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RESPONSE OF SOME VEGETATIVE INDICATORS OF FABA BEANS TO ORGANIC RESIDUE SOLUTION AND SPRAYING WITH PROLINE

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Abstract

An experiment was conducted during the fall season of 2020 in one of the protected facilities (plastic house) in the Faculty of Agriculture, University of Kufa/Iraq. This research aimed to study the effect of applying three types of decomposing organic residue solution to soil (cow, sheep, and chicken), and foliar spraying of proline with three concentrations (0, 40 and 80) mg·L^{-1} on some indicators of the vegetative growth of a local variety of faba bean. A factorial experiment was conducted according to R.C.B.D with three replications. The results revealed significant effects of organic residue solution of chicken for plant height 46.03 cm, leaf number 26.10 (leaf·plant^{-1}), branch number 4.32 (branch·plant^{-1}), and chlorophyll content 44.04 (SPAD unit) in comparison with cow residue solution. Moreover, spraying with proline at 80 mg·L^{-1} realized a significant increase in leaf number 25.96 (leaf·plant^{-1}), branch number 3.73 (branch·plant^{-1}), and relative chlorophyll content 34.68 (SPAD unit) compared to the control treatment. Consequently, the combination of the two factors was the most efficient treatment for faba bean plant growth indicators studied aforementioned.

Key words*: faba bean, organic residues, proline, vegetative growth.*

INTRODUCTION

Faba bean *Vicia faba* is one of the main leguminous crops grown in the winter season in order to obtain green pods or soft or dry seeds, which are rich in proteins, carbohydrates, and vitamin B complex, which makes this crop of good significance to compensate as well for the high price of animal protein (Abbas, 2013). It is used to treat many conditions such as kidney stones, liver impairment, and eye diseases (Khalil et al., 2015). Farmers prefer using animal organic fertilizer over other synthetic chemical fertilizers in fertilizing and caring for the soil for several benefits that benefit the soil and crops. Therefore, animal organic fertilizers can reduce the losses that may be caused to plants and the environment as a result of the use of synthetic fertilizers. Human kinds realized in the past the importance of organic fertilizer in soil fertilization, as they noticed better growth of plants in the lands where their livestock graze, and thus it became common to add organic fertilizers and disseminate the remains of previous crops before each new planting (Laboski et al., 2003). Recently, the focus on the use of mineral fertilizers has led to many problems, the most important of which is the pollution of groundwater with the residuals of those fertilizers, in addition to the increase in the content of nitrates in vegetable products and their negative effects on human and animal health. It is reported that 80% of nitrates are sourced from consuming vegetables, and if they are not assimilated in the formation of proteins, they are stored in the cells (Al-Redhaiman, 2004). Supporting crops with decomposed organic fertilizers which are not available in large quantities in most countries due to the cost and slowness of their decomposition processes, necessitates adding them in the form of solutions in order to save the added quantities per unit area and homogenize the fertilizer distribution and facilitate its availability to the plant root area (Radhi, 2010). Proline, an amino acid, is widely found in higher plants and greater quantities than the rest of the amino acids (Abraham et al., 2003). Further, it is a very osmotic active compound and increases the stability of cell membranes and reduces their breakdown in case of exposure to sodium and chloride ions

(Mansour, 1998), through its interaction with the phospholipids in the membranes and protects the protein complexes (protein structures) against denaturation (Samaras et al., 1995). Moreover, proline plays a protective factor for enzymes (Solomen et al., 1994) and other cytosolic organelles (Van Rensburg et al., 1993). In addition, it is a key factor to solve the problem of flower dropping of bean plants as a result of exposure to some environmental stresses (Fang et al., 2010), and accordingly, this work was achieved to investigate the response of some vegetative indicators of faba bean plants to proline spray and the addition of animal organic residue solution.

MATERIALS AND METHODS

Experiment site. The field trial was carried out for the fall season 2020 in one of the protected facilities (plastic house) belonging to the Faculty of Agriculture, University of Kufa, Najaf city, Iraq.

