Effect of sowing date and phosphorus fertilizer on growth and yield of wheat (*Triticum aestivum* L.).

تأثير التسميد الفوسفاتي ومواعيد الزراعة في نمو وحاصل الحنطة (*Triticum aestivum* L.).

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Abstract

A field experiment was conducted at the experimental farm, Agriculture College, Karbala University, during 2007-2008 growing season. The aim of this study was to determine the influence of sowing date (15/11 , 25/11 and 5/12) assigned in the main plots and 5 levels of phosphorus (0,30,60,90 and 120) kg P_2O_5 ha assigned in the subplots on some characteristics of wheat plant. Plant growth , yield and yield components of wheat plant cv. Alfateh were determined. The experiment was arraneed as split–plot within randomized complete block design R.C.B.D. means were compared using LSD at p= 5%. Results could be summarized as follow :

First and second sowing dates gave the highest number of spike/ m^2 and biological yield. The second sowing date gave the highest number of grains / spike . whereas the third sowing date gave the highest weight of 1000 grains.

The highest percentage of determination coefficient(r^2) during 1st sowing date was obtained from flag leaf area and number of grains per spike (0.82 and 0.77),. respectively .

The highest percentage of determination coefficient during the second sowing date was obtained from the biological yield ,flag leaf area ,number of grains / spike and number of spike /m^2 (0.93 ,0.83,0.77 and 0.76), respectively. The third sowing date gave the highest percentage of determination coefficient represented from 1000 grains weight.

Regarding phosphorus fertilization ,120 kg P_2O_5/ha gave the highest flag leaf area , number of spike / m^2 , number of grains/ spike and grains yield (46.59 cm^2 , 346.60 spike , 36.83 grains and 5310 kg P_2O_5/ha), respectively.

المستخلص :

نفذت تجربة حقلية في الموسم الزراعي 2007 -2008 في الحقل التجريبي التابع لكلية الزراعة جامعة كربلاء في الحسينية لدراسة تأثير مواعيد الزراعة (11/15 , 11/25 و 5 / 12) كعامل رئيسي ومستويات التسميد الفوسفاتي (0 , 30 , 60 , 90 و 120) كغم P_2O_5 / هـ كعامل ثانوي في بعض صفات النمو والحاصل ومكوناته في الحنطة صنف الفتح . نفذت التجربة حسب تصميم الألواح المنشقة مع القطاعات الكاملة المعشاة RCBD وخلصت نتائج الدراسة الى ما يلي :-

حقق كل من الموعدين الأول والثاني واللذان لم يختلفان عن بعضهما معنوياً أعلى معدل لعدد السنابل في المتر المربع والحاصل البايلوجي وتفوق الموعد الثاني في تحقيق اعلى معدل لعدد الحبوب في السنبلة في حين اعطى الموعد الثالث اعلى معدل لوزن 1000 حبة . فسرت مساحة ورقة العلم وعدد الحبوب في السنبلة في الموعد الأول حسب معامل تحديد اعلى نسبة من تغايرات الحاصل بلغت (0.82 و 0.77) في حين فسر الحاصل البايلوجي ومساحة ورقة العلم وعدد الحبوب في السنبلة وعدد السنابل في المتر المربع اعلى نسبة من تغايرات الحاصل في الموعد الثاني بلغت (0.93 , 0.83 , 0.77 و 0.76) أما في الموعد الثالث فأن وزن 1000 حبة فسر أعلى نسبة من تغايرات الحاصل بلغت 0.71 , وأن ذلك انعكس على الحاصل الحبوبي وتفوق الموعد الثاني والذي لم يختلف معنوياً عن الموعد الأول في تحقيق أعلى حاصل بلغ 4667 كغم/هـ . تفوق المستوى السمادي 120كغم P_2O_5 وحقق أعلى معدل لمساحة ورقة العلم وعدد السنابل في المتر المربع وعدد الحبوب في السنبلة والحاصل بلغ (46.59 $سم^2$, 346.60 سنبلة , 36.83 حبة و 5310 كغم/هـ) على التوالي .

Introduction:

Sutable sowing date and fertileization expecially phosphate fertilization as well as the understand of the relation ship between these two facters and the yield of wheat are of importance.

Increasing phosphate fertilization in plays a principal role in both ways ,increasing the yield and reducing the negative effect caused by delaying the sowing date (1and 2) . Increasing levels of phosphate fertilization from 0 to 78 kg P_2O_5/ ha increased the yield (0.79 t / ha (2).

