

EFFECT OF PHOSPHORUS FERTILIZER ON GROWTH OF SOME LOCAL WHEAT CULTIVARS AT AL-GABAL AL-AKHDAR, LIBYA.

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ABSTRACT

Two field experiments were carried out during 2003/2004 and 2004/2005 seasons to study the effect of phosphorus levels on growth attributes of some local wheat (*Triticum durum*) cultivars at Al-Gabal Al-Akhdar, Libya. A split plot design with three replication was used in both seasons. The main findings could be summarized as following:

All studied characters were increased with increasing plant age.

The difference between wheat cultivars among all studied traits except plant height at tillering stage in the first season were insignificant at all growth stages in both seasons. Zarda cultivar tended to give the highest value of all studied traits, except photosynthesis efficiency (PE) at tillering stage, at all growth stages in the first season. The superiority of Zarda cultivar was true for extension coefficient (-cl) at seedling and tillering stages, PE at elongation stage, net assimilation rate (NAR) at seedling stage, leaf area index (LAI) and plant height at seedling stage, biomass duration rate (BDR) and crop growth rate (CGR) at all growth stages and specific leaf weight (SLW) at seedling and elongation stage in the second season. Margawi cultivar produced the lowest values of all studied characters at all growth stages in both seasons.

The highest P levels (45kg P/ha.) gave the highest values of Ec at tillering stage, PE, LAI and LAR at seedling stage, BDR and CGR at seedling and tilling stages. Whereas, increasing P levels up to (35 kg P/ha.) increased -cl, PE, LAI, LAR and BDR to the highest values at elongation stage. The differences between the highest two P levels were insignificant at all growth stages in both seasons.

The interaction between cultivars and P levels had a significant effect on plant height and leaf area ratio (LAR) in the first season only.

INTRODUCTION

Wheat is considered one of the most important crops in terms of area and production and it a staple food for more than one third of the world population. In Libya, wheat area was 315.000 hectare yielded about 350,000 tons with an average of 0.9 t/ha. The consumption of wheat is about 1.05 million tone per year (Ministry of Agriculture, 2000).

Therefore, efforts have been made to minimize the gab between production and consumption through expanding the wheat cultivated area and increasing productivity per unit area. Consequently, increasing wheat production is a major concern of the agronomists. This could be achieved by cultivating the promising wheat cultivars and applying the recommended favorable cultural practices such as phosphorus fertilization.

Association between physiological characters and yield of grains in cereals especially wheat seems to be important when aiming to improve productivity via phosphorous fertilizer. There is a scarcity of information about

such association under different phosphorous levels especially when a wheat crop is concerned. Several investigators found that the positive effect of phosphorus application on one or more from growth and physiological characters of wheat (Brown *et al.*, 1977; Osman *et al.*, 1977; Murata 1981; Atia and Aly, 1998; Halvorson *et al.*, 2002; Fayun *et al.*, 2003; Singh *et al.*, 2003). Moreover, wheat cultivars differed in growth and physiological characters as well as yield and its components (Loomis and Williams, 1970; Swati *et al.*, 1990; Chala and Heavelink, 1995; Shashi *et al.*, 1998; Ragasits *et al.*, 2000; Shivran *et al.*, 2000). Thus, the study reported here is planned to find out the effect of phosphorus levels on growth of some local wheat cultivars under Al-Gabal Al-Akhdar conditions.

MATERIALS AND METHODS

This investigation was carried out at Gamal Abd-El Nasser Experimental Farm, Al-Gabal Al-Akhdar, situated at latitude 20° and 33° north latitude, Libya during 2003/2004 and 2004/2005 seasons. Three local cultivars of wheat (*Triticum durum*) (Margawi, Zarda and IB₄₉F₃) and five phosphorus levels (0, 15, 25, 35 and 45 kg P/ha.) were used in both seasons.

Chemical and physical soil properties as well as monthly average of maximum, minimum, average temperature, rainfall and moisture at Al-Baida Location during the experimental seasons were given in Table 1 and 2, respectively.

