EFFECT OF PHOSPHOROUS APPLICATION ON CHICKPEA NODULES PRODUCTION AND SOME FERTILITY PROPERTIES OF CALCAREOUS SOIL OF DUHOK-KRG- IRAQ

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ABSTRACT
A field experiment was carried out during spring season of 2020 at research station of the College of Agricultural Engineering Sciences to evaluate the effect of different phosphorus levels on chickpea nodules production, soil physical and chemical after phosphorus application. A randomized complete block design was used, with three replications, five application rates of P$_2$O$_5$, 0, 15, 30, 45, 60 Kg.ha$^{-1}$. The results revealed that the phosphorus levels were highly significantly affected on number of nodules plant$^{-1}$, seed yield, plant height, number of main and secondary branches per plant, first pod height and number of pods plant$^{-1}$, and also, results showed the maximum number of nodules per plant (43.33) yield (667.7) Kg.ha$^{-1}$, plant height (54.33) cm, main and secondary branches (4) and 2.3 respectively, first pod height (26.17 cm) and maximum pods plant$^{-1}$ 27.67 was recorded at maximum rate of phosphorus, (60 Kg.ha$^{-1}$). Regarding agronomic efficiency percent, the results exhibited maximum value of this percent was recorded at 60 Kg.ha$^{-1}$ P$_2$O$_5$, the results indicated application of 60 Kg.ha$^{-1}$ gave the highest values for all studied traits and recorded highest value of coefficient determination ($R^2$) 0.95, 0.94, 0.91 and 0.99, for plant height, secondary branches per plant, pod height and number of pod plant$^{-1}$ respectively. The results exhibited highly significant and positive correlation for seed yield 0.92, 0.90, 0.87 and 0.84 with number of pods plant$^{-1}$, plant height, number of main and secondary branches plant$^{-1}$ respectively. Application of phosphorus the soil increases some physical and chemical properties of soil such as pH, EC, available of phosphorus, organic matter and cation exchange capacity.

KEY WORD: chickpea, production, phosphorus, local variety.

INTRODUCTION
Phosphorus is considered an important nutrient for formation and translocation of carbohydrate, fatty acid, and other essential inter compound. An application of phosphorus has been found to improve the roots system of plant. Phosphorus caused increase in the lateral and fibrous roots, which results in more nodule bacteria increase in the rate of nitrogen fixation in leguminous crops. (Siphiwe et al., 2017)

Chick pea (Cicer arietinum L.) is an important pulse crop, it recognized as legume with source of protein, nutrients, and carbohydrates (Iaranjo, 2014). It is adaptable to wide climate variation, has low production cost and promotes biological fixation of atmospheric nitrogen. (Nascimento, 2016 and Bala, 2017).

Khan et al., 2010 indicated the production is limited by lack of plant nutrient available in the soil because majority of farmers hardly use of fertilizer for legume cultivation. However, there is a possibility to enhance the productivity through optimum fertilization and management, as there is a wide gap between the average yield production and yield potential of crop. Plant nutrition, suitable cultivars and correct fertilizer has
significant effect on yield and yield components.

Phosphorus effect on the number of nodules, number of pods, weight of pods, green pods yield and protein content(percent) were markedly increased with increasing phosphorus levels up to 60 Kg.ha⁻¹ over control (Dotaniya et al., 2014).

Phosphorus fertilization is among the main practices of crop management, yet, it is considering complex in tropical soils because of the high capacity of phosphorus for covalent adsorption to soil (Gazola et al., 2013) and because of low natural availability of P to plant. In chickpea balanced phosphorus nutrition in fundamental for establishing symbiosis with nitrogen fixing rhizobacteria and it stimulates nodulation, in development of roots, plant growth and seed yield and quality (Balai et al., 2017). Also phosphorus variability in optimum quantities is needed for early growth stage, development of the reproductive parts, root growth, reduced disease incidence and early maturity compare to vegetative growth. Phosphorus availability in considerable quantities is critically need for seed yield. (Gidagoe et al., 2012)

The aim of this study was to evaluate chickpea yield and soil chemical and physical attributes under different application rates of phosphorus.

