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EFFECT OF NITROGEN, PHOSPHORUS AND SEEDING RATES ON WHEAT PRODUCTION AND WEED CONTROL IN SIWA OASIS

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ABSTRACT

Two field experiments were carried out in Tegzerte Research Station; Desert Research Center, Tegzerte, Siwa Oasis during winter seasons of 2002/2003 and 2004/2004 years to study the effect of nitrogen fertilization levels as (0, 80 and 100 Kg N. fed-1) and phosphorus fertilization levels (0, 15 and 31Kg P_20_5 fed^{-1}) and wheat seeding rates (70, 80 or 90 kg. fed^{-1}) on wheat production and weed control.

Results indicated that increasing phosphorus and nitrogen fertilization levels as well as seeding rates led to increase significantly wheat growth, yield and its components i.e (plant height, spike length, number of spiklets per spike, seed index as 1000 grain weight, number of spikes/m^2, grain, straw and biological yields), while fresh and dry weights of associated weeds were reduced as a result of applying the treatments. On the other hand, number of tillers /plant showed significant increase as a result of elevating both nitrogen and phosphorus fertilization, while it demonstrated significant reduction by increasing seeding rates.

Number of tillers per plant was significantly increased as a result of applying the following first order interactions (31 kg P_20_5 fed^{-1} × 0 kg N.fed^{-1}), (0 kg N.fed^{-1} × 90 kg grains .fed^{-1}) and (31 kg P_20_5 fed^{-1} × 90 kg grains.fed^{-1}). All the first order interactions i.e (phosphorus × nitrogen fertilization levels), (nitrogen fertilization levels × seeding rates) and (phosphorus fertilization levels × seeding rates), increased significantly all the studied characters.

Regarding the second order interaction, higher values of wheat yields and its attributes, as well as higher reduction of fresh and dry weights of associated weeds were obtained from the interaction between (31 kg P.fed^{-1} × 100 kg N.fed^{-1} ×90 kg grains.fed^{-1}). While higher number of tillers per plant was obtained from the interaction between (31 kg P_20_5 fed^{-1} × 100 kg N.fed^{-1} ×70 kg grains.fed^{-1}).

Keywords: wheat, weeds, nitrogen, phosphorous, fertilization, seeding rates, Siwa Oasis.

INTRODCUTION

Wheat (*Triticum aestivum,* L.) is the main human daily meal source of carbohydrates. As with many countries in economic transition, many future productivity increases have to come from increased yields, with little opportunities for expansion of cropland; the sparse and precarious resources of the region, make this a daunting task (Oweis *et al.*, 1998).In Egypt wheat is the most important cereals crop in terms of area and production. It provides the Egyptians with almost 35% of the total food calories. (El-Gizawy, 2005).

Among all the promises areas available for the agricultural extension in Egypt, the North Western Coast may be ranked the first including Siwa oasis in the southern part. Unfortunately, this region was remarkable to be exposed for mutable environmental stresses that constrain the chances of agricultural extension. Some of theses constraints are biotic such as (weeds, insects, plant diseases and overgrazing) and some are abiotic such as (salinity, drought particularly in the northern part, low fertility and soil texture) as reported by Hegazi, 2005.

Natural flora may classified as weeds when struggle with the newly introduced economic crops to the region such as wheat for the inadequate major production elements in most cases. Yet, using herbicides to end this battle for the economic crop side is acceptable at any level neither economical nor environmental. Perhaps, offering intensively the main production elements alike (nitrogen or phosphorus fertilization or even higher but reasonable grain rates) for the competitive cash crop such as wheat may facilitate the challenge victory (Bar-Tal *et al*, 2004). Crops grown in competition with weeds can be adversely affected through alteration of light intensity or loss of nutrients and water to unwanted plants (Buchanan and McLaughlin, 1975; Sexsmith and Pittman, 1963). Hassanein *et al.,* (2005) reported that removal of all annual weeds significantly increased wheat grain yield. The losses due to weeds/wheat competition for all season ranged between 19.8 – 89.4% compared to weed free for all season due to various densities and species of weeds. The best grain yield was obtained by removal of weeds for all season. So, using integrated weed management systems (IWMS) may have the potential to reduce herbicide use (and associated costs) and may provide more robust weed management over the long term (Swanton and Weise, 1991). Managing for increased competitive ability of crops with weeds is an important means of achieving improved weed management programs (Liebman *et al.,* 2001).