Wheat cultivars were devoted to the main plots of the split plot design with three replications. Levels of P applied to the soil were randomly arranged in the sub plot. The area of each sub plot was 2x3m (6m²). Wheat grains (80 kg/ha.) were hand drilled in rows 15 cm apart at 12 and 22 November in the first and the second seasons, respectively. Phosphorus fertilizer as diammonium phosphate (18-46) was added during sowing. Whereas, nitrogen element was equivalent by urea (46%) and applied in the rate of 32.29, 51.04, 69.70, 88.54 and 116.60. (Gabal, 1982) at the same time, The normal agricultural practices for growing wheat at Al-Gabal Al-Akhdar were followed.

At three growth stages, i.e. seedling, tillering and elongation stages, the plants in area of 0.25m² were uprooted, tied and labeled and the following growth characters were estimated:

- | | |
|----------------------------------|-------------------------------|
| 1.Plant height (cm) | 2.Extent coefficient (-a) |
| 3.Photosynthesis efficiency (PE) | 4.Net assimilation rate (NAR) |
| 5.Leaf area index (LAI) | 6.Leaf area ratio (LAR) |
| 7.Biomass duration rate (BDR) | 8.Crop growth rate (CGR) |
| 9.Specific leaf weight (SLW) | |

All growth characters from, except plant height, were measured according to Otter-Nacke *et al.* (1986), Monteith (1994), Watson (1952), Sinclair (1991) Norman and Arkebauer (1991), Marcelis and Koningm (1995), Marcelis and Koningm (1995) and Kiniry *et al.* (1989). respectively. Moreover, chemical analyses of grains were determined according to the method described by Chapman and Pratt (1978). All data were subjected to statistical

analysis according to Snedecor and Cochran (1967) and using SAS program and treatment means compared by Least Significant Difference Test (LSD) at the level of 0.05.

Table 1: Mechanical and chemical characteristics of soil experiments during 2003/2004 and 2004/2005 seasons.

properties	2003/2004 season	2004/2005 season
Fine sand (%)	23.80	23.91
Silt (%)	44.28	50.18
Clay (%)	31.92	25.91
Texture	Clay loam	Clay loam
PH	7.90	7.30
Electrical conductivity	0.536	0.426
Ca carbonate (%)	21.00	13.00
Organic matter (%)	2.72	5.46
Total N (%)	0.25	0.31
Aval. P (ppm)	2.00	4.00
EC (gm/cm ³)	1.71	1.86
C.E.C (m eq/L)	4.69	4.80

Table 2: Meteorological records of Al-Baida in 2003/2004 and 2004/2005 seasons.

Month of growth season	2003/2004 season					2004/2005 season				
	Temperature Max.	Temperature Min.	Temperature Aver.	Rain (mm)	R.H (%)	Temperature Max.	Temperature Min.	Temperature Aver.	Rain (mm)	R.H (%)
Oct.	28.5	16.6	22.5	---	51	29.9	17.7	23.8	---	57
Nov.	20.2	11.6	15.9	58.6	70	21.3	14.3	17.8	128.5	69
Dec.	14.9	8.3	11.6	122.4	78	13.5	17.0	15.3	89.9	77
Jan.	13.3	7.5	10.4	266.9	77	13.6	7.5	10.6	209.9	80
Feb.	15.3	7.6	11.5	55.7	70	12.3	5.9	9.1	53.4	67
March	19.1	9.7	14.4	15.8	64	17.2	8.3	12.8	91.9	64
April	21.5	11.7	16.6	23.9	55	20.1	9.9	15.0	10.0	56
May	25.5	13.6	19.6	---	48	26.2	14.8	20.5	---	47

*AL Shahat Meteorological station, El Baida

RESULTS AND DISCUSSION

1. Differences among the three cultivars:

Results in Tables (3&4) indicated that the differences between wheat cultivars among all studied traits, except plant height at tillering stage in the first season were insignificant at all growth stages in both seasons.

