins that have a role in increased cell division and break apical sovereignty (Taiz and Zeiger,1998). This result is in conformity with the finding of Nassar *et al.* (2011), Kamal and Ghanim (2012) and Neama *et al.* (2014).

Pod Length

Data in Table 3 indicate that the use of deep tillage significantly influenced pod length, it could be noticed that plowing with 40 and 50 cm depth gave the greater length for pod (16.29 and 17.30, respectively) compared with 14.95 for 30 cm depth. This result was probably due to the role of deep tillage in increasing porosity and then the spread of the roots because of cracking compacted layers and retain as much water and thus optimizing water and nutrients (Lampurlanes *et al.*, 2001), which reflected positively in increased plant growth indicators (Table 3), including the length of pods.

As for the spraying of AYE, it significantly affected pod length. The plants that sprayed with 8 g/l gave the highest length of pod reached to 17.07 cm compared to 15.16 and 16.31 for plants sprayed by 0 and 4 g/l, respectively (Table 3). The reason may be due to its stimulatory effects on cell division and enlargement (Wanas, 2002). Also due to that AYE contains some bio-constituents that encouraging growth as vitamin B_1, B_2 and folic acid which has an important role in the metabolism of carbohydrates and amino acids building, which represents the basic units to build proteins, which reflected positively on the length of pods (Nagodo, 1991). This result agrees with that of Nassar *et al.* (2011) for bean plants.

Number of Pods in Plant

As shown in Table 3, results indicate that the depth of tillage 50 cm gave the highest number of pods in plant amounted to 25.18, significantly differed ($P < 0.05$) from the other depths with an increase by 10.7 and 26.6% more than the number of pods in plant obtained in the depth 30 and 40 cm, respectively. The reason may come back here to the role of tillage in the positive impact in many physical, chemical and biological characteristics which improve the number of branches (mentioned above) and these reflect on the pods number. This result is not consistent with the observation obtained by De Giorgio and Fornaro (2004), who found no significant differences in the number of pods in the plant (as well as the lack of difference in number of seeds per plant) as a result of the difference in the depth of tillage output of different tillage systems.

As for the effect of the AYE, data in Table 3 show significant differences between the plants when using active yeast concentration of 4 or 8 g/l in the number of pods in the plant which gave 23.31 and 23.90, respectively, compared with 20.61 pods in the plant in control treatment. It was observed and reported that yeast extract treatment improved flower formation and their set in some plants due to its high auxins and cytokinins content and its beneficial effect on carbohydrates accumulation (Barnett *et al.*, 1990; Mady, 2009). These results are in agreement with the results obtained by El-Tohamy and El-Greadly (2007) and Mahmoud *et al.* (2013).

Number of Seeds in Pod

As shown in Table 3, the number of seeds in pod was significantly affected by increasing the depth of tillage. Plants in soil tilling at 50 cm recorded greatest number of seeds in pod (4.16) by an increasing percentage 21.3 and 10.0 compared to plant grown in 30 and 40 cm depth. These differences may be attributed to the ease of spread of the roots and increase its density, depth and size and thus gaining a greater amount of water and nutrients, reflecting on improving and stimulating most of plant growth traits. These results are in agreement with those of Sojka *et al.* (1997) on oats (*Avena sativa* L.).

Regarding with the foliar application of AYE, data in Table 3 demonstrate that the number of seeds in pod significantly increased by increasing AYE concentration. The

concentration of 8 g/l was the most favourable for increasing number of seeds in pod and gave the largest number amounted up to 4.19, significantly by percentage 11.4 and 22.5 compared to control and plants sprayed with 4 g/l, respectively. This result agrees with that of El-Shafey *et al.* (2016).

Weight of Green Pods in Plant

Data presented in Table 4 show that the plowing and AYE and their interaction significantly affected the weight of green pods in plant. The maximum stimulatory effect of tillage depth was observed in plant plowed by 50 cm depth, which recorded 547.5 g/plant and significantly differed and increased by 67.3 and 29.4% compared with 30 and 40 cm depth, respectively. Many of the studies pointed that amount of roots was increased and root distribution at depth was improved by sub-soiling. Also, the crops extracted more water from the sub-soil, and less from the top soil, so, there was a general trend that sub-soiling increased crop water-use efficiency (Rengasamy and Reid, 1993). This result is not consistent with that of Lestingi *et al.* (2011) who found, in general, the different tillage system (which led to the difference in the depths of tillage) had no significant impact on the seed yield of horse bean (*Vicia faba* L. minor).