Experiment material. This research aimed to study some vegetative growth indicators of a local variety of faba bean plants in response to different types of organic residue solution and different concentrations of spraying with proline. Cow and chicken residues were collected from the fields of the Faculty of Agriculture - University of Kufa, while sheep residues were prepared from one of the private sector fields in Najaf region. A water solution was made from these three residues in a volumetric ratio of 3:1 as to (organic fertilizer: water) respectively, while proline and faba bean seeds were purchased from the local market. Prior to planting, random soil samples were collected from the field site with a depth of between 0-30 cm, in order to test some of the soil physical and chemical properties (Table 1).

Table 1. Chemical and physical properties of the field soil

Electrical Conductivity E.C. ($dS \cdot m^{-1}$)	pH	Organic Matter ($g \cdot kg^{-1}$)	Nitrogen ($mg \cdot kg^{-1}$)	Phosphorus ($mg \cdot kg^{-1}$)
1.26	7.55	3.20	2.35	1.60
Potassium ($mg \cdot kg^{-1}$)	Clay %	Silt %	Sand %	Soil Texture
0.50	6.90	7.60	85.5	Sandy soil

The seeds of faba bean were planted after soaking them in water for 24 hours to accelerate their germination, then seeds were planted on 24/11/2020, with a rate of 10 plants in each experimental unit, with a distance of 20 cm between one plant and another. Organic residue solution was added to each experimental unit accordingly. Proline was sprayed three times during the season on the vegetative growth of bean plants and the first spray was applied when seedlings reached 3-4 true leaves then leaving 14 days between other sprays (Alhasnawi et al., 2020). All the operations of the recommended agricultural management were implemented as needed.

Experiment design. This field trial included two factors; the first factor was three types of decomposing animal organic residue solution (cow, sheep, and chicken) and the second factor was three concentrations of spraying with proline (0 without spraying, 40, and 80) $mg \cdot L^{-1}$. A factorial experiment was conducted according to a Randomized Complete Block Design (RCBD) with two factors as aforementioned with three replicates.

Vegetative growth indicators. Five plants were randomly selected from each experimental unit to measure the vegetative indicators which were plant height (cm), average number of leaves per plant, average number of lateral branches per plant, and relative content of total chlorophyll in leaves using SPAD field device.

Statistical procedure. Data in this study were analyzed according to the analysis of variance (two-way ANOVA), then least significant difference (L.S.D) procedure at $p < 0.05$ was employed for the mean separation of the studied indicators (Montgomery, 2020). Statistix 10 (Analytical Software, 2013) was used for all statistical analyses.

RESULTS AND DISCUSSIONS

Results in Table 2 indicated that all the treatments of the organic residue solution of different types (cow, sheep, chicken) resulted in a significant improvement in all studied vegetative growth indicators. The organic residue solution of chicken realized the maximum average for plant height 46.03 cm, leaf number 26.10 ($leaf \cdot plant^{-1}$), branch number 4.32 ($branch \cdot plant^{-1}$), and relative chlorophyll

content 44.04 (SPAD unit) in comparison with cow residue solution. This growth increment of bean plants may be due to the influence of the animal organic residue in improving the chemical, physical, and biological characteristics of the medium soil (Abbas, 2013). Furthermore, the process of fermentation of organic residues before use may have contributed to the availability of many nutrients. Subsequently, these elements have an important role as they play many biological and physiological processes, stimulating nutrient contents in plant tissues, cell division and elongation, or forming cell membranes that increase plant growth such as plant height, lateral branch number, leaf number, and leaf chlorophyll (Al-Sahaf, 1989). Faba bean growth indicators were affected significantly by foliar application of proline at the 0.05 probability except for plant height. Increasing concentration of the applied proline caused increases in plant vegetative indicators (Table 2). The highest concentration of proline at (80 mg·L^{-1}) recorded the highest average for leaf number 25.96 (leaf·$plant^{-1}$), lateral branch number 3.73 (branch·$plant^{-1}$), and relative chlorophyll content 34.68 (SPAD unit) compared to the control treatment (without spraying). This may be due to the fact that spraying with proline boosts the growth and elongation of the roots and thus enhance the growth of plant vegetative group. Moreover, proline acts as an enzymatic preserver under the action of hormones and enzymes necessary for growth and helps the plant cells to absorb water in turn leading to an increase in the number of leaves and branches of the plant. These results are in accordance with (Amin et al., 2014) and (Ismail and Halmy, 2018). In addition, the increase in the chlorophyll content in leaves when sprayed with proline may be due to the fact that proline helped in the activity of many enzymes, especially the enzymes responsible for the formation and construction of chlorophyll molecule or increasing the plant photosynthesis capacity, and consequently increasing the content of chlorophyll in leaves.