Manipulation of crops fertilization is a promising agronomic practice in reducing weed interference in crops, and considered as one of the main elements of (IWMS) (Ditomaso, 1995).Research results on the effect of soil fertility on germination and growth of weed species has been variable (Banks *et al.,* 1976; Fawcett *et al.,* 1978; Henson and Jordan, 1982 and Wells, 1979). Researchers in Europe observed that the number of viable weed seeds in soil did not change when N, P and K were applied in all possible combinations(Roberts, 1968). Other researchers (Fawcett *et al.,* 1978; Sexsmith and Pittman, 1963) reported that the rate and time of fertilizer application, N in particular, influenced the number of germinating weed seeds in the soil. More weed seedlings were present when high rates of N were applied.

Nitrogen (N) is the major nutrient added to increase crop yield and its components (Raun and Johnson, 1999 and Camara *et al.,* 2003). Hitherto, components that can affect efficiency of N utilization by wheat are time of application, leaching of nitrate from the root zone, denitrification, volatilization and runoff (Clapp, 1973 and Spratt, 1974). But it is not always recognized that altered soil N levels can affect crop-weed competitive interactions. Nitrogen fertilizer, as well as fresh and composted manure, can affect weed germination and establishment (Egley and Duke, 1985; Menalled *et al.,* 2002).When N levels are increased up to optimum levels, crop vigor and grain yield increase (Johnson *et al.,* 1973). Exceeding this optimum level can result in excessive vegetation instead of higher grain yields.

Phosphorus (P) is the second major nutrient that produces significant increment in wheat growth and productivity if added in appreciated dosages as a fertilizer. It is very important for most of the physiological processes of plant growth and metabolism. Applying phosphorus fertilization at the perfect time and quantity increased significantly wheat growth including number of tillers per plant, number of grain per spike and grain index per plant (Sij *et al.,* 2006)

Cultural management techniques, such as reduced crop row spacing, can increase a crop's ability to compete with weeds for incoming sunlight. Changes in raw spacing and plant population alter the spacing of plants between and within rows, which can influence crop yield. Seedlings grown in close proximity to each other express phytochrome-mediated responses by developing narrow leaves, long stems, and less massive roots (Kasperbauer and Karlen, 1994).Reduced row spacing's are thought to increase weed control by increasing the competitiveness of a crop with weeds and by reducing light transmittance to the soil surface (Tharp and Kells, 2001).

Jaime *el al.,* (2004), indicated that increasing seeding rates of the irrigated winter wheat led to increase the grain yield and wheat growth as a result of reducing the competition between the wheat and associated weed plants for the wheat side.

Moreover, Guoping *et al.,* (1999), found that increasing seeding rate of wheat in presence of proper quantities of nitrogen and phosphorus fertilization led to increase wheat growth and productivity accompanied with noticeable reduction in weeds growth and number of weed seedlings per area. They added that increasing seeding rate didn't affect the wheat yield as long the required production requirements were provided including the fertilization and irrigation water.

This study aimed to evaluate using nitrogen and phosphorus fertilization besides elevated seeding rates as integrated weed management system (IWMS) elements in order to increase wheat growth and productivity under Siwa oasis conditions, towards saving the virgin environment from pollution, besides minimizing production coast.

MATERIALS AND METHODS

Two field experiments were carried out in Tegzerte Research Station; Desert Research Center, Tegzerte, Siwa during winter seasons of 2003 and 2004 years to study the effect of nitrogen, phosphorus fertilizers and seeding rates on wheat production and weed control.

The experimental soil was tilled three overlapping times. During soil preparation, (20 $m^3.fed^{-1}$) of balady manure and calcium super phosphate fertilizer (15.5% P_2O_5) following the experimental scheme as (0, 15 and 31Kg P_2O_5. fed-1) were added. Nitrogen fertilizer was added as ammonium nitrate, (33 % N) following the experimental scheme as well as (0, 80 and 100 Kg N. fed-1) in two equal dosages i.e. just before the first and the second irrigation.

