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EFFECT OF TRADITIONAL AND NANO PHOSPHOROUS FERTILIZATION AND SOIL MOISTURE CONTENT ON THE GROWTH AND YIELD OF TWO WHEAT CULTIVARS, TRITICUM AESTIVUM L. IN CALCAREOUS SOIL FROM NINEVEH GOVERNORATE

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ABSTRACT

A pot experiment was conducted under greenhouse conditions to study the effect of phosphorus fertilization under to soil moisture content on some growth indicators, yield and seed content of nitrogen and phosphorous for two wheat cultivars, Adnaniah and Sham-6, in calcareous soil suffering from a lack of available phosphorus. The results indicated that phosphorous fertilization led to an improvement in plant growth, as it caused an increase in the relative water content of leaves, chlorophyll percentage, nitrogen and phosphorous seed content, grain yield and protein percentage. Phosphorous fertilization played an important role in increasing the ability of the two wheat cultivars to withstand water stress conditions and reduce the negative impact resulting from the lack of water on plant growth, while the exposure of the two wheat cultivars to water stress there was a decrease in the values of previous growth indicators, grain yield and its content of N and P elements. Sham 6 variety was more responsive than the Adnaniya variety, as this variety outperformed in all the studied traits, in addition to that it obtained the best growth and higher yield under conditions of water shortage.

INTRODUCTION

The wheat crop (*Triticum aestivum* L) is one of the most important strategic crops in the world due to its implant part in bread production and food security, as it ranks first in terms of cultivated area and production. It is the main crop in Iraq, especially in Nineveh Governorate, which covers about 50% of the cultivated areas in Iraq from this crop (Ewaid *et al*, 2020) , and although Iraq is the first to plant wheat on its land, this crop is still suffering from low productivity and deteriorating quality due to the problem of drought, in addition to the lack of use of modern technologies(DAS ,2020).

Phosphorous plays an important role in plant life through its entry into the synthesis of nucleic acids that carry genetic traits and its entry into the synthesis of phospholipids which play an important role in building cellular membranes. Rich in energy in the form of ATP and ADP and in enzymes ((Al-Leela *et al.*, 2019) .Phosphorous in the alkaline soil solution is subjected to several reactions that lead to a decrease in its availablity for the plant, so phosphorus may precipitate in the form of unsusceptible tri-calcium phosphate, adsorbed on the surface of calcium carbonate, and clay minerals retain the element phosphorous (McDowell *et al.*, 2003). Duo to those problems especially in the soil of Nineveh Governorate as a result of the high $CaCO_3$ content, which reaches more than 35% (Staples *et al*., 2006). The researchers tended to reduce the use of these fertilizers and try to use modern technologies represented in nano-fertilizers to reduce the previous problems.

Nano-fertilizers plays an important role in the metabolic processes of the plant by increasing the activity of the photosynthesis process, which leads to an increase in the activity of the plant because of its small size, which contributes to making it fast absorbing and stable under different conditions, that means its remain used for a long time (Subramanian *et al*., 2015).The main problems facing wheat cultivation, especially in dry and semi-arid regions, is Lack of water and low soil moisture content. Therefore, this crop is subject to fluctuations in production from year to year due to variation in rainfall. Lack of water in the soil affects water uptake, root pressure, seed germination, stomata closure, transpiration, photosynthesis, enzymatic activity, and other processes, which in turn affect plant growth (Prasad *et al* .,2003) The lack of phosphorous in the soil of Iraq and its role in plant nutrition, in addition to the drought and shortage of water ,this study has been carried out.