Increasing the phosphate levels from 0 to 149 kg P_2O_5 increased N concentration , grains yield and biological yield (3). However , 100 kg P_2O_5 / ha was recommended in middle and southern Iraq (4). The number of spikes per square meter and the grains yield decreased due to delaying the sowing date (2 and 5). Contradiction results were obtained a bout the response of eheat yield to the sowing date. While delaying sowing date from 20 /10 to 1/ 12 caused a reduction in the grain yield from 2.05 to 0.78 t /ha (6) . Delaying the date from 15/10 to 1/1 caused a decrement in the grain yield ,biological yield and the plant hight , and the branches number per square meter and no significant difference was found between 15/ 10 and 15 / 11 sowing dates (7) .

In Iraq , it was recommended that November , 15^{th} is the sutable sowing date for middle and south Iraq (4). Other workers mentioned that sowing date at 19 / 11 was the best (8). Sowing date at 25 / 11 was better than 5/11 and 15 / 12 sowing dates which gave higher yield of grains 458 and 443 kg / ha for two growing seasons (9).

This experiment was conducted to asses the response of wheat plant to different sowing dates and different levels of phosphate fertilization as well as diagnosing the most determined components on grain yield.

Materials and methods

A field experiment was conducted at the experimental farm , Agricullure College Kerbala University during the growing season of 2007/2008.

Seeds of wheat plants *Triticum aestivum* L.cv. Alfateh were sown on 15/11 , 25/11 and 5/ 12 . Five levels of P_2O_5 (0,30,60,90,and 120) kg / hactar were used. Seeds were sawn in a rate of 100 kg/ha on rows 2m long ,15 cm apart , in a silty loam soil table (1) . Fifty kg / ha Nitrogen fertilizer was added during the growing season namely at 3 true leaf stage , the appearance of the 2^{nd} internode and at the booting stage . All practices needed by the plants were adopted as recommended by (10).

At 100 % flowering stage , plant height recorded and the flag leaf area was calculated according to (11) . At maturity stage , 0.6 m^2 was harvested from each experimented unit in order to determine grains yied , biological yield , spikes number per square meter ,weight of 1000 grains and grains number /spike . Nitrogen was determined using Microkijldahl method (12) and protein percent was then computed.

A split – plot arrangement within randomized complete block design with three replicatis was used. Least significant difference was used to compare means at 5% probability level (13).

Results & discussions

1) Plant hight (cm)

Sowing dates signicanlty affected the plant height (Table 2). The first sowing date gave higher value of plant hight (108.93 cm).

On the other hand , the third sowing date gave the least plant hight. This could by attributed to the reduction of period required for cell elongalion due to the low temperature during that period. These results were in agreement with (7 and 8). Niether phosphate fertilizer nor the interaction were effective on the plant hight.

2) Flag leaf area:

Table (3) should that sowing dates significantly affected on the flag leaf area ,where the first sowing date was the last giving an average of 48 cm^2. The reduction in the flag leaf area during the late sowing date could be due to the reduction of growth and expantion of the leaf

accompanied with high temperature (15) . Same results were obtained by (14). The opposite effect of late sowing date on the flag leaf area could also be due to the reduction of Nitrogen absorption during the early vegetative growth (16) .

Phosphate fertilize had a pronouned effete on the flag leaf area where 120 kg P_2O_5 gave the highest value compared with the control treatment .this could be due to the role of p in plant cell division , DNA , RNA synthesis and chloroplast synthesis (14,17).

3) No .of spikes /m^2

Sowing dates had a significant effect on the number of spikes per square meter where the first sowing date gave the higher value 340.4 spikes compared with the late sowing date table (4) . This result could be explained that in the late sowing date fertilizer dereased the number of spikes because the growth of plants comceded with high temperate lading to increasnig the respirator and consequently the reducation in assimilate's of photosynthesis . for the previos result , the competiton between the main stem and the branches will be high leading to a decrease in the number of spikes (18).the phosphate fertilzolin also affected on the number of spikes per square meter ,where the level 120 kg P_2O_5 gave the highest nimber of spikes i.e. 346.6 companed with the other treatments . the interaction between sowing date and fertilizer level on the number of spikes was also significant . The highest value was obtained from plants of the second sowing date received 120 kg P_2O_5. These results were in accordance with that obtained by (19).

4) Grains number per spike :

The second sowing date significantly exceeded other two sowing dates giving 36.6 grains /spike table (5). This result was the same as reported by (9). Where the temperature at that was suitable for flowerets fertilization . The phosphate fertilizer also affected on this trait where 120 kg P_2O_5 gave the highest number of grains 36.83 compared with that obtained from the control treatment which gave 3.13 grains . The introaition between sowing date and phosphate fertitlizer showed a significant effect on this character giving 38.33 grains per spike.