The interaction between animal organic residue solution and foliar spray of proline (Table 2) referred to significant effects for the bean vegetative parameters. The combination of chicken solution with the spraying of proline at a concentration of (80 mg.L^{-1}) notably realized the highest average for plant height 46.94 cm, leaf number 29.10 (leaf·$plant^{-1}$), lateral branch number 4.52 (branch·$plant^{-1}$), and relative chlorophyll content 49.74 (SPAD unit). However, the interaction treatment of cow solution without proline spray gave the lowest average for plant height 35.80 cm, leaf number 18.90 (leaf·$plant^{-1}$), lateral branch number 1.84 (branch·$plant^{-1}$), and relative chlorophyll content 14.45 (SPAD unit). These results are consistent with Amanullah et al. (2010) and Reda et al. (2014).

Table 2: Influence of the Organic Residue Solution and proline spray on some phenotypic indicators of faba bean

Treatments	Plant Height (cm)	Leaf No. (leaf·$plant^{-1}$)	Branch No. (branch·$plant^{-1}$)	Relative Chlorophyll Content (SPAD unit)
Effect of Organic Residue Solution (3:1) as volume				
Cow	36.33	20.50	2.44	17.21
Sheep	39.78	22.69	3.22	29.42
Chicken	46.03	26.10	4.32	44.04
L.S.D 0.05	**1.78**	**2.06**	**0.21**	**1.75**
Effect of Proline (mg·L^{-1})				
0	39.59	19.70	2.86	26.00
40	41.24	23.63	3.39	29.99
80	41.32	25.96	3.73	34.68
L.S.D 0.05	**N.S.**	**2.06**	**0.21**	**1.75**

		Effect of the interaction			
Cow		35.80	18.90	1.84	14.45
Sheep	**0**	38.73	18.70	2.62	24.52
Chicken		44.23	21.50	4.12	39.04
Cow		35.91	20.50	2.44	17.21
Sheep	**40**	40.88	22.70	3.42	29.42
Chicken		46.92	27.70	4.32	43.34
Cow		37.28	22.10	3.04	19.98
Sheep	**80**	39.74	26.68	3.62	34.32
Chicken		46.94	29.10	4.52	49.74
L.S.D 0.05		**3.08**	**3.57**	**0.36**	**3.03**

N.S. means non-significant.

CONCLUSIONS

It is concluded from the research that adding animal organic residues and spraying with proline had a significant impact on improving the bean vegetative growth parameters, especially the addition of chicken solution with proline spray at 80 $mg \cdot L^{-1}$.

REFERENCES

Abbas, S. M. (2013). The influence of biostimulants on the growth and on the biochemical composition of Vicia faba cv. Giza-3 beans. *Romanian Biotechnological Letters*, *18*(2), 8061-8068.

Abraham, E., Rigo, G., Szekely, G., Nagy, R., Koncz, C., & Szabados, L. (2003). Light-dependent induction of proline biosynthesis by abscisic acid and salt stress is inhibited by brassinosteroid in Arabidopsis. *Plant Molecular Biology*, *51*, 363–372.