MATERIALS AND METHODS

A pot experiment was conducted under greenhouse conditions, using calcareous soil from Nineveh Governorate suffering from phosphorus deficiency with a silty clay loam texture, classified into the Entisols group (Smith, 1986), soil was collected from the surface (0.0-30.0 cm.) and air-dried, passed through a 2mm sieve, Some chemical and physical analyzes (Table 1) were carried out according to the methods given in (Rowell ,1996).Plastic pots (diameter = 25cm, length =25cm)were filled with (7) kg of air-dry soil, then all the pots were fertilized with a basic fertilizer batch of 200 kg N ha^{-1} and 70 kg K ha^{-1} , using both urea and potassium sulfate (Yang, *et.al.*, 2020), while the phosphorous fertilization included five treatments which are, control treatment (F1), conventional phosphorous adding to the soil before planting (F2) using triple superphosphate 46% P_2O_5 according to the fertilizer recommendation 160 kg P ha^{-1} (Al-Hamdani *et al*., 2014). Nano phosphorous (17% P) adding to the leaves (F3) according to the manufacturer's recommendation 2 g L^{-1}, 50% conventional ground fertilization + 50% nano-fertilization (F4), 75% conventional ground fertilization + 25% nano fertilization (F5).

On 22November 2021, 10 seeds were sown in each pot, After germination plants were thinned to 3 plants per pot. The experimental plants were placed under two moisture levels, 50% (W1) and 75% (W2) from field capacity, time of watering plants was determined by weighing the pots and adding water to obtain the initial wet weight.

Nano-fertilizer has been used by spraying the shoots of plants in two stages of plant growth, the first in the branching stage when the plants reached the stage Z14.23 according to Zadok scheme, and the second in the stem elongation stage when the plants reached the Z35 stage.

The experiment was carried out using three replications according to a complete random design (CRD) as a factorial experiment with three factors, the significant differences between the treatments were evaluated using the least significant difference (LSD) test based on (Hoshmand, 2018).

Table (1) Some chemical and physical properties of the study soil

electrical conductivity EC (1:1)	ds m^{-1}	0.46
pH(1:1)		7.4
Organic matter	g kg^{-1}	12.6
CEC	C mol kg^{-1}	22.2
Calcium carbonate	g kg^{-1}	241
available Nitrogen	mg kg^{-1}	32.4
available phosphorous	mg kg^{-1}	8.2
available potassium	mg kg^{-1}	285
field capacity	g kg^{-1}	240
bulk density	M g m^{-3}	1.31
Sand	g kg^{-1}	154.5
Silt	g kg^{-1}	522.0
Clay	g kg^{-1}	323.5
Texture		silty clay loam

$$\text{The relative water content of the leaves(RWC)} = \frac{\text{Fresh weight - dry weight}}{\text{Blow weight - dry weight}} \times 100$$

The total chlorophyll concentration was measured on (28/3/2022) using a chlorophyll meter model spad 502.

The experiment was completed on 7/5/2022 and the seeds were dried at 70 °C for 48h and weighed. The seeds were digested using concentrated sulfuric acid and perchloric acid (Tandon ,2005), the nitrogen concentration in the extract was measured using a Microkjeldahl according to (Sarkar ,2005), the concentrations of P and K were determined according to the methods mention by (Tandon 2005).The amount of absorbed quantity of the element was calculated using the relationship (Jones, 1982).

A= Elemental concentration (%) x dry weight of seeds per pot x 100

A: the seed content of the element (g pot $^{-1}$)

RESULTS AND DISCUSSION

1- Physical and chemical characteristics of soil:

Various physicochemical properties of soil are presented in (Table 1). Soil was calcareous which contained more than (241) g kg^{-1} $CaCO_3$ and characterized by low organic matter content (12.6) g kg^{-1} and had high pH value(7.4), Soil texture is a silty clay loam. As for the concentration of available phosphorous in the soil (Olsen's solution) which is (8.2)mg kg^{-1} and this concentration is lower than the normal limit of phosphorus in the soil, which is (10-20) mg kg^{-1} as indicated by (Al-Mosili *et al*., 2019). The high pH of this soil, increase of calcium carbonate and the decrease in the percentage of organic matter,all that leads to the available phosphorus involve in a series of reactions with carbonate minerals and calcium ion in the soil solution or exchange on the surfaces of clay minerals (sedimentation and adsorption reactions) forming phosphate compounds with varying degrees of solubility (Lue *et al*., 1987).