The region conditions recommended bread wheat cultivar (Sakha 93) grains which were obtained every year from Wheat Research Section, Agricultural Research Center (A.R.C.), Giza, Egypt, were drilled at seed rates following the experimental scheme as (70, 80 or 90 kg. fed^{-1}) on 15^{th} and 17^{th} November in the first and second seasons, respectively.

The experimental design was a split split-plot design in four replicates, where the phosphorus fertilization treatments occupied the main plots, nitrogen fertilization treatments were arranged in the sub main plots and seeding rates treatments in the sub-sub main ones. The area of the experimental unit was 10.5 m^2 (3×3.5)with 15 rows, 20 cm apart and 4m length.

The mechanical and chemical properties of the experimental soil at 30 and 60 cm soil depth are presented in tables (1 and 2), while the chemical analysis of the applied balady manure in (table 3). The chemical composition of the used brackish irrigation water containing 2500-2800 ppm as dissolved salts is presented in (table 4).

Table 1: Mechanical and physical properties of Tegzerte soil at different depth.

Depth (cm)	CaCo3 %	Particles size distribution (mm) as %				Texture
		Coarse Sand (1-0.5)	Fine sand (0.25- 0.1)	Silt (0.05 – 0.002)	Clay < 0.002	
0-30	37.72	7.97	77.04	14.99	-	Sandy Loam
30-60	59.42	6.44	77.78	15.78	-	Sandy Loam

Table 2: Chemical properties of Tegzerte soil at different depth.

Depth (cm)	PH	EC (m mhos/cm)	Anions (meq/L)				Cations (meq/L)			
			CO_3^-	HCO_3^-	SO_4^{--}	CL^-	Ca^{++}	Mg^{++}	Na^{++}	K^+
0-30	7.97	8.92	Nil	2.0	18.73	63.9	35.2	4.8	43.48	1.15
30-60	7.83	8.43	Nil	3.0	23.37	64.9	36.3	5.9	47.17	1.90

Table 3: Chemical analysis of applied manure

Season	Moisture content %	Organic carbon %	Total nitrogen %	C/N ratio	Organic matter %
2003	10.3	21.41	36.82	10.0	2.12
2004	19.42	19.34	34.17	13.0	1.45

Table 4: Chemical composition of the irrigation water sample in Tegzerty farm

Season	PH	EC (ds/m)	Anions (meq/L)				Cations (meq/L)			
			CO_3^-	HCO_3^-	SO_4^{--}	CL^-	Ca^{++}	Mg^{++}	Na^{++}	K^+
2003	8.26	4.37	-	1.8	8.68	36.25	7.5	10.0	28.0	1.23
2004	8.32	4.35	-	1.7	8.7	38.4	7.8	12.1	31.3	1.20

Ten wheat guarded plants were taken as a sample at harvest time (19^{th} and 24^{th} of May in the first and the second seasons, respectively) to determine plant height (cm), number of tillers per plant, spike length (cm), number of spiklets per spike and seed index as 1000 grain weight (g). likewise, one square meter plants were harvested then converted into ton per feddan to determine yield and its components i.e. (number of spikes per m^2 , biological, grain and straw yields ton/fed.)

Accordingly, samples of the accompanied weeds were collected twice at 90 and 120 days from sowing date in the two seasons. Means of weeds fresh and dry weights were determined as g/square meter in each plot.

Data of all parameters were exposed to the proper statistical analysis of variance according to the ANOVA procedure given by Snedecor and Cochran (1967). After passing the homogenizing test for data of both years, the combined analysis was done following Waller and Duncan (1969). Duncan's multiple range tests was used to verify the significant differences between means of treatments as described by Duncan (1955).

RESULTS AND DISCUSSION

A- Effect of phosphorus fertilization levels

Data in table 6 indicated that, wheat growth, yield and its attributes i.e (plant height, number of tillers /plant, spike length, number of spiklets per spike, seed index as 1000 grain weight, number of spikes/m^2, grain, straw and biological yields) were highly significant improved as a results of increasing phosphorus fertilization levels from 0, 15.5 and up to 31 kg P_2O_5.fed^{-1} ,respectively . On the other hand, fresh and dry weights of the accompanied weeds per square meter were reduced significantly as a result of applying all treatments.