**MATERIALS AND METHODS**

The influence of phosphorus levels on yield and some growth parameters were estimated in an experiment carried out at the field of College Agricultural Engineering Sciences- Dohuk University Iraqui Kurdistan Region. The experiment units were laid out in randomize complete block design (RCBD) with three replicates. The experiment units consist four rows with four-meter length and the distance between rows 0.30 m (with plot size 3.6 m²).

Local variety of chickpea and five triple super phosphate P₂O₅ doses (0.15,30,45 and 60 Kg.ha⁻¹) were applied before planting date with planting lines. Experimental managed in accordance with the recommended cultural and other field management practices such as hand weeding, nitrogen application. The data were recorded randomly on five plants and these plants at the end of flowering and it was washed with water and then the counting process started for the number of nodule per plant seed yield Kg.ha⁻¹, plant height cm, number of main and secondary branches per plant, first pod height and number of pod plant. The agronomic efficiency was calculated by using the following formula

\[
AE = \frac{YFT - YCT}{ARFR} \quad (MC\ Donald\ et\ al.,\ 2001)
\]

Where,

- **AE**: Agronomic efficiency in Kg of seeds per Kg nutrient applied
- **YFT**: Yield in treatment fertilized with P, Kg. ha⁻¹
- **YCT**: Yield in control treatment Kg. ha⁻¹
- **ARFR**: Application rate in treatment fertilizer with P, Kg. ha⁻¹

The monthly climatology information was obtained from the station of College Agricultural Engineering Sciences, Table 1.
The climatic of the experimental field location during growing season 2020-2021, (rainfall and air temperatures).

| Years | Months | Rainfall mm | Temperature °C |
|-------|--------|-------------|----------------|
|       |        |             | Max. | Min.  |
| 2019  | Oct.   | 3           | 30.8 | 18.2  |
| 2019  | Nov.   | 30          | 22.1 | 9.3   |
| 2019  | Dec.   | 107         | 14.6 | 6.9   |
| 2020  | Jan.   | 89.5        | 10.6 | 4.1   |
| 2020  | Feb.   | 76          | 11.7 | 4.3   |
| 2020  | Mar.   | 310         | 18.6 | 9.8   |
| 2020  | Apr.   | 55          | 19.8 | 10.7  |
| 2020  | May    | 16.5        | 21.2 | 11.6  |

The important physico-chemical properties of these soils (pH, EC, organic matter, particle size distribution, CEC, Available phosphorus, etc.) were determined by following methods described by Jackson (1973). The data were subjected to analysis of variance with (man tab analysis program, 2017) and using Duncan’s Multiple Range Test (MRT) to determine the superiority of treatment means.

RESULTS AND DISCUSSION

The analysis of variance for the studied traits of chickpea under varying levels of phosphorus presented in Table 2. The results revealed that the phosphorus levels have significant effect on number of nodules plant\(^{-1}\), seed yield, plant height, number of main and secondary branches, first pod height and number of pods plant\(^{-1}\). These results are similar to finding of Lopes, 2016 and Oliveira et al., 2017. Who reported that the phosphorus application enhances growth as well as yield contributing growth parameters of the chickpea.

Table (2): Analysis of variance for studied traits chickpea under different levels of phosphorus.

| S.O.V       | d.f  | No. of nodule | yield Plants Kg | Plant height cm | No. of main branch Plant\(^1\) | No. of secondary branch Plant\(^1\) | Pod height cm | No. of pod Plant\(^1\) |
|-------------|------|---------------|-----------------|-----------------|-----------------------------|----------------------------------|----------------|----------------------|
| Replication | 2    | 114.87        | 286             | 95.76           | 0.0667                      | 1.8000                           | 27.950         | 0.600                |
| Treatments  | 5    | 236.90**      | 75742**         | 140.13*         | 1.6000**                    | 7.9333**                         | 8.942**        | 130.500**            |
| Error       | 10   | 32.45         | 230             | 92.94           | 0.1500                      | 0.6333                           | 2.992          | 3.850                |
| Total       | 17   |               |                 |                 |                             |                                  |                |                      |

* significant at probability 0.05, ** significant at probability 0.01.