2 -Effect of phosphorous fertilization and soil moisture content on some physiological traits

A- relative water content (%) of leaves

It is noted from Table (2) that the relative water content of leaves increased insignificantly in all phosphorous fertilizer treatments (except for treatment F2, which recorded a significant increase) compared to the control treatment that recorded the lowest values 83.72%, while the highest relative water of leaves was 89.81 % at F2 treatment, and also increase in soil moisture content from 50% (W1) to 75%(W2) of field capacity caused a significant increase in the relative water content of leaves from 83.40% to 92.43%. The effect of interaction between the two factors of soil moisture content and fertilization, it is noted that the soil moisture content at 75% of the field capacity exceeded the moisture content of 50% of the field capacity and significantly under all phosphorous fertilization treatments, and the highest water content of leaves was 94.77% and 94.16% in the two fertilization treatments F2 and F3 respectively. The high relative water content of leaves as a result of phosphorous fertilization may be due to good and appropriate fertilization increases and improves the efficiency of water consumption and thus increases the water content of leaves, as well as phosphorus has an important role in stimulating the growth and deepening of roots, and thus increasing the plant's ability to absorb water (Ebeling *et al.*, 2002). These results are consistent with the findings of (Ghorchiani *et al*., 2018) , and that the relative water content of the leaves of the two cultivars increased When irrigated at the level of 75% of the field capacity, it may be attributed to the increase in the moisture content of the soil, and thus increase in the amount of water absorbent (Turner *et al.*, 1978), the results obtained are in agreement with the results of (Ahmad *et al.* , 2021), that the difference in the relative water content of the leaves in the two cultivars Wheat may be due to the influence of the genetic factor due to the difference in their ability to control the degree of stomata opening and the osmotic regulation inside the leaf cells (Sallam *et al*., 2019).

B-chlorophyll concentration (spad)

Table No. (3) shows that the fertilization treatments had a clear effect on the chlorophyll concentration. The concentration of chlorophyll increased significantly in all fertilization treatments compared to the control treatment that recorded the lowest values (13.61) spad, while the F5 fertilization treatment recorded the highest concentration of chlorophyll (18.39) Spad and an increase of 35.12% compare with control treatment, and the increase in soil moisture content led to a significant increase in chlorophyll concentration by 54.35%, , the table(3) shows a significant effect of wheat cultivar In this trait, Sham-6 cultivar outperformed in performance by 3.04%, as the concentration of chlorophyll in this cultivar reached (16.60) comparison with (16.11) in the Adnaniya cultivar. It is noted from the previous table that the highest concentration of chlorophyll was (22.76) in Sham 6V2 cultivar was irrigated with 75% of the field capacity when fertilizing(F4).

Table (2) The effect of phosphorous fertilization and soil moisture content on the relative water content (%) for leaves