This may indicate that, phosphorus is one of the macro elements as well, which is very important because it synthesis the nucleic acids, phospholipids, NADP and NAD coenzymes. In addition it contributes in ATP and proteins formation. Nevertheless, it encourages the meristemic parts such as apical and bestial meristems, so that it is concentrated in it. (Clarkson and Hanson, 1980 and Sasha *et al.,* 2007). When phosphorus fertilization levels were elevated, bestial meristemic tissues were enhanced to produce more tillers. Therefore, wheat becomes more capable to compete with the associated weeds for the production inputs (Sij *et al.,* 2006). Nevertheless, as described before, phosphorus is so important to increase grain weight through increasing the source-sink. relationships, in addition it increase the plant photosynthesis rate and plant mineral uptake from soil (Madigan *et al.,* 2003 and Sasha *et al.,* 2007).

B-Effect of nitrogen fertilization levels

Results in table 5 indicated that, wheat growth, yield and its attributes i.e (plant height, number of tillers /plant, spike length, number of spiklets per spike, seed index as 1000 grain weight, number of spikes/m^2, grain, straw and biological yields) were highly significant improved as a results of increasing nitrogen fertilization levels from 0, 80 and up to 100 kg N.fed^{-1} ,respectively. On the other hand, fresh and dry weights of the accompanied weeds per square meter were reduced significantly as a result of applying all treatments.

It could be concluded that, nitrogen is one of the macro elements that perform protein molecule, purines, pyrimidins, porphyriens and co-enzymes. Purines and pyrimidins are forming RNA and DNA, while porphyriens contains very important phyto-chemical substances such as chlorophyll and cytochromes which are so important for photosynthesis and respiration. Co-enzymes are very important for enzymes activation in all the plant biotic reactions. Nitrogen is a very important component of vitamins as well, which is so important substances for plant metabolism.

T5-6-7

(Clarkson and Hanson, 1980, Hartley and Schlesinger, 2002 and Camara *et al.,* 2003), Referring to the obtained results related to nitrogen fertilization applications, it is clear that nitrogen encouraged the growth of wheat and its accompanied weeds in the same time. Yet, the wheat plant is one of those plants which are more capable to challenge for the environmental factors rather than weeds. Therefore, when its growth was encouraged as previously described accompanied weeds had no chance to grow normally or to be capable to challenge for the production inputs. Consequently, wheat growth and development was enhanced, out of increasing its perfusion of the production inputs and minimizing the competition with its associated weeds.

C-Effect of seeding rates

Results in table 7 indicated that, wheat growth, yield and its attributes i.e (plant height, spike length, number of spiklets per spike, seed index as 1000 grain weight, number of spikes/m^2, grain, straw and biological yields) were highly significant improved as a results of increasing seeding rates from 70, 80 and up to 90 kg.fed^{-1} ,respectively . On the other hand, fresh and dry weights of the accompanied weeds per square meter were reduced significantly as a result of applying all treatments. Only number of tillers /plant which demonstrated significant reduction by increasing seeding rates.

Several investigators reported that increasing seed rate may be one of the most efficient eco-friendly methods for controlling weeds, when wheat grains were elevated, wheat plants were been capable to combat with the associated weeds for the production inputs. Elevating grain rates led to increase weed control by increasing the competitiveness of a crop with weeds and by reducing light transmittance to the soil surface, where wheat plants were more capable for light interception rather than its associated weed plants (Yehia *et al.,* 1993, Kasperbauer and Karlen, 1994 and Tharp and Kells, 2001).

D-Effect of the interactions

Results in tables (8, 9 and 10) illustrated that, all the first order interactions i.e (phosphorus × nitrogen fertilization levels), (nitrogen fertilization levels × seeding rates) and (phosphorus fertilization levels × seeding rates), respectively, increased significantly all the studied characters i.e. (plant height, spike length, number of spiklets per spike, seed index as 1000 grain weight, number of spikes/m^2, grain, straw and biological yields). Meanwhile, all the first order interactions were talented to reduce significantly fresh and dry weights of the associated weeds per square meter. However, higher wheat plant heights, yields and its attributes accompanied with higher reduction in fresh and dry weights of associated weeds were obtained from the first order interactions between maximum levels of phosphorus, nitrogen fertilizations and seeding rates i.e. (31 kg P_2O_5.fed^{-1} × 100 kg N.fed^{-1}), (100 kg N.fed^{-1} × 90 kg grains .fed^{-1}) and (31 kg P_2O_5.fed^{-1} × 90 kg grain .fed^{-1}) compared to the other treatments. Meanwhile, higher values of number of tillers /plant compared to the other treatments were obtained from the interactions between (31 kg P_2O_5.fed^{-1} × 0 kg N.fed^{-1}), (0 kg N.fed^{-1} × 90 kg grains .fed^{-1}) and (31 kg P_2O_5.fed^{-1} × 90 kg grains.fed^{-1}).