Effect of different phosphorus levels on studied traits were presented in Table 3. The results showed that, the maximum number of nodules plant\(^{-1}\) was (43.33) recorded when fertilizer with (60 Kg P\(_2\)O\(_5\) ha\(^{-1}\)) and the minimum number of nodules per plant 20.67 recorded at fertilizer treatment 15 Kg P\(_2\)O\(_5\) ha\(^{-1}\). The result in
relation relying on to the grain yield Kg. ha\(^{-1}\) of chickpea as under the effect of various phosphorus levels, grain yield value was (667.7 Kg. ha\(^{-1}\)) was obtained by (60 Kg P\(_2\)O\(_5\) ha\(^{-1}\)) application while, the lowest value 315.2 Kg. ha\(^{-1}\) was recorded in control with no phosphorus application. Depending on the plant height the maximum plant height (54.33 cm) was observed at fertilizer treatment (60 Kg P\(_2\)O\(_5\) ha\(^{-1}\)) whilst, the minimum plant height (38.03 cm) was noted in control treatment.

The number of main and secondary branches per plant increased with increasing phosphorus rate. Maximum numbers branches (4.00) and 8.33 recorded at fertilizer treatment 60 Kg P\(_2\)O\(_5\) ha\(^{-1}\), minimum number of branches plant (2) and (4) respectively were obtained by zero phosphorus application. Regarding to first pod height the highest value (26.17) were recorded at 60 Kg P\(_2\)O\(_5\) ha\(^{-1}\) while, lower value (22.33) was recorded at control treatment. The data in Table (2) showed that the number of pod per plant increasing when plant received to 60 Kg P\(_2\)O\(_5\) ha\(^{-1}\), pods per plant (27.67) were recorded at the maximum rate of phosphorus and the minimum value (11) was obtained in zero phosphorus application on the basis of the results in the Table (3), thus can it concluded that the application of phosphorus rate 60 Kg P\(_2\)O\(_5\) ha\(^{-1}\), significantly improved agronomic traits, plant height, number of main and secondary branches, number of nodules per plant and number of pods plant\(^{-1}\), 100 seed weight and grain yield because phosphorus helped to increase the size of the root system, which led to an increase the absorption the nutrients from soil. Observations confirmations these founding by Bala. 2017, Seid \textit{et al.}, 2015 and Laranjo \textit{et al.}, 2014.

### Table (3): Mean of the studied traits of the chickpea under different phosphorus levels.

| Treatments | No. of Nodules plant\(^{-1}\) | Seed yield kg. ha\(^{-1}\) | Plant height Cm | No. of main branches Plant\(^{-1}\) | No. of secondary branches Plant\(^{-1}\) | First pod height cm | No. of pods. plant\(^{-1}\) |
|------------|-----------------------------|-----------------------------|-----------------|-------------------------------------|----------------------|-------------------------|--------------------------|
| control    | 25.670b                     | 315.200d                    | 38.030a         | 2.000b                              | 4.667c               | 22.330a                 | 11.000d                  |
| 15         | 20.670ab                    | 346.500d                    | 51.330a         | 2.667b                              | 4.667c               | 23.000a                 | 14.670cd                 |
| 30         | 23.330b                     | 394.200c                    | 52.670a         | 2.667b                              | 6.000bc              | 24.500a                 | 18.670bc                 |
| 45         | 28.330b                     | 600.700b                    | 54.000a         | 3.000ab                             | 7.333ab              | 26.000a                 | 23.000ab                 |
| 60         | 43.330a                     | 667.700a                    | 54.330a         | 4.000a                              | 8.333a               | 26.170a                 | 27.670a                  |
| p. value   | 0.009                       | 0.000                       | 0.278           | 0.003                               | 0.002                | 0.088                   | 0.000                    |

Means that do not share a letter are significantly different at p value <0.05.