<table>
<tr><th rowspan="2">Var</th><th rowspan="2">Moisture</th><th colspan="5">Fertilizer</th><th rowspan="2">×Var Moisture</th><th colspan="2" rowspan="2">Humidity effect</th><th rowspan="2">Varieties effect</th></tr>
<tr><th>F1</th><th>F2</th><th>F3</th><th>F4</th><th>F5</th></tr>
<tr><td rowspan="2">V1</td><td>W1</td><td>79.63</td><td>82.95</td><td>85.90</td><td>86.43</td><td>78.87</td><td>82.75</td><td rowspan="2">W1</td><td rowspan="2">83.40</td><td rowspan="2">88.13</td></tr>
<tr><td>W2</td><td>90.63</td><td>97.27</td><td>96.33</td><td>91.10</td><td>92.10</td><td>93.48</td></tr>
<tr><td rowspan="2">V2</td><td>W1</td><td>78.21</td><td>86.72</td><td>82.65</td><td>80.51</td><td>92.13</td><td>84.04</td><td rowspan="2">W2</td><td rowspan="2">92.43</td><td rowspan="2">87.72</td></tr>
<tr><td>W2</td><td>86.40</td><td>92.28</td><td>91.99</td><td>91.38</td><td>94.90</td><td>91.39</td></tr>
<tr><td rowspan="2">Var Fertilizer</td><td>V1</td><td>85.13</td><td>90.11</td><td>91.12</td><td>88.77</td><td>85.49</td><td colspan="4" rowspan="5">The least significant difference(LSD) at the 0.05 level:
Var : 3.79
Moisture : 3.79
Fertilizer: 5.99
Var× moisture : 5.36
Var× fertilizer: 8.47
Moisture× fertilizer: 8.47
Var × moisture × fertilizer : 11.98</td></tr>
<tr><td>V2</td><td>82.31</td><td>89.50</td><td>87.32</td><td>85.95</td><td>93.52</td></tr>
<tr><td rowspan="2">Moisture fertilizer</td><td>W1</td><td>78.92</td><td>84.83</td><td>84.27</td><td>83.47</td><td>85.50</td></tr>
<tr><td>W2</td><td>88.15</td><td>94.77</td><td>94.16</td><td>91.24</td><td>93.50</td></tr>
<tr><td>Fertilizer</td><td></td><td>83.72</td><td>89.81</td><td>89.22</td><td>87.36</td><td>89.51</td></tr>
</table>

The increase in chlorophyll concentration in fertilization treatments may be due to an increase in the phosphorous element within the plant as a result of fertilization and thus an increase in the activity of enzymes responsible for the formation of complex chlorophyll. In agreement with the results of(Bojović *et al* .,2005).

The decrease in the concentration of chlorophyll in the plant with the decrease in soil moisture content may be due to the increase in the concentration of abscisic acid ABA, and that the accumulation of this acid ,that lead to close the stomata under conditions of water deficiency and this acid inhibits the process of chlorophyll formation (Osakabe *et al*., 2014), and the results are consistent with those

3- EFFECT OF FERTILIZING WITH PHOSPHOROUS AND SOIL MOISTURE CONTENT ON THE NITROGEN AND PHOSPHOROUS CONTENT OF SEEDS (G POT^{-1})

A - NITROGEN

It is noticed from Table No. (4) that the fertilization treatments had a clear effect on the amount of nitrogen absorbed in two wheat cultivars. The nitrogen content in the seeds increased significantly in all fertilization treatments, and the highest nitrogen content of the seeds was (1.00 g pot^{-1}) in the treatment(F5), while the control treatment recorded the lowest values (0.32) g pot^{-1}, the nitrogen content increased from (0.54 to 0.77) g pot^{-1} in the two treatments W1 and W2 respectively, with a percentage of increase 42.5%. It is noted from the previous table that there is a significant effect of wheat cultivar on this trait. Sham 6 cultivar outperformed in the seed nitrogen content (0.92 g pot^{-1}) compared to Adnaniya (0.39) g pot^{-1} cultivar with an increase of 135%. The soil content of 75% of the field capacity (W2) exceeded the moisture content of 50% of the field capacity (W1) significantly in all phosphorous fertilization treatments, and the highest nitrogen content was (1.16) g pot^{-1} in the treatment (F5). The increase in the content of wheat seeds Of nitrogen may be due to the increase in the concentration of phosphorous within the plant cells as a result of fertilization and this leads to the formation of a dense and deep root system that helps to increase the roots and increase the amount of nitrogen absorbed (Rossowsky *et al.,* 1989) and this increase it can be attributed to the increase in the demand for nitrogen as a result of the improvement of plant growth due to the addition of phosphorous element. The results that were reached are in agreement with the findings of (De Groot *et al.*,2003). The decrease in the nitrogen content of seeds when irrigated by 50% of the field capacity can be attributed to the important role of water in the process of dissolution and movement of nutrients from the soil to the plant. (Erlandssoon,1975), the results agree with what was indicated by (Reddy, 2012) .