T8-9

T10

T11

Results in table (11) indicated that, the second order interaction between the three main factors i.e (phosphorus × nitrogen fertilization levels × seeding rates) led to increase significantly all wheat studied parameters i.e. (plant height, number of tillers /plant, spike length, number of spiklets per spike, seed index as 1000 grain weight, number of spikes/m^2, grain, straw and biological yields), while it reduced significantly the fresh and dry weights of the associated weeds. Higher values of wheat yields and its attributes, as well as higher reduction of fresh and dry weights of its associated weeds were obtained from the interaction between (31 kg P_2O_5.fed^{-1} × 100 kg N.fed^{-1} ×90 kg grains.fed^{-1}). Only, higher observation of number of tillers per plant was obtained from the interaction between (31 kg P_2O_5. fed^{-1} × 100 kg N.fed^{-1} ×70 kg grains.fed^{-1}).

Perhaps increasing the crop seed rates while the production inputs such as phosphorus and nitrogen fertilization were presented in suitable levels may increase the crop growth and accompanied weeds at the same time. Yet, weeds seedlings are challenged by the entire competition between the weeds plants itself and external one between weeds and the cash crop for the environmental factors the way it puts weeds in many prejudiced challenges. Thus, it increases the cash crop production and decrease the accompanied weeds growth and productivity, particularly if the cash crop is a great challenger such as wheat. (Yehia *et al.,* 1993 and Guoping *et al.,* 1999)

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دراسة تأثير مستويات التسيمد الآزوتي و الفوسفاتي و معدلات التقاوي علي إنتاجية القمح ومقاومة الحشائش بواحة سيوة

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أقيمت تجربتان حقليتان بمحطة بحوث تجزرتي التابعة لمركز بحوث الصحراء – بواحة سيوة خلال الموسمين الشتويين لموسمي ٢٠٠٣ ، ٢٠٠٤ ، وذلك لدراسة تأثير مستويات التسميد النتروجيني (صفر ، ٨٠ ، ١٠٠ كيلو جرام نتروجين /فدان) ، و مستويات التسميد البوتاسي (صفر ، ١٥ ، ٣١ كيلوجرام فوسفور/فدان) ، و معدلات التقاوي (٧٠ ، ٨٠ ، ٩٠ كيلوجرام /فدان) علي مقاومة الحشائش وعلاقة ذلك بإنتاجية القمح .

أظهرت النتائج أن زيادة معدلات التسميد الفوسفاتي ، والنتروجيني ، إضافة إلي زيادة معدلات التقاوي، قد أدت إلي زيادة معنوية في نمو القمح و زيادة المحصول و مكوناتة معنوياً. (إرتفاع النبات ، طول السنبلة، عدد سنيبلات السنبلة، وزن الألف حبة ،عدد سنابل المتر المربع، محصول الحبوب و القش و كذلك المحصول البيولوجي)، بينما أدت نفس المعاملات إلي نقص معنوي في الوزن الغض و الجاف للحشائش المصاحبة للقمح في المتر المربع. في حين أظهرت عدد أشطاء النبات زيادة معنوية للزيادة في معدلات السماد النتروجيني و الفوسفاتي ، إلا أنها قد أظهرت نقصاً معنوياً للزيادة في معدلات التقاوي .

بالنسبة لتفاعل الدرجة الأولي ، فيما عدا عدد الأشطاء/للنبات فقد أظهرت جميع الصفات المدروسة الأخري زيادة معنوية لجميع تفاعلات الدرجة الأولي ، وقد تم الحصول علي أعلي النتائج من جميع التفاعلات الثنائيه الممكنه لأعلي معدلات للتسيمد النتروجيني و الفوسفاتي و معدلات التقاوي. بينما أظهرت عدد الأشطاء/نبات زيادة معنوية لكل من التفاعلات الثنائية التالية : (٣١ وحدة فوسفور/فدان × صفر وحدة نتروجين/فدان) ، (صفر وحدة نتروجين/ فدان × ٩٠ كجم تقاوي/فدان) ، (٣١ وحدة فوسفور/فدان × ٩٠ كجم تقاوي/فدان).