The data in Table (4) indicating the agronomic efficiency percent under different levels of phosphorus application. The results exhibited that the maximum value was recorded at 60 Kg P\(_2\)O\(_5\) ha\(^{-1}\) and was 1.469 %, while the lower value 5.22% was obtained at 15 Kg P\(_2\)O\(_5\) ha\(^{-1}\),fertilizer level so, it necessary to use an adequate amount of plant nutrients at balanced rates for improving plant growth, yield and yield components. Similar results were obtained by Prajapati \textit{et al.}, 2017.
Table (4): Agronomic efficiency under different levels of phosphorus.

| Treatment | YFT  | YCT  | ARFT | AE   |
|-----------|------|------|------|------|
| 15        | 346.5| 315.2| 60   | 0.522|
| 30        | 394.2| 315.2| 120  | 0.658|
| 45        | 600.7| 315.2| 180  | 1.586|
| 60        | 667.7| 315.2| 240  | 1.469|

Where,
YFT= Yield in treatment fertilized with P, Kg. ha\(^{-1}\)
YCT= Yield in control treatment Kg. ha\(^{-1}\)
ARFT= Application rate in treatment fertilizer with P, Kg. ha\(^{-1}\)
AE= Agronomic efficiency in Kg of seeds per Kg nutrient applied

Fig. 1(A to G) the application of 60 Kg P\(_2\)O\(_5\) ha\(^{-1}\) gave the highest value of all studied traits and the same figure showed that the plant height, secondary branches, also the figure show, first pod height and number of pod plant\(^{-1}\), was most components of chickpea attributes the seed yield after phosphorus application and recorded the correlate between yield and some of the traits by adding the phosphorus element were high and here the effective role of phosphorus in different traits appears at high doses to get the best growth and productivity. the highest value of coefficient determination (R) 0.95, 0.94, 0.94, and 0.99 respectively.
From the data in Tables 5, the results indicated highly a significant and positive correlation among studied parameters of chickpea. For seed yield were 0.922, 0.90, 0.87, and 0.84 with number of pods plant$^{-1}$, plant height, number of main and secondary branches plant$^{-1}$ respectively. For the number of nodules plant$^{-1}$ also observed highly significant and positive correlation with seed yield and the value was 0.84, while the secondary branches plant were positively correlated with number of nodules plant (0.79) and seed yield (0.89) and (0.79) with plant height. Similar results were also confirmed by many researches Jakhar, 2014, and Amare et al., 2020.

**Table (5):** simple correlation coefficient between yield and some growth parameters in chickpea.

| Parameters          | No. of Nodules | Seed yield kg ha$^{-1}$ | Plant height cm | No. of main branches | No. of secondary branches | Pod height |
|---------------------|----------------|-------------------------|-----------------|----------------------|--------------------------|------------|
| Seed yield kg ha$^{-1}$ | 0.879**       |                         |                 |                      |                          |            |
| Plant height cm     | 0.784**       | 0.923**                 |                 |                      |                          |            |
| No. of main branches| 0.829**       | 0.806**                 | 0.757**         |                      |                          |            |
| No. of secondary branches | 0.793**   | 0.890**                 | 0.793**         | 0.702**              |                          |            |
| Pod height          | 0.571*        | 0.562*                  | 0.592*          | 0.462                | 0.568*                   |            |
| No. of pods         | 0.849**       | 0.922**                 | 0.909**         | 0.871**              | 0.842**                  | 0.447      |

Thus, application to soil in this study increase some physical and chemical properties of soil in Table 6. the results in the same table exhibited that reduction of pH from 7.9 to 7.61 and EC from 0.557 to 0.520 while the increase of phosphorus application rates change in physical and chemical attributes and increased in a variable phosphorus, organic matter, cation exchange capacity, and recorded values 4.08, 18.8, 32.4 respectively. this relation was considered positive for plant development. This is in line with finding of Rodinel et al., 2018 and Dotaniya et al., 2014.
Table (6): The chemical and physical properties of soil experimental site.