Table 4. Effect of tillage depth and yeast extract and their interaction on green pods yield (g/plant)

Yeast concentration (g/l)	Tillage depths (cm)			Means for yeast concentration
	30	40	50	
0	295.2	342.3	406.3	354.6c
4	296.6	408.0	568.6	424.4b
8	389.8	498.6	667.5	518.6a
Mean for tillage depths	327.2c	423.0b	547.5a	
LSD (P<0.05) for interaction		82.6		

Regarding with the foliar application of AYE, data in Table 4 show that the concentration of 8 g/l gave the largest weight of green pods in plant reached to 518.6 g/plant with an increasing percentage by 46.2 and 22.2, compared with control and 4 g/l, respectively. This finding is in agreement with the results obtained by Abou El-Yazied and Mady (2012) and Mahmoud *et al.* (2013).

Interaction between TD and AYE showed significant effect in the weight of green pods. The results in Table 4 show that the plants plowed with depth of 50 cm and sprayed with 8 g/l AYE gave the greatest weight amounted to 667.5 g/plant compared to 30 cm depth × no yeast spraying which recorded the lowest (295.2 g/plant).

The previously obtained results on weight of green pods could be attributed to the stimulation effect of deeper tillage and yeast extract on plant growth and on increasing yield components which reflected on yield.

Data were analyzed to calculate the expected weight of green pods in plant; we obtained the following regression equation :

$$Y=20.84\ X_1+143.7\ X2 - 582 \quad R=.943$$

Where,

Y=Weight of green pods in plant (g)
X_1=Number of pods in plant
X_2=Number of seeds in pod

REFERENCES

Abou El-Yazied, A. and Mady, M. A. (2012). Effect of boron and yeast extract foliar application on growth, pod setting and both green pod and seed yield of broad bean (*Vicia faba* L.). *J. Amer. Sci.* **8** : 517-34.

Adday, S. H., Muhsin, S. J. and Hameed, F. M. (2008). Design and manufacture sub-soiler manure laying implement and studying. *Basrah J. Agric. Sci.* **21** (Spl. Issue) : 1-17.

Ahmed, G. A. (2004). Influence of active dry yeast addition on growth and volatile oil content of chamomile (*Matricaria recutita* L.). *Assiut J. Agric. Sci.* **35** : 330-43.

Al-Khafaji, H. H., Talib, M. S. and Hadi, K. F. (2018). Effect of organic manure and plant population on growth and yield of *Vicia faba* L. *Res. Crops* **19** : 405-08.

Amer, S. S. A. (2004). Growth, green pod yield and seed yield of common bean (*Phaseolus vulgaris* L.) as affected by active dry yeast, salicylic acid and their interaction. *J. Agric. Sci. Mansoura Univ.* **29** : 1407-22.

Barnett, J. A., Payne, R. W. and Yarrrow, D. (1990). Yeast characteristics and identification. Cambridge Camb., CBZBR. pp. 999.

De Giorgio, D. and Fornaro, F. (2004). Tillage systems for a sustainable growth of broad bean (*Vicia faba* L. manor) in a semi-arid region of southern Italy. 13th International Soil Conservation Organization Conference.

Demjanova, E., Macak, M., Dalovic, I., Majernik, F., Tyr, S. and Smatana, S. (2009). Effect of tillage system and crop rotation on weed density, weed species composition and weed

biomass in maize. *Agron. Res.* **7** : 785-92.

El-Kotb, H. M. A. (2013). Combination effects of tillage systems and organic manures on some physio-chemical properties of calcareous soil and faba bean productivity. *N. Y. Sci. J.* **6** : 193-202.

El-Shafey, A. I., El-Feky, S. S. and Abo-Hamad, S. A. (2016). Effect of sowing time and foliar application of yeast extract on growth and productivity of different cultivars of faba bean (*Vicia faba* L.). *Egypt J. Bot.* **56** : 35-48.

El-Tohamy, W. A. and El-Greadly, N. H. M. (2007). Physiological responses, growth, yield and quality of snap beans in response to foliar application of yeast, vitamin E and zinc under sandy soil condition. *Aust. J. Basic and Appl. Sci.* **1** : 294-99.

Ghoname, A. A., Dawood, G., Riad, G. and El-Tohamy, W. A. (2009). Effect of nitrogen forms and biostimulants foliar application on the growth, yield and chemical composition of hot pepper grown under sandy soil condition. *Res. J. Agric. and Biol. Sci.* **5** : 840-52.

Govaerts, B., Sayre, K. D. and Deckers, J. (2005). Stable high yield with zero tillage and permanent bed planting. *Field Crops Res.* **94** : 33-42.