In the first season, Zarda cultivar tended to give the highest values of all studied traits at all growth stages except PE at the second growth stage (tillering stage) compared with the other two cultivars. In the second season, the superiority of Zarda cultivar was true for -al at first and second growth stages, PE at elongation stage, NAR at seedling stage, LAI at tillering and elongation stages, LAR and plant height all growth stages and SLW at

tillering stage. Moreover, IB₄₉F₃ cultivar gave the highest values of -ci at elongation stage, PE at tillering stage, NAR at tillering and elongation stages, LAI at the first stage, BDR and GDR at all growth stages and SLW at seedling and elongation stages in the second season. On the contrary, Margawi cultivar produced the lowest values of all studied traits at all growth stages in both seasons.

Table 3: Effect of cultivars on some growth and physiological characters in 2003/2004 season.

Grow stage	Cultivars	Plant Length (cm)	-ci (Lux/cm ²)	PE (mg m ² /day)	NAR (g/m ² /day)	LAI	LAR (g/m ²)	BDR (g/m ² /day)	CGR (g/day)	SLW (g/m ²)
Seedling	Margawi	11.40	1.12	0.64	0.005	0.26	0.05	0.17	0.25	0.09
	Zarda	14.54	2.10	3.72	0.008	0.76	0.04	0.40	0.55	0.13
	IB ₄₉ F ₃	12.97	1.76	2.05	0.006	0.52	0.04	0.28	0.38	0.09
	LSD _{0.05}	NS	NS	NS	NS	NS	NS	NS	NS	NS
Tillering	Margawi	19.62	3.85	9.10	0.001	0.70	2.76	1.67	2.61	0.22
	Zarda	25.57	4.72	10.00	0.003	1.00	2.63	1.96	2.28	0.30
	IB ₄₉ F ₃	21.06	4.49	10.20	0.001	0.90	2.47	1.78	2.37	0.27
	LSD _{0.05}	2.35	NS	NS	NS	NS	NS	NS	NS	NS
Elongation	Margawi	39.78	11.00	10.90	0.004	2.60	3.37	4.63	4.31	0.73
	Zarda	46.53	11.24	11.60	0.005	1.70	4.36	5.70	5.91	0.84
	IB ₄₉ F ₃	45.33	10.58	8.50	0.006	1.60	3.91	5.27	5.50	0.68
	LSD _{0.05}	NS	NS	NS	NS	NS	NS	NS	NS	NS

EC= Extinction Coefficient, PE= photosynthesis Efficiency, NAR=Net Assimilation Rate, LAI= Leaf Area Index, BDR= Biomass Duration Rate, CGR=Crop Growth Rate, SLW=Specific Leaf Weight and NS=Not Significant

Table 4: Effect of cultivars on growth characters at different growth stages in 2004/2005 season.

Grow stage	Cultivars	Plant length (cm)	-ci (Lux/cm ²)	PE (mg/m ² /day)	NAR (g/m ² /day)	LAI	LAR (g/m ²)	BDR (g/m ² /day)	CGR (g/day)	SLW (g/m ²)
Seedling	Margawi	17.13	1.83	0.94	0.001	0.11	0.33	0.59	0.79	0.04
	Zarda	18.37	1.96	0.83	0.001	0.11	0.39	0.59	0.78	0.04
	IB ₄₉ F ₃	18.25	1.61	0.10	0.001	0.16	0.29	0.65	0.85	0.05
	LSD _{0.05}	NS	NS	NS	NS	NS	NS	NS	NS	NS
Tillering	Margawi	27.83	2.15	6.15	0.039	2.52	0.46	2.02	2.64	1.36
	Zarda	28.57	2.84	7.05	0.030	2.86	0.94	1.87	2.38	1.76
	IB ₄₉ F ₃	28.15	2.64	7.24	0.048	2.25	0.51	2.35	3.25	1.33
	LSD _{0.05}	NS	NS	NS	NS	NS	NS	NS	NS	NS
Elongation	Margawi	54.91	4.96	19.90	0.068	6.60	0.57	12.49	15.54	0.97
	Zarda	58.98	4.99	27.90	0.058	8.56	0.78	12.31	16.02	0.68
	IB ₄₉ F ₃	57.84	5.10	27.10	0.074	7.60	0.51	3.92	17.29	0.79
	LSD _{0.05}	NS	NS	NS	NS	NS	NS	NS	NS	NS