| Parameters       | Units           | (Depth 0-30) Before planting | (Depth 0-30) After planting |
|------------------|-----------------|-----------------------------|-----------------------------|
| Ph               | 1:2             | 7.96                        | 7.61                        |
| EC               | ds.m⁻¹          | 0.557                       | 0.520                       |
| Ca²⁺             | mmol.C.L⁻¹      | 2.50                        | 2.42                        |
| Mg²⁺             | mmol.C.L⁻¹      | 2.30                        | 2.08                        |
| Na⁺              | mmol.C.L⁻¹      | 0.34                        | 0.42                        |
| K⁺               | mmol.C.L⁻¹      | 0.19                        | 0.20                        |
| HCO₃⁻             | mmol.C.L⁻¹      | 3.80                        | 3.68                        |
| CO₃²⁻             | mmol.C.L⁻¹      | Appear                      | Appear                      |
| Cl⁻              | mmol.C.L⁻¹      | 0.74                        | 0.72                        |
| SO₄²⁻             | mmol.C.L⁻¹      | 0.70                        | 0.66                        |
| Available phosphorus P | Mg.kg⁻¹ | 3.89                        | 4.08                        |
| Organic matter   | g.kg⁻¹          | 17.5                        | 18.8                        |
| Cation exchange capacity | Cmol.kg⁻¹ | 29.8                        | 32.4                        |
| Total calcium carbonate | g.kg⁻¹ | 212                         | 218                         |
| Sand             | g.kg⁻¹          | 84                          | Soil texture silty clay     |
| Silt             | g.kg⁻¹          | 432                         | 430                         |
| Clay             | g.kg⁻¹          | 484                         | 492                         |
| Bulk density     | g.cm⁻³          | 1.29                        | 1.23                        |

Phosphorous Applications

| Treatment | Available phosphorous (mg.kg⁻¹) |
|-----------|---------------------------------|
| Control   | 0                               |
| 15        | 3.89                            |
| 30        | 4.88                            |
| 45        | 6.9                             |
| 60        | 7.92                            |

REFERENCES
Amare, T, Asnake, F and Bantayhu, M. (2020). Genetic variability and association analysis of Desi-type chickpea advanced lines under potential environmental in north Gondar Ethiopia. Congent food and Agriculture 6(1): 1-36.

Bala, L. K. (2017). Effect of phosphorus and zinc on growth, yield and economics of chick pea. Inter. of current microbiology and applied sciences. 6 (3): 1174-1181.

Balai.K, sharma.Y, Jajoria.M, Deewan.P and R. Verma. (2017). Effect of phosphorus and zinc on growth, yield and economics of chickpea. International Journal of current microbiology and applied sciences. 6 (3) 1174-1181.

Dotaniya. Ml,pingoliya. K. K, M. Lata, R, Vema, K. L. Decwan, P. Dolanyia.
(2014). Role of phosphorus in chickpea production. African. J. of Agric. Research. 9(51):3736-3743.

Gazola, P.N. moria and A. condido (2013). Efeito residual do aplicacao de fosfato monoammonio revestido por diferentes polimeros na cultura de milho. Revista Ceres. 60 (6) 876-884.

Gidago, G. S. Beyene and W. Worku. (2012). The response of haricot bean (Phaseolus vulgaris L.) to phosphorus application on ultisols at Areka, Southern Ethiopia. J. Biol. Agric. Healthc. 1(3):38-49.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd, New Delhi.

Jakhar, D.A, N. S. (2014). Genetic diversity studies in chickpea. Bangladesh. J. of Botany 45(3) :459-464.

Khan, H.R. (2010). Response of chickpea (Cicer arietinum L.) to zinc supply and water deficits. Ph.D. Decertation. Span. J. Agric. Res. 8(3): 797-807.