Table (3): The effect of phosphorous fertilization and soil moisture content on the percentage of chlorophyll (spad)

Var	Moisture	Fertilizer					Var Moisture	Humidity effect		Varieties effect
		F1	F2	F3	F4	F5				
V1	W1	10.36	13.00	13.80	13.86	14.10	12.86	W1	13.02	16.11
	W2	15.66	17.50	19.13	21.63	22.90	19.36			
V2	W1	10.60	11.83	13.43	14.03	14.40	12.85	W2	19.85	16.60
	W2	17.83	19.53	19.43	22.76	22.16	20.34			
Var Fertilizer	V1	13.01	14.83	16.46	17.75	18.50	The least significant difference (LSD) at the 0.05 level Var : 0.27 Moisture: 0.27 Fertilizer:0.43 Var* moisture : 0.39 Var* fertilizer : 0.62 Voisture* fertilizer : 0.62 A var * moisture * fertilizer : 0.87			
	V2	14.21	15.68	16.43	18.40	18.28				
Moisture Fertilizer	W1	10.48	12.00	13.61	13.95	14.25				
	W2	16.75	18.51	19.28	22.20	22.53				
Fertilizer		13.61	15.25	16.45	18.07	18.39				

b- PHOSPHOROUS

The results of Table (5) indicate that the addition of phosphate fertilizers caused a significant increase in the phosphorous content of seeds in all fertilization treatments compared to the case without fertilizing which recorded the lowest values (0.042) g pot^{-1} , while the F5 fertilization treatment recorded the highest content of phosphorous (0.164) g pot^{-1}, as for the effect of soil moisture content, it is noted that the highest phosphorous content of the seeds was (0,116) g pot^{-1} when irrigated with 75% of the field capacity (W2), which was significantly superior to the treatment of irrigation 50% of Field capacity (W1), with an increase of 45%.The cultivar (Sham 6) recorded the largest amount of phosphorous absorbed, which (0.137) g pot^{-1} compared to the variety Adnaniya, which amounted to (0.58) g pot^{-1}, with regard to the effect of the dual interaction of soil moisture and fertilization factors, It is noted that the highest content of phosphorous was when the irrigation treatment was 75 % (W2) in all fertilization treatments, and the highest amount of phosphorous was absorbed (0.198) g pot^{-1} in treatment (F5W2).

Table (4): The effect of fertilizing with phosphorous and soil moisture content on the nitrogen content of seeds (g pot^{-1})

<table>
<tr><th rowspan="2">Var.</th><th rowspan="2">Moisture</th><th colspan="5">Fertilizer</th><th rowspan="2">Var. Moisture</th><th rowspan="2" colspan="2">Humidity effect</th><th rowspan="2">Varieties effect</th></tr>
<tr><th>F1</th><th>F2</th><th>F3</th><th>F4</th><th>F5</th></tr>
<tr><td rowspan="2">V1</td><td>W1</td><td>0.19</td><td>0.31</td><td>0.33</td><td>0.46</td><td>0.51</td><td>0.36</td><td rowspan="2">W1</td><td rowspan="2">0.54</td><td rowspan="2">0.39</td></tr>
<tr><td>W2</td><td>0.25</td><td>0.35</td><td>0.36</td><td>0.55</td><td>0.65</td><td>0.43</td></tr>
<tr><td rowspan="2">V2</td><td>W1</td><td>0.33</td><td>0.58</td><td>0.69</td><td>0.89</td><td>1.17</td><td>0.73</td><td rowspan="2">W2</td><td rowspan="2">0.77</td><td rowspan="2">0.92</td></tr>
<tr><td>W2</td><td>0.51</td><td>0.89</td><td>1.00</td><td>1.45</td><td>1.68</td><td>1.11</td></tr>
<tr><td rowspan="2">Var Fertilizer</td><td>V1</td><td>0.22</td><td>0.33</td><td>0.34</td><td>0.50</td><td>0.58</td><td rowspan="5" colspan="4">The least significant difference in LSD at the 0.05 level:
Fertilizer: 0.056
Moisture : 0.035
Var : 0.035
A var * moisture: 0.050
Var * fertilizer: 0.079
Moisture * fertilizer 0.079
Var * Moisture * fertilizer : 0.112</td></tr>
<tr><td>V2</td><td>0.42</td><td>0.73</td><td>0.84</td><td>1.17</td><td>1.42</td></tr>
<tr><td rowspan="2">Moisture fertilizer</td><td>W1</td><td>0.26</td><td>0.44</td><td>0.51</td><td>0.68</td><td>0.84</td></tr>
<tr><td>W2</td><td>0.38</td><td>0.62</td><td>0.68</td><td>1.00</td><td>1.16</td></tr>
<tr><td>Fertilizer</td><td></td><td>0.32</td><td>0.53</td><td>0.59</td><td>0.84</td><td>1.00</td></tr>
</table>