Haider, M. U., Hussain, M., Khan, M. B., Ijaz, M., Sattar, A., Akram, M. and Hassan, W. (2016). Effect of seed priming and seed size on wheat performance under different tillage systems. *Int. J. Agric. Biol.* **18** : 858-64.

Hassan, R. K. and Lehmood, A. M. (2019). Effect of spraying time and concentration of liquid fertilizer on the growth and yield of broad bean (*Vicia faba* L.). *Res. Crops* **20** : 501-06.

Hoffman, D., Jiang, Q, Men, A., Kinkema, M. and Gresshoff, P. M. (2007). Nodulation deficiency caused by fast neutron mutagenesis of the model legume, *Lotus japonicus*. *J. Plant Physiol.* **164** : 460-69.

Kamal, A. M. and Ghanem, K. M. (2012). Impact of some bio-stimulants on organically cultivated snap bean plants. *Egypt J. Appl. Sci.* **27** : 289-304.

Kumar, S., Sharma, P. K., Anderson, S. H. and Saroch, K. (2012). Tillage and rice-wheat cropping sequence influences on some soil physical properties and wheat yield under water deficit condition. *Open J. Soil Sci.* **2** : 71-81.

Lal, G. P. (1989). Conservation tillage for sustainable agriculture : Tropic versus temperate environments. *Adv. Agron.* **42** : 85-197.

Lampurlanes, J., Angas, P. and Cantero-Martinez, C. (2001). Root growth, soil water content and yield of barley under different tillage systems on two soils in semi-arid conditions. *Field Crops Res.* **69** : 27-40.

Lestingi, A., Bovera, F., De Giorgio, D., Ventrella, D. and Tateo, A. (2011). Effect of tillage system on seed yield, chemical composition and nutritive value of horse bean (*Vicia faba* L. minor) grown under Mediterranean conditions. *J. Food, Agric. and Environ.* **9** : 228-35.

Mady, M. (2009). Effect of foliar application with yeast extract and zinc on fruit setting and yield of faba bean (*Vicia faba* L.). *J. Biol. Chem. and Environ. Sci.* **4** : 109-127.

Mahmoud, R., Asmaa, El-Desuki, M., Mona, M., Abdel-Mouty and Aisha, H. Ali (2013). Effect of compost levels and yeast extract application on the pea plant growth, pod yield and quality. *J. Appl. Sci. Res.* **9** : 149-55.

Nagodo, W. T. (1991). Yeast technology universal foods corporation. Milwaukee. Wisconsin. Published by Van Nostrils Reinhold, New York. pp. 273.

Nassar, R. A. M., Ahmed, Y. M. and Nassar, D. M. A. (2011). Effect of foliar spray with active yeast extract on morphological, anatomical and yield characteristics of kidney bean (*Phaseolus vulgaris* L.). *Aust. J. Basic and Appl. Sci.* **5** : 1071-79.

Neama, M. Marzauk, Shafeek, M. R., Helmy, Y. I., Ahmed, A. A. and Magda, A. F Shalaby (2014). Effect of vitamin E and yeast extract foliar application on growth, pod yield and both green pod and yield of broad bean (*Vicia faba* L.). *Middle East J. Appl. Sci.* **4** : 61-67.

Rengasamy, J. I. and Reid, J. B. (1993). Root system modification of faba bean (*Vicia faba* L.) and its effect on crop performance. 2. Role of water stress. **33** : 197-215.

Singh, A. K., Bharati, R. C., Manibhushan, N. Ch. and Pedpati, A. (2013). An assessment of faba bean (*Vicia faba* L.) current status and future prospect. *African J. Agric. Res.* **8** : 6634-64.

Singh, A. K. and Bhatt, B. P. (2012). Faba bean (*Vicia faba* L.) : A potential leguminous crop of India. ICAR Regional Centre for Eastern Region, Patna, India. pp. 518.

Sojka, R. E. D., Horne, J., Ross, C. W. and Baker, C. J. (1997). Sub-soiling and surface tillage effects on soil physical properties and forage oat stand and yield. *Soil and Tillage Res.* **40** : 125-44.

Spencer, T. F. T., Dorothy, S. M. and Smith, A. R. W. (1983). Yeast genetics. Fundamental and Applied Aspects, Springer,Verlag, NY, USA. pp. 16-18.

Taiz, L. and Zeiger, E. (1998). *Plant Physiology, 3rd edn.* Sinauer Associates INC, *Publishers,* Sunderland, Massachusetts, USA. pp. 110.

Wanas, A. L. (2002). Response of faba bean (*Vicia faba* L.) plants to seed soaking application with natural yeast and carrot extracts. *Annals Agric. Sci., Moshtohor* **40** : 259-78.