بالنسبة لتفاعل الدرجة الثانية ، فقد أظهرت جميع الصفات المدروسة زيادة معنوية للتفاعل بين أقصي معدلات لكل من التسميد الفوسفاتي و النتروجيني و معدلات التقاوي (٣١ وحدة فوسفور/فدان × ١٠٠ وحدة نتروجين/ فدان × ٩٠ كجم تقاوي/فدان)، في حين تم الحصول علي أعلي عدد أشطاء/نبات من تفاعل (٣١ وحدة فوسفور/فدان × ١٠٠ وحدة نتروجين/ فدان × ٧٠ كجم تقاوي/فدان).

وبناء علية توصي هذة الدراسة بعدم تطبيق المبيدات بغرض مقاومة الحشائش للحفظ علي بيئة واحة سيوة خالية من جميع الملوثات ، ويمكن بديلا عن ذلك زيادة معدلات السماد الفوسفاتي و النتروجيني و معدلات التقاوي لتصل إلي (٣١ وحدة فوسفور/فدان + ١٠٠ وحدة نتروجين/ فدان + ٧٠ كجم تقاوي/فدان)، بالشكل الذي يسمح بحسم الصراع بين المحصول الإقتصادي و الحشائش علي مدخلات الإنتاج لصالح المحصول الإقتصادي ، وبالتالي زيادة المحصول بوحدة المساحة نتيجة لنقص نمو الحشائش المصاحبه له.

Table 5: Effect of different phosphorus fertilization levels on wheat growth characters, yield and its attributes and associated weeds fresh and dry weights. (combined analysis of 2003 and 2004 growing seasons).

Phosphorus fertilization levels kg P_2O_5 . fed^{-1}	Studied characters										
	Plant height (cm)	No. Tillers / plant	Spike length (cm)	No. Spiklets /spike	*Seed Index (g)	No. spikes / m^2	Grain yield ton/fed.	Straw yield ton/fed.	Bio-logical yield ton/fed.	Weeds fresh weight (g/m^2)	Weeds dry weight (g/m^2)
0	77.8 C	3.1 C	9.4 C	15.2 C	41.6 C	363.5 C	1.20 C	2.01 C	3.21 C	74.1 A	16.5 A
15.5	90.9 B	4.3 B	10.3 B	16.7 B	43.2 B	419.7 B	1.63 B	2.44 B	4.67 B	65.7 B	14.6 B
31	94.9 A	5.1 A	10.9 A	18.1 A	44.1 A	447.1 A	1.77 A	2.66 A	4.44 A	63.4 C	14.0 C

*** Seed index as 1000 grain weight (g).**
Means having the same capital letters in the same row are not significantly differed at P≥ 0.05

Table 6: Effect of different nitrogen fertilization levels on wheat growth characters, yield and its attributes and associated weeds fresh and dry weights. (combined analysis of 2003 and 2004 growing seasons).

Nitrogen fertilization levels kg N. fed^{-1}	Studied characters										
	Plant height (cm)	No. Tillers / plant	Spike length (cm)	No. Spiklets /spike	*Seed Index (g)	No. spikes / m^2	Grain yield ton/fed.	Straw yield ton/fed.	Bio-logical yield ton/fed.	Weeds fresh weight (g/m^2)	Weeds dry weight (g/m^2)
0	69.5 C	2.7 C	8.7 C	14.5 C	39.9 C	260.1C	0.77 C	1.15 C	1.93 C	74.9 A	16.7 A
80	95.6 B	4.6 B	10.5 B	17.4 B	44.3 B	473.5 B	1.86 B	2.89 B	4.75 B	68.1 B	15.1 B
100	98.5 A	5.2 A	11.4 A	18.1 A	44.7 A	496.7 A	1.98 A	3.07 A	5.04 A	60.3 C	13.3 C

*** Seed index as 1000 grain weight (g).**
Means having the same capital letters in the same row are not significantly differed at P≥ 0.05

Table 7: Effect of seeding rates on wheat growth characters, yield and its attributes and associated weeds fresh and dry weights. (combined analysis of 2003 and 2004 growing seasons).