5) Weight of 1000 grains (gm)

Table (6) showed that the third sowing date gave higher weight of 1000 grains (i.e.27.16) compared with the 1st and the end sowing dates. This trait was also influenced by fertilization with phosphate where the control treatment was the best. Plants grown with out P fertilizer the 3rd sowing date gave better interaction on the weight of 1000 grains. This could be explained due to compensation between yield components (20 and 21)

6) The biological yield (kg/ha) :

Sowing dates significantly influenced the biological yield of wheat plants (Table 7). The third sowing date was the least 7424 kg /ha giving a reduction percent 16.34% and 17.83 % compared with 1st and the 2nd sowing dates, respectively. This could also be due to the increase in the temperature at that time leading to reduce the asimilats of photosynthesis . This result agreed with (20). The phosphate fertilizer level 120 kg/ha gave the highest biological yield matching to 9848 kg/ ha companed with that obtained from control treatment, while the best intraction was obtained from plants grown from the 2nd sowing date and 120 kg P_2O_5 /ha. Giving 10655 kg/ha.

7) Grains yield (kg/ha) :

the same trend of that mentioned with the biological yield was noticed. The superiority of 1st and 2nd sampling dates in this trait could be due to the number of spikes per square meter and the number of grains per spike. This finding could be explained by the limiting factors that affecting the yield during early and late sowing dates. During the suitable sowing date the number of spikes/m2 will be the most determinal facto (Table 10) meanwhile , during the late sowing date ,the weight of the grain will be the most determintal factor (2). The level of 120 kg P_2O_5 / ha achieved the best yield of grains giving 35.35 % increase compared with the control treatment . This result was due to the increase of P absorption leading to an increase in yield per unit area (19 and 22) . No effect was found du to the interaction between these two factors on the yield of grains.

8) Protein % :

Data in (Table 9) showed a marked influence of fertilization with 120 kg P_2O_5 /ha on the percentage of protein compared the control treatment. Increasing P levels leading to an increase in the root growth and consequently an increase in the absorption of nutrients this will be reflected by increasing protein content . These results coincided with that found by (23) who mentioned the synergistic effect between N and P leading to increase amino acids and protein synthesis. These are also agreed with that found by (3). Table (9) als showed a significant effect of sowing dates and fertilization on the protein concentration where higher percentage of protein was obtained from plants received 90 kg P_2O_5 in the third sowing date.

Table (1) Some physical and chemical properties of soil

Properties	Values
Soil pH	7.73
Soil Ec (ds/ m)	4.42
Available N(mg/kg soil)	362
Available P(mg/ kg soil)	9.3
Available K(mg/kg soil)	167.2
Sand (g/kg soil)	103
Silt (g/kg soil/0	649
Clay (g/kg soil)	248
Soil texture	Silty loam

Table (2) : Effect of sowing dates and phosphate fertilization and their interactions on the height of wheat plant (cm).

P2o5 levels / Sowing dates	0	30	60	90	120	Mean
15/11	109.00	105.33	112.00	107.3	111.00	108.93
25/11	96.00	95.67	98.67	103.33	108.33	100.40
5/12	82.00	83.33	83.00	84.00	84.33	83.33
Mean	95.67	94.78	97.89	98.22	101.22	

L S D $_{P=5\%}$ Sowing dates =10.838 P_2O_5 = N . S Interaction = N . S

Table (3) : Effect of sowing dates and phosphate fertilization and their interaction on the Flag leaf area (cm^2).

P2o5 levels / Sowing dates	0	30	60	90	120	Mean
15/11	45.67	46.50	47.00	50.07	50.83	48. 01
25/11	36.67	38.20	40.67	42.67	45.67	40.77
5/12	36.33	38.00	39.87	41-67	43.27	29.83
Mean	39.56	40.90	42.51	44.80	46.59	

L S D $_{P=5\%}$ Sowing dates = 1.309 P_2O_5 = 1.072 Interaction = N . S.

Table (4) : Effect of sowing dates and phosphate fertilization and their interactions on the spikes No. / m^2 .