Laranjo, M. A. Alexander and Solivira. (2014). Legume growth-promoting rhizobia: an overview on the Meso rhizobium genus. Microbiological research. 169(1): 2-17.

Lopes, J. F. (2016). Productive ecosposicao meiernal do feilao em respostas as aduabaco es miedinio enianel Revista Ceras 63 (3): 419-426.

McDonald, G.K., Graham, R.D., Lloyd, J., Lewis, J., Lonergan, P., Khabaz-Saberi, H. (2001). Breeding for improved zinc and manganese efficiency in wheat and barley. Proceeding of the 10th Australian Agronomy Conference. Department of Plant Science, Waite Institute, Glen Osmond, SA, Hobart.

Nascimento. W. M. And A.Bala (2016). Hortalicas Leguminosa. Brasilia Empresa Brasileira de pesquisa Agro pecuaria 5,(2):232-237.

Oliveira. C. (2017). Producao de sementes de soja enriquecidas com phosphorus. Revista C eres, 64 (3):282-290.

Prajapati. B. J, Nitin. G. A. Gamit and H.J. chhaganiya. (2017). Effect of integrated phosphorus management on growth, yield attributes and yield of chickpea. Forming and management 2(1):36-40.

Rodinel. F. P., N. Maria, A. candido and M. Rodrigues. (2018). Chick pea production and soil chemical attributes after phosphorus and molybdenum fertilization. Ciencia Agrotecnologia.42(5) 474-483.

Seid. H., Yirga. F and F. Tibebu. (2015). Effect of phosphorus fertilizer on yield and yield components of chick pea. International J. of Agri. Extension and Rual Development studies. (1) (1) : 29-35.

Siphiwe. G.Z, Jude. J. O and B.O. John. (2017). Growth, yield and water efficiency of chick pea (Cicer arietinum): response to biochar and phosphorus fertilizer application. Archives of Agronomy and soil science. 10 (1):1-15.
کارتیکورا زیدەکرنا فوسفوری ل سەر بەرەهم نیناس گژینک نوکا و هەندەک تایبەت مەندیت فیزیایی و کێبەییەکە بێت ناھێنجەن کڵسی دەهووە - ھەرەیە کوردستانەیە عەیرەکی.

یوختە

تایبەتیەکە دەبەستەیە دەواوین بەوەیە 2020دا یە دا لەبەرەکەیە لەگەڵیتەکەرەکە تەنەدەژیە بەڵام بەڵامەکە دانیئەکە لەسەر گژینک بەرەوەیە و تایبەتەکەیە بین نیژیایییە و کێبەییەکە بێت ناھێنجەن زیدەکرنا فوسфорی. دیزاینەکەیە کەرتەیەیەکە هەرمەکەیە لەکارتنەیە، دەگەڵ سەن دەوە بەرەوەیە، و بەرەکەیەکەیەکە نزیدەکرنا Z0 (P2O5) 0.15، 30، 45، 60 کیلوجرام/هیکتار.

لەنجەمەسە دەیاربێتەکە کە مەنی هەوڵو لەسەر ھژمارا گژینک رژیومکی-1.