Alhasnawi, N. J. R., Al-Bayati, A. S., & Aldhalimi, S. A. (2020). Promotion of the growth and yield of Okra (Green velvet cultivar) by using different levels of Humi Max (Organic Liquid fertilizer). *Plant Archives*, *20*(2), 6751-6754.

Al-Sahaf, F. H. (1989). *Applied plant nutrition*. Dar Al Hekma Press. Ministry of Higher Education and Research Scientific research. Baghdad University. Iraq. pp 31-69.

Amanullah, M., Sekar, S., & Vincent, S. (2010). Plant growth substances in crop production: A review. *Asian Journal of Plant Sciences*, *9*(4), 215- 222.

Al-Redhaiman, K. N. (2004). Pollution of the environment with nitrogenous chemical fertilizers, its causes and risks. *Scientific publications of the Saudi Society for Agricultural Sciences*. *67*, Riyadh, Saudi Arabia.

Amin, A. A., Abouziena, H. F., Abdelhamid, M. T., Rashad, E. S. M., & Gharib, A.F. (2014). Improving growth and productivity of faba bean plants by foliar application of thiourea and aspartic acid. *International Journal of Plant and Soil Science*, *3*(6), 724-736.

Analytical Software (2013). Statistix 10: User's manual. Analytical Software. Tallahassee, Florida.

Fang, X., Turner, N. C., Yan, G., Li, F., & Siddique, K. H., (2010). Flower numbers, pod production, pollen viability, and pistil function are reduced and flower and pod abortion increased in chickpea (*Cicer arietinum* L.) under terminal drought. *Journal of experimental botany*, *61*(2), 335-345.

Ismail, E. E. M., & Halmy, M. M., (2018). Effect of Proline and Potassium Humate on Growth, Yield and Quality of Broad Bean under Saline Soil Conditions. *Journal of Plant Production*, *9*(12), 1141-1145.

Khalil, N. A., El- Metwally, E. A., Shafik, M. M., & Al-Murshidy, W. A. (2015). *Cereal and legume Crops.* Faculty of Agriculture, Cairo University. pp. 186.

Laboski, C. A., & Lamb, J. A. (2003). Changes in soil test phosphorus concentration after application of manure or fertilizer. *Soil Science Society of America Journal*, *67*(2), 544-554.

Mansour, M. M. F. (1998). Protection of plasma membrane of onion epidermal cells by glycinebetaine and proline against NaCl stress. *Plant Physiology and Biochemistry*, *36*(10), 767–772.

Montgomery, D. C. (2020). *Design and analysis of experiments*. 10th Edition, John Wiley & Sons Ltd., New York.

Radhi, N. J. (2010). *The effect of seed generation and type of organic waste solution on the growth and yield of hybrid eggplant in protected agriculture*. Master thesis, Al-Musiab Technical College, Iraq.

Reda F., Magdi, T. A., & El-Lethy, S. R. (2014). The Role of Zn and B for Improving (*Vicia Faba* L.) Tolerance to Salinity Stress. *Middle East Journal of Agriculture Research*, *3*(4), 707-714.

Samaras, Y., Bressan, R. A., Csonka, L. N., Garcıa-Rıos, M. G., Paino, D., Urzo, M., & Rhodes, D. (1995). *Accumulation during drought and salinity*. N. Smirnoff (Eds.), Environment and plant metabolism. Bios Scientific Publishers. Oxford, pp. 161-187.

Solomen, A., Beer, S., Waisel, Y., Jones, G. P., & Paleg, L. G. (1994). Effects of NaCl on the carboxylating activity of Rubisco from *Tamarix jordanis* in the presence and absence of proline-related compatible solutes. *Physiologia Plantarum*, *90*(1), 198-204.

Van Rensburg, L., Kruger, G. H., & Kruger, H. (1993). Proline accumulation as drought – tolerance selection criterion: its relationship to membrane integrity and chloroplast ultrastructure in *Nicotiana tabacum* L. J. *Journal of Plant Physiology*, *141*(2), 188-194.