P2o5 levels / Sowing dates	0	30	60	90	120	Mean
15/11	310.00	430.70	338.30	356.60	356.60	340.40
25/11	301.60	301.60	335.00	358.90	376.70	334.70
5/12	200.00	246.60	265.00	281.70	306.70	260.00
Mean	270.50	296.30	312.80	332.40	346.60	

L S D $_{P=5\%}$ Sowing dates =12.58 P_2O_5 = 8.67 Interaction = 16.45

Table (5) : Effect of sowing dates and phosphate fertilization and their interactions on grains No . / spike .

P2o5 levels / Sowing dates	0	30	60	90	120	Mean
15/11	31.58	34.50	35.27	36.50	38.33	35.23
25/11	34.16	35.96	36.00	36.66	28.00	36.16
5/12	27.66	29.16	30.00	32.16	34.16	30.63
Mean	31.13	33.21	33.75	35.11	36.83	

L S D $_{P=5\%}$ Sowing dates =0.86 P_2O_5 = 0.44 Interaction= 0.97

Table (6) : Effect of sowing dates and phosphate fertilization and their interactions on Weight of 1000 grains .

P2o5 levels / Sowing dates	0	30	60	90	120	Mean
15/11	25.66	25.66	24.33	24.00	24.00	24.73
25/11	26.00	25.30	24.00	24.00	23.50	24.56
5/12	29.83	28.50	26.33	25.66	25.50	27.16
Mean	27.16	26.48	24.88	24.55	24.33	

L S D $_{P=5\%}$ Sowing dates =0.18 P_2O_5 = 0.36 Interaction = 0.57

Table (7) : Effect of sowing dates and phosphate fertilization and their interactions on biological yield (Kg / ha) .

P2o5 levels / Sowing dates	0	30	60	90	120	Mean
15/11	7222	8344	9000	9253	10555	8875
25/11	8111	8278	8783	9353	10655	9036
5/12	5889	7000	7567	8333	8333	7424
Mean	7074	7874	8450	8980	9848	

L S D $_{P=5\%}$ Sowing dates = 260.2 P_2O_5 = 264.5 Interaction= 450.0

Table (8) : Effect of sowing dates and phosphate fertilization and their interactions on grains yield Kg / ha .

P2o5 levels / Sowing dates	0	30	60	90	120	Mean
15/11	4000	4125	4367	4983	5593	4614
25/11	4176	4237	4399	5000	5500	4667
5/12	3604	4000	4500	4700	4803	4322
Mean	3923	4121	4422	4894	5310	

L S D $_{P=5\%}$ Sowing dates =269.30 P_2O_5 = 267.10 Interaction = N . S.

Table (9) : Effect of sowing dates and phosphate fertilization and their interactions on the percentage of protein .

P2o5 levels / Sowing dates	0	30	60	90	120	Mean
15/11	6.26	7.50	8.50	8.24	9.72	8.04
25/11	6.34	7.86	7.52	9.99	8.54	8.05
5/12	5.98	7.73	8.45	10.33	9.91	8.48
Mean	6.19	7.69	8.16	9.52	9.39	

L S D $_{P=5\%}$ Sowing dates =N . S . P_2O_5= 0.65 Interaction = 1.13

Table (10) : Linear regression equations and determination coefficient between studied characteristics with grains yield in 3 sowing dates .

1 st sowing date

characteristics	Linear regression equations	determination coefficient (R^2)
Plant height	Y=3112.64+13.78*X	0.02
Flag leaf area	Y=-6696.08+236.21*X	0.82
Spikes No. /m^2	Y=-4566.07+26.96*X	0.61
Grains No. /spike	Y=-3313.54+224.96*X	0.77
Weight of 1000 grains	Y=15749.58+-389.87	0.57
Biological yield	Y=555.71+0.46*X	0.70

2 nd sowing date

characteristics	Linear regression equations	determination coefficient (R^2)
Plant height	Y=-2927.16+75.64*X	0.68
Flag leaf area	Y=-7337.06+276.17*X	0.83
Spikes No. /m^2	Y=-40.40+14.06*X	0.76
Grains No. /spike	Y=-8057.28+351.89	0.77
Weight of 1000 grains	Y=11702.48+-254.39	0.66
Biological yield	Y=-281.18+0.55+X	0.93

3 rd sowing date

characteristics	Linear regression equations	determination coefficient (R^2)
Plant height	Y=3881.11+529*X	0.00
Flag leaf area	Y=-2893.02+179.65*X	0.67
Spikes No. /m^2	Y=1166.99+12.13*X	0.56
Grains No. /spike	Y= -1397.62+186.70*X	0.54
Weight of 1000 grains	Y=10845.61+-234.96	0.71
Biological yield	Y=714.30+0.49*X	0.58

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