بەرەوەمە تەوەیە، بڵندییە رژیومکی، ھژمارا چەقین سەرهکی و لاوەکی، بڵندییە کێپەیکەت نەکەی و ھژمارا کێپەیکەت رووەکی-1. و ھەرەوەسە دەبەختەکە دەوەکەیە بەڵەسەر ھژمارا گژینک لەسەر ھژمارا گژینک بۆ ھژمارا چەقین سەرهکی (43.3) نە، بەرەوەم (66.7) کیلوجرام/هیکتار بڵندییە رژیومکی-1 (54.3) سم، چەقین سەرهکی و لەوەکی (4) و (2.3) و بڵندییە کێپەیکەت نەکەی (26.17) و بڵندترین ناستەکە بڵندیکە رووەکی-1 (27.67) تۆمارکر ل بڵندترین رژیومکی فوسفوری و نەنە گێرەیە لەجێکە سەرەیە بیا شیانەیەکەنی دا نەنجەمە دەیاربێتەکە کە بڵەدەکەن کە زیدەکرنا (P2O5) 0.2 کیلوجرام/هیکتار. دا بڵەدەکەن یە دەبە دەوەکەیە بێت ھەمی تەوەیەکەنی وەکو نەوەسیسە دەدەت و بڵەدەکەنی بەب بەسەریشنانەکە بێت (R) (0.95، 0.94، 0.91 و 0.9) بۆ بڵندیکە رژیومکی و چەقین سەرهکی و لاوەکی و ھژمارا کێپەکەیەکە-1 لەدوویف نیک. دەبەحەکەیە بۆ بڵەدەکەنی یە دەوەکەیە بۆ بڵەدەکەنی 82.90 و 8.4 دەگەل ھژمارا کێپەکەیەکە رووەکی-1 بڵندییە رژیومکی، ھژمارا چەقین سەرهکی و لاوەکی بەنی رووەکی-1 لەدوویف نیک. زیدەکرنا (ھاپتیناتا) فوسفوری بۆ ناکەن دەبە لەگەڵیتەکە زیندەکەنیە لەدەکەنی یە دەوەکەیە بین نیژیایییە و کێبەییەکە بێت ناھێنجەنی: (ھژمارا و O.M - هایدروجینی pH- گەھانەکان کاردنی - EC - و فوسفوری قەچۆرم - ، و مادەمەکە لەندەمی - و CEC- شیانەکە لەگەڵیتەکە کەڵێتیووان -

شۆکە بە نەفەکە: نۆک وەکو بەرەهەم، فوسفوری جۆبی نافەکەیە.
تأثير الفسفور المضاف على انتاج العقد البكتيرية للحمض وبعض الخصائص الخصوية للنبة الجسية

دهوك- إقليم كوردستان العراق

الخلاصة

طبقت تجربة حقلية خلال الموسم الربيعي لعام 2020 في حقل كلية علوم الهندسة الزراعية - جامعة دهوك لدراسة تأثير مستويات مختلفة من الفسفور على تكوين العقد البكتيرية وخصائص النبتة الفيزيائية والكيميائية باستخدام تصميم القطاعات العشوائية الكاملة وثلاث مكررات.

أظهرت النتائج وجود فروقات عالية المعنوية للفسفور على عدد العقد البكتيرية في النبات وعدد الفروع الرئيسية والثانوية وارتفاع أولاً القرننة وحاصل البذور وعدد القرنات في النبات. كما أظهرت النتائج قيم عالية لعدد القرنات في النبات (43.33) وحاصل البذور (666.7) كغم/هكتار وارتفاع أولاً قرننة 26.17 سم وعدد القرنات في النبات (27.67). أما بالنسبة إلى معامل الاقتصادي ممثلًا كنسبة مئوية فإن أعلى القيم سجلت عند معدل 60 كغم/هكتار و P2O5 وجميع الصفات الميدادية. كما أشارت النتائج إلى حصول قيم عالية لمعامل التحديد إذ بلغت (R2) 0.95 0.94 0.95 0.94 0.94 0.94 0.94 0.94 0.94 0.94 لارتفاع النبات وعدد الفروع الثانوية وارتفاع النبات وارتفاع أول قرننة على التوالي وعند دراسة الارتباط بين الحاصل والصفات الأخرى فقد كان الارتباط موجباً ومعنوناً لصفات عدد القرنات في النبات 0.922 وارتفاع النبات 0.90 وعدد الفروع الرئيسية 0.87 والثانوية 0.84 كما أدى إضافة الفسفور إلى حصول تغيرات في بعض الخصائص الكيميائية للنبتة شملة درجة الحمضة والتوصل الكهربائي والفسفور الجاهز والمادة العضوية وسعة التبادل الكاتيوني.

كلمات مفتاحية: حمض، انتاج، فسفور، صنف محلي