The decrease in the phosphorous content of the seeds of the two wheat cultivars in the unfertilized treatments may be due to the low concentration of available phosphorus in the study soil (8.2)ppm due to the high pH value and the increase in the proportion of calcium carbonate (Table 1), and consequently the interaction of phosphorus with carbonate minerals or calcium dissolved or calcium exchanged on the surface of clay (Tunesi *et al.*, 1999), the ground addition of phosphorus caused an increase in the available quantity of this element in the soil and thus increased its absorption by the plant, and the foliar application of nano-phosphorous fertilizer caused an increase in the absorption and concentration of phosphorus in the plant, The findings are in agreement with that of (De Groot *et al.*, 2003). Increasing the phosphorous content of seeds by increasing the moisture content of the soil may be attributed to the important role of water in the process of dissolution and the movement of nutrients from the soil to the plant due to the increase in the thickness of the water membranes that form inside the soil, and this in turn leads to an increase in the spread of nutrients through it (AL Taher *et al*, 2021), in addition to the fact that the rate of plant absorption of nutrients decreases when the plant is exposed to water stress conditions due to the decrease in the rate of transpiration process, effective transport and permeability of plasma membranes (Gratato *et al.*,2005) .

Table (5): Effect of fertilizing with phosphorous and soil moisture content on the phosphorous content of seeds (g pot^{-1})

Var	Moisture	Fertilizer					Var Moisture	Humidity effect		Varieties effect
		F1	F2	F3	F4	F5				
V1	W1	0.021	0.032	0.032	0.057	0.071	0.04	W1	0.080	0.058
	W2	0.032	0.057	0.065	0.096	0.117	0.07			
V2	W1	0.048	0.090	0.107	0.149	0.191	0.11	W2	0.116	0.137
	W2	0.066	0.100	0.129	0.217	0.278	0.15			
Var Fertilizer	V1	0.026	0.044	0.049	0.077	0.094	The least significant difference in LSD at the 0.05 level: Fertilizer: 0.0094 Moisture : 0.0059 Var : 0.0059 Var moisture : 0.0084 Var fertilizer: 0.0133 Moisture *fertilizer: 0.0133 Var * moisture * Fertilizer : 0.0188			
	V2	0.057	0.095	0.118	0.183	0.234				
Moisture fertilizer	W1	0.034	0.061	0.069	0.103	0.131				
	W2	0.049	0.078	0.097	0.156	0.198				
Fertilizer		0.042	0.070	0.083	0.130	0.164				

4-THE EFFECT OF FERTILIZATION AND SOIL MOISTURE CONTENT ON THE QUANTY AND QUALITY YIELD OF GRAINS GRAIN YIELD (G POT^{-1})