These results indicated that there is enough genetic variation among the three cultivars for the main physiological traits. Moreover, the superiority of Zarda cultivar may be due to the adaptability of this cultivar to climatic conditions and irrigation system. The results obtained by Loomis and Williams (1970), Swati *et al.* (1990), Chala and Heavelink (1995), Shashi *et al.* (1998), Ragasits *et al.* (2000), Shivran *et al.* (2000), indicated marked differences among wheat cultivars in one or more of growth and physiological traits.

2. Response to P application.

Tables (5&6) show the effect of phosphorus levels on growth attributes of wheat at different growth stages in 2003/2004 and 2004/2005 seasons.

It is quite clear from these results that all studied characters were increased with increasing plant age. This is a logic phenomenon due to the progress in plant growth and development.

Table 5: Effect of phosphorus levels on some growth and physiological characters at different growth stages in 2003/2004 seasons .

Grow stage	P levels	Plant length (cm)	-cl (Lux/cm ²)	PE (mg/m ² /day)	NAR (g/m ² /day)	LAI	LAR (g/m ²)	BDR (g/m ² /day)	CGR (g/day)	SLW (g/m ²)
Seedling	0 (control)	12.81	1.76	2.72	0.008	0.62	0.03	0.29	0.38	0.22
	15	11.76	1.49	1.37	0.006	0.47	0.04	0.25	0.35	0.24
	25	13.62	1.81	2.37	0.006	0.55	0.04	0.29	0.40	0.25
	35	13.72	1.58	1.92	0.005	0.47	0.05	0.26	0.36	0.26
	45	12.95	1.75	2.30	0.007	0.46	0.04	0.30	0.47	0.28
	LSD _{0.05}	NS	NS	NS	NS	NS	NS	NS	NS	NS
Tillering	0 (control)	21.98	4.11	5.80	0.000	0.81	2.67	1058	2.03	0.11
	15	22.00	4.33	8.90	0.001	0.94	1.04	1.70	2.32	0.09
	25	22.69	4.40	9.20	0.001	1.30	3.93	1.63	2.02	0.09
	35	21.48	4.49	12.60	0.004	1.50	3.16	1.94	2.75	0.10
	45	22.27	4.51	12.30	0.001	2.10	2.30	2.18	2.97	0.14
	LSD _{0.05}	NS	NS	NS	NS	1.19	NS	NS	NS	NS
Elongation	0 (control)	43.60	10.28	4.10	0.004	1.00	3.45	4.61	4.73	0.93
	15	43.56	10.02	4.40	0.005	0.92	1.65	5.04	5.41	0.98
	25	45.28	11.29	10.50	0.003	1.80	5.85	4.51	4.61	1.31
	35	45.32	11.92	18.40	0.002	3.20	4.02	5.63	5.74	2.14
	45	41.64	11.21	14.30	0.002	2.90	4.40	6.21	5.69	1.21
	LSD _{0.05}	NS	1.12	9.06	NS	1.40	NS	NS	NS	NS