Seeding rates kg. fed^{-1}	Studied characters										
	Plant height (cm)	No. Tillers / plant	Spike length (cm)	No. Spiklets /spike	*Seed Index (g)	No. spikes / m^2	Grain yield ton/fed.	Straw yield ton/fed.	Bio-logical yield ton/fed.	Weeds fresh weight (g/m^2)	Weeds dry weight (g/m^2)
70	83.6 C	4.8 A	9.5 C	15.8 C	43.4 A	399.1 B	1.44 C	2.23 C	3.67 C	73.4 A	16.4 A
80	87.8 B	4.2 B	10.1 B	16.6 B	43.1 B	403.9 B	1.51 B	2.36 B	3.89 B	67.4 B	15.1 B
90	92.2 A	3.5 C	11 A	17.7 A	42.4 C	427.3 A	1.64 A	2.53 A	4.16 A	62.5 C	13.8 C

*** Seed index as 1000 grain weight (g).**
Means having the same capital letters in the same row are not significantly differed at P≥ 0.05

Table 8: Effect of the interaction between the different phosphorous and nitrogen fertilization levels on wheat growth characters, yield and its attributes and associated weeds fresh and dry weights. (combined analysis of 2003 and 2004 growing seasons).

Treatments		Studied characters										
Phosphorus fert. levels kg P_2O_5 . fed^{-1}	Nitrogen fert. levels N kg. fed^{-1}	Plant height (cm)	No. Tillers / plant	Spike length (cm)	No. Spiklets /spike	*Seed Index (g)	No. spikes / m^2	Grain yield ton/fed.	Straw yield ton/fed.	Bio-logical yield ton/fed.	Weeds fresh weight (g/m^2)	Weeds dry weight (g/m^2)
0	0	74.1 G	3.4 D	8.7 E	14.3 G	42 D	354.5 E	1.1 F	1.8 H	2.9 H	77.7 A	17.3 A
	80	78.1 F	3 DE	9.3 D	15.2 F	41.7 D	342.9 E	1.2 E	2 G	3.2 G	72.8 B	16.2 B
	100	81.3 E	2.8 E	10.1 C	16.1 DE	41.2 E	392.9 D	1.3 D	2.2 F	3.5 F	71.8 BC	16 BC
15.5	0	87.2 D	5.1 B	9.9 C	15.8 E	43.6 B	409 CD	1.5 C	2.3 E	3.9 E	72.8 B	16.2 B
	80	90.7 C	4.3 C	10.1 C	16.6 D	43.4 B	420.6 C	1.6 C	2.4 D	4.1 D	65.8 D	14.6 D
	100	94.6 B	3.4 D	11 B	17.8 BC	42.5 C	429 BC	1.7 B	2.6 C	4.3 C	58.7 E	12.9 E
31	0	89.6 CD	5.9 A	10.1 C	17.3 C	44.5 A	434 BC	1.7 B	2.5 C	4.2 C	69.7 C	15.5 C
	80	94.6 B	5.2 B	10.8 B	18 B	44.2 A	448 AB	1.8 B	2.6 B	4.4 B	63.5 D	14.1 D
	100	100.6 A	4.2 C	12 A	19.1 A	43.5 B	459.8 A	1.9 A	2.8 A	4.7 A	57 E	12.4 E

*** Seed index as 1000 grain weight (g).**
Means having the same capital letters in the same row are not significantly differed at P≥ 0.05

Table 9: Effect of the interaction between nitrogen fertilization levels and seeding rates on wheat growth characters, yield and its attributes and associated weeds fresh and dry weights. (combined analysis of 2003 and 2004 growing seasons).