The results in Table (6) indicate that the addition of phosphate fertilizers caused a significant increase in grain yield in all fertilization treatments, compared to case without fertilization, which recorded the lowest values. The highest weight of the yield (43.91) g pot^{-1} when treated with F5, Soil moisture content had a significant effect on the weight of the crop, The yield increased from (33.29) g pot^{-1} in the irrigation treatment 50% of the field capacity to (41.06) g pot^{-1} in the irrigation treatment 75% of the field capacity.The increase in grain yield as a result of fertilizing with phosphorous may be due to the fact that this element significantly improves the growth and activity of the roots and increases their depth. Similar was obtained by (Abdel-Aziz *et al.*,2016.) The decrease in grain yield when irrigated by 50% of the field capacity may be due to a decrease in the rate of photosynthesis as a result of a decrease in the percentage of chlorophyll (Table 3) , The results obtained are in agreement with the results of (Hasanpour *et al.*, 2012).

Table (6): Effect of fertilizing with phosphorous and soil moisture content on grain yield (g pot^{-1})

Var	Moisture	Fertilizer					Var Moisture	Humidity effect		Varieties effect
		F1	F2	F3	F4	F5				
V1	W1	00.19	26.00	21.66	27.66	28.66	24.59	W1	33.29	26.66
	W2	24.00	29.33	26.00	31.33	33.00	28.73			
V2	W1	32.33	43.66	39.33	44.33	50.66	42.06	W2	41.06	47.69
	W2	44.66	52.00	48.00	59.00	63.33	53.39			
Var Fertilizer	V1	21.50	27.66	23.83	29.49	30.83	The least significant difference in LSD at the 0.05 level: Fertilizer: 2.85 Moisture : 1.80 Var : 1.80 رVar moisture : 2.55 Var fertilizer : 4.04 Moisture fertilizer : 4.04 Var * Moisture * Fertilizer : 5.71			
	V2	38.49	47.83	43.66	51.66	56.99				
Moisture Fertilizer	W1	25.66	34.83	30.49	35.99	39.66				
	W2	34.33	40.66	37.00	45.16	48.16				
Fertilizer		29.99	37.74	33.74	40.58	43.91				

B-protein (%)

The results of Table (7) indicate that the fertilization caused a significant increase in the percentage of protein, and the highest protein percentage 13.77% was in the (F5) treatment, with an increase of 105% compared to the control treatment , and the effect of soil moisture content, it was observed that the protein content increased from 9.87% to 10.98% in the two treatments W1 and W2, respectively, with an increase of 11.2%. Sham 6 recording the highest protein content 11.62%, significantly superior with an increase of 25.8% than the the percentage of protein in the seeds of the cultivar Adnani. The increase in the proportion of protein when adding phosphate fertilizer can be attributed to the high efficiency of phosphorus in increasing nitrogen uptake (Shabbir *et al*, 2005), in addition to the important role of phosphorus in the formation of energy-rich compounds and the formation of DNA and RNA that are involved in protein biosynthesis (Da Silva *et al*, 2019). A decrease in the protein content in seeds with a decrease in the moisture content in the soil may be due to a decrease in the amount of absorption of nitrogen and phosphorous elements (Table 4 and Table 5), consequently, a decrease in the process of protein synthesis and its properties Transfer to seed. The results are in agreement with those of(Abdelkader *et al.*, (2012).

Table (7): Effect of fertilizing with phosphorous and soil moisture content on protein percentage (%) in seeds