Phosphorus levels had no significant effect on all studied traits at all growth stages in the first season except -cl and PE at elongation stage as well as LAI at tillering and elongation stages. In the second season, all studied characters at all growth stages expect BDR and CGR at tillering and

elongation stages were significantly affected with changing in phosphorus levels. The highest P levels (45kg P/ha.) gave the highest values of -cl at the second stage, PE, LAI and LAR at 1st stage, BDR and CGR at seedling and tillering stages. Whereas, increasing P levels up to 35 kg P/ha. increased -cl, PE, LAI, LAR and BDR to the highest values at elongation stage. The differences between the highest two P levels were insignificant at all growth stages in both seasons. These results may be due to the important of adding phosphorus which play a considerable role in plant photosynthesis and formation of dry matter. This increase in dry accumulation might be due to the more suitable temperature than to respiration. These results are in agreement with those obtained by Brown *et al.* (1977), Osman *et al.* (1977), Murata (1981), Atia and Aly (1998), Halvorson *et al.* (2002), Fayun *et al.* (2003) and Singh *et al.* (2003).

Table 6: Effect of phosphorus levels on growth and characters at different growth stages in 2004/2005 seasons.

Grow stage	P levels (kg P/ha.)	Plant length (cm)	-cl (Lux/cm ²)	PE (mg/m ² /day)	NAR (g/m ² /day)	LAI	LAR (g/m ²)	BDR (g/m ² /day)	CGR (g/day)	SLW (g/m ²)
Seedling	0 (control)	14.15	2.72	0.04	0.001	0.06	0.22	0.45	0.60	0.07
	15	15.94	2.47	0.06	0.001	0.08	0.31	0.55	0.72	0.05
	25	18.65	1.92	0.08	0.001	0.11	0.31	0.56	0.72	0.04
	35	21.68	1.68	0.12	0.001	0.14	0.41	0.72	0.93	0.04
	45	19.17	1.76	0.14	0.002	0.16	0.43	0.77	1.07	0.03
	LSD _{0.05}	2.28	0.26	0.06	0.001	0.02	0.08	0.19	0.35	0.01
Tillering	0 (control)	23.21	1.03	2.95	0.066	1.00	0.38	1.86	2.68	0.87
	15	27.42	1.54	5.30	0.047	2.08	0.51	2.02	2.75	1.19
	25	27.02	1.77	6.04	0.035	2.17	0.55	2.02	2.73	1.32
	35	30.69	2.29	9.46	0.024	3.44	0.80	2.42	2.81	2.05
	45	32.19	2.38	10.33	0.025	3.93	0.76	2.26	2.86	1.97
	LSD _{0.05}	1.37	0.30	2.39	0.021	0.44	0.19	NS	NS	0.58
Elongation	0 (control)	52.48	4.38	13.30	0.119	4.62	0.33	12.38	15.97	1.15
	15	56.44	4.77	20.20	0.083	5.69	0.40	13.35	17.12	1.10
	25	56.19	5.14	25.40	0.061	7.03	0.46	13.28	17.03	0.79
	35	61.75	5.48	39.50	0.035	11.79	0.79	13.28	16.87	0.51
	45	59.33	5.32	26.30	0.033	8.80	0.76	12.26	14.43	0.53
	LSD _{0.05}	4.06	0.64	14.10	0.031	2.27	0.22	NS	NS	0.30

3. Effect of interaction

The following discussion will be concerned on the characteristics that significantly affected by the interaction between wheat cultivars and phosphorus levels only.

Wheat plants markedly differed in their response to cultivars and phosphorus levels as shown in Table (7) with respect to plant height and leaf

area ratio (LAR) in the first season. The tallest plants (113.3, 115.0 and 105.7 cm) were realized when either IB₄₉F₃ or Zarda and Margawi cultivars were treated with 25 kg P/ha. or 45 kg P/ha., respectively. While the shortest plants were obtained with planting the tested cultivars and control (without P). Concerning LAR, planting Margawi and IB₄₉F₃ which received 35 kg P/ha. produced the highest value, while this value was obtained by planting Zarda cultivar and 45 kg P/ha.

Table 7: The effect of cultivars x phosphorus levels interaction on plant height and leaf area ratio (LAR) in the first season.