<table>
<tr><th rowspan="2">Var.</th><th rowspan="2">Moisture</th><th colspan="5">Fertilizer</th><th rowspan="2">Var Moisture</th><th rowspan="2" colspan="2">Humidity effect</th><th rowspan="2">Varieties effect</th></tr>
<tr><th>F1</th><th>F2</th><th>F3</th><th>F4</th><th>F5</th></tr>
<tr><td rowspan="2">V1</td><td>W1</td><td>6.41</td><td>7.72</td><td>9.76</td><td>10.49</td><td>11.37</td><td>9.15</td><td rowspan="2">W1</td><td rowspan="2">9.87</td><td rowspan="2">9.23</td></tr>
<tr><td>W2</td><td>6.70</td><td>7.58</td><td>8.74</td><td>11.08</td><td>12.54</td><td>9.32</td></tr>
<tr><td rowspan="2">V2</td><td>W1</td><td>6.40</td><td>8.30</td><td>11.08</td><td>12.68</td><td>14.58</td><td>10.60</td><td rowspan="2">W2</td><td rowspan="2">10.98</td><td rowspan="2">11.62</td></tr>
<tr><td>W2</td><td>7.28</td><td>10.78</td><td>13.12</td><td>15.45</td><td>16.62</td><td>12.65</td></tr>
<tr><td rowspan="2">Var. Fertilizer</td><td>V1</td><td>6.55</td><td>7.65</td><td>9.25</td><td>10.78</td><td>11.95</td><td rowspan="5" colspan="4">The least significant difference in LSD at the 0.05 level:
Fertilizer: 0.402
Moisture : 0.254
Var : 0.254
Var moisture : 0.360
ar fertilizer: 0.569 V
Moisture fertilizer : 0.569
Var * moisture * Fertilizer : 0.805</td></tr>
<tr><td>V2</td><td>6.84</td><td>9.54</td><td>12.10</td><td>14.06</td><td>15.60</td></tr>
<tr><td rowspan="2">Moisture Fertilizer</td><td>W1</td><td>6.40</td><td>8.01</td><td>10.42</td><td>11.58</td><td>12.97</td></tr>
<tr><td>W2</td><td>6.99</td><td>9.18</td><td>10.93</td><td>13.26</td><td>14.58</td></tr>
<tr><td>Fertilizer</td><td></td><td>6.69</td><td>8.59</td><td>10.67</td><td>12.42</td><td>13.77</td></tr>
</table>

CONCLUSION

Nano-phosfforus fertilizer is considered as supplementery fertilizer to super – phosphate fertilizer. The higher yield come from the treatment using (75% traditional + 25%nano phosphorus). Using phosphorus fertilizer increase the ability of wheat to withstanding the deficit of soil moisture content

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CONFLICT TO INTEREST

The authors declare that they have no conflicts of interest

تأثير التسميد بالفسفور التقليدي والنانوي والمحتوى الرطوبي للتربة في نمو و حاصل صنفين من الحنطة *Triticum aestivum* L. في تربة كلسية من محافظة نينوى

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الخلاصة

أجريت تجربة أصص تحت ظروف البيت البلاستيكي لدراسة تأثير التسميد بالفسفور والمحتوى الرطوبي للتربة في بعض مؤشرات النمو والحاصل ومحتوى البذور من عنصري النتروجين والفسفور لصنفين من الحنطة هما

العدنانية وشام–6 وذلك في تربة كلسية من محافظة نينوى تعاني من نقص الفسفور الجاهز، .أشارت النتائج إلى أن التسميد بالفسفور أدى إلى تحسن النمو النباتي لصنفي الحنطة حيث سبب زيادة في المحتوى الرطوبى النسبي للأوراق و نسبة الكلوروفيل ومحتوى البذور من عنصري النتروجين والفسفور وحاصل الحبوب ونسبة البروتين، وكان للتسميد بالفسفور دور مهم في زيادة قدرة صنفي الحنطة على تحمل ظروف الاجهاد المائي وتقليل الاثر السلبي الناتج عن نقص الماء في نمو النبات، ب، بينما ادى تعرض صنفي الحنطة إلى الاجهاد المائي الى حصول انخفاض في قيم مؤشرات النمو السابقة وحاصل الحبوب ومحتواها من عنصري N وP، كما اختلف صنفي الحنطة في مدى استجابتهما لعوامل الدراسة اذ لوحظ ان الصنف شام6 كان اكثر استجابة من الصنف عدنانية فقد تفوق هذا الصنف في جميع الصفات المدروسة بالاضافة الى انه حصل على افضل نمو واعلى حاصل تحت ظروف نقص الماء .

الكلمات المفتاحية : الفسفور النانوي, السوبرفوسفات الثلاثي , المحتوى الرطوبي للتربة , الحنطة

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