Levels Cultivars	P	Plant height (cm)					Leaf area ratio, (gm/m ²)				
		0	15	25	35	45	0	15	25	35	45
Margawi		83.0	10.4	94.7	105.7	104.3	0.029	0.037	0.057	0.075	0.048
Zarda		93.0	105.0	100.3	115.0	109.3	0.032	0.043	0.039	0.027	0.042
IB ₄₉ F ₃		93.0	95.7	113.3	101.0	97.7	0.037	0.040	0.042	0.060	0.035

LSD at 5% level: 10.2

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تأثير التسميد الفوسفاتي علي نمو بعض أصناف القمح المحلية تحت ظروف الجبل الأخضر - ليبيا

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قسم المحاصيل - كلية الزراعة - جامعة عمر المختار - ليبيا

أجريت تجربتان حقليتان خلال الموسمين 2003/2004، 2004/2005 لدراسة تأثير التسميد بمعدلات مختلفة من الفوسفور علي بعض الصفات الفسيولوجية لثلاث من أصناف محلية من قمح الدبورم الصلب تحت ظروف منطقة الجبل الأخضر (الواقعة بين خطي عرض 30°، 33° والمرتفعة عن سطح البحر حوالي 590 م) ليبيا. وقد استخدم تصميم القطع المنشقة مرة واحدة في موسمي الزراعة. ويمكن تلخيص أهم النتائج المتحصّل عليها فيما يلي:

لم تختلف الأصناف فيما بينها اختلافا معنويا من حيث تأثيرها علي كل الصفات المدروسة في كل مراحل العمر في ماعدا طول النبات في مرحلة التفريع في الموسم الأول وذلك في موسمي الزراعة. اتجه الصنف أزردة إلي إعطاء اعلي قيم لكل الصفات المدروسة عدا معامل اعتراض الأشعة الشمسية في مرحلة التفريع وذلك في الموسم الأول. وكان تفوق نفس الصنف مؤكدا لكل من معامل اعتراض الأشعة الشمسية في مرحلتي البادرة والتفريع وكفاءة التمثيل الضوئي في مرحلة الاستطالة وصافي البناء الضوئي في مرحلة البادرة ودليل مساحة الورقة في مرحلة البادرة ومعدل استدامة نمو المحصول في كل مراحل النمو والوزن النوعي للأوراق في مرحلة البادرة وذلك في الموسم الثاني. وقد أعطى الصنف مرجاوي أقل القيم لكل الصفات المدروسة في جميع مراحل النمو في موسمي الزراعة.

لقد أدت إضافة المعدل (45 كجم/هكتار) من الفوسفور إلي الحصول علي اعلي القيم من كل من معامل اعتراض الأشعة الشمسية في مرحلة التفريع وكفاءة التمثيل الضوئي ودليل مساحة الأوراق والمساحة النسبية للأوراق في مرحلة البادرات ومعدل استدامة نمو المحصول في مرحلتي البادرات والتفريع. بينما أدى التسميد بالمعدل 35 كجم/هكتار للحصول علي اعلي القيم من كل من معامل اعتراض الأشعة الشمسية وكفاءة التمثيل الضوئي ودليل مساحة الأوراق والمساحة النسبية للأوراق ومعدل استدامة المحصول في مرحلة الاستطالة. كما لوحظ أن الاختلافات بين المعدلين (35 و 45 كجم/هكتار) كانت غير معنوية في جميع مراحل النمو في موسمي الزراعة. أدى التفاعل بين الأصناف ومعدلات الفوسفور إلي حدوث تأثير معنوي علي كل من طول النبات والمساحة النسبية للأوراق في الموسم الأول فقط حيث كانت أطول النباتات ناتجة عن زراعة أي من الصنفين IB49F3 أو أزردة عند تسميدهما بمعدل 25 أو 45 كجم/هكتار في حين إن الصنف IB49F3 والصنف المرجاوي قد أعطيا أكبر مساحة نسبية للأوراق عند تسميدهما بمعدل 35 كجم/هكتار.