Treatments		Studied characters										
Nitrogen fert. levels kg N. fed^{-1}	Seeding rates kg. fed^{-1}	Plant height (cm)	No. Tillers / plant	Spike length (cm)	No. Spiklets /spike	*Seed Index (g)	No. spikes / m^2	Grain yield ton/fed.	Straw yield ton/fed.	Bio-logical yield ton/fed.	Weeds fresh weight (g/m^2)	Weeds dry weight (g/m^2)
0	70	66 G	3.1 E	8.2 F	14 F	40.3 D	252.8 D	0.67 G	1.01 G	1.70 G	80.4A	18A
	80	90.8 D	5.3 B	9.9 D	16.6 D	39.5 E	461.9 C	1.76 D	2.73 D	4.50 D	73.3B	16.4B
	90	94.1 C	6 A	10.6 C	16.9 D	43.7 C	483BC	1.9 BC	2.93 C	4.82 C	66.5C	14.8C
80	70	69.3 F	2.8 EF	8.6 E	14.3 F	40 D	243.7 E	0.75 F	1.16 F	1.93 F	75 B	16.7B
	80	95.6 C	4.6 C	10.3 C	17.3 C	44.4 B	474 BC	1.84 C	2.86 C	4.72 C	68 C	15.1C
	90	98.5 B	5.2 B	11.2 B	18.1 B	45 A	494 AB	1.94 B	3.04 B	5.01 B	59.1E	13E
100	70	73.2 E	2.3 F	9.5 D	15.2 E	44.8 A	283.8 D	0.86 E	1.27 E	2.15 E	69.2C	15.4C
	80	100.4 B	3.8 D	11.3 B	18.4 B	45.1 A	484 BC	1.96 B	3.07 B	5.02 B	63.1D	13.9D
	90	102.9 A	4.3 C	12.3 A	19.3 A	44 BC	513.9 A	2.08 A	3.23 A	5.28 A	55.3F	12.1F

*** Seed index as 1000 grain weight (g).**
Means having the same capital letters in the same row are not significantly differed at P≥ 0.05

Table 10: Effect of the interaction between phosphorus fertilization levels and seeding rates on wheat growth characters, yield and its attributes and associated weeds fresh and dry weights. (combined analysis of 2003 and 2004 growing seasons).

Treatments		Studied characters										
Phosphorus fert. levels kg P_2O_5. fed^{-1}	Seeding rates kg. fed^{-1}	Plant height (cm)	No. Tillers / plant	Spike length (cm)	No. Spiklets /spike	*Seed Index (g)	No. spikes / m^2	Grain yield ton/fed.	Straw yield ton/fed.	Bio-logical yield ton/fed.	Weeds fresh weight (g/m^2)	Weeds dry weight (g/m^2)
0	70	63 I	2.3G	8.4 H	13G	39.2I	220.9G	0.53 I	0.79 I	1.36 I	82.6A	18.4A
	80	83.2F	3.3DE	9.5E	16E	42.7F	419.8E	1.46 F	2.5 F	3.94 F	76.1B	17B
	90	87.2E	3.6D	10.2D	16.7D	43E	449.7D	1.6 E	2.73 E	4.34 E	63.6EF	14.1EF
15.5	70	71.3H	2.8F	8.7G	14.9F	40.1H	273.2F	0.84 H	1.28 H	2.12 H	72.4C	16.1C
	80	99.6D	4.7C	10.7C	17.4C	44.5D	486.6C	1.97 D	2.94 D	4.91 D	63 F	13.9F
	90	101.7C	5.4B	11.5B	17.8C	45C	499 BC	2.07 C	3.11 C	5.17 C	61.9 F	13.7F
31	70	74.2G	3.1EF	9.1F	15.7E	40.5G	286.2F	0.92 G	1.39 G	2.31 G	69.6D	15.5D
	80	104.1B	5.7B	11.3B	18.9B	45.7B	514B	2.14 B	2.23 B	5.39 B	65.3E	14.5E
	90	106.5A	6.6A	12.3A	19.9A	46.1 A	541.2A	2.27 A	3.37 A	5.61 A	55.3G	12.1G

*** Seed index as 1000 grain weight (g).**
Means having the same capital letters in the same row are not significantly differed at P≥ 0.05

Table 11: Effect of the interaction between nitrogen, phosphorus fertilization levels and seeding rates on wheat growth characters, yield and its attributes and associated weeds fresh and dry weights. (combined analysis of 2003 and 2004 growing seasons).

Treatments			Studied characters										
Phosphorus fert. levels kg P_2O_5. fed^{-1}	Nitrogen fert. levels kg N. fed^{-1}	Seeding rates kg. fed^{-1}	Plant height (cm)	No. Tillers / plant	Spike length (cm)	No. Spiklets /spike	*Seed Index (g)	No. spikes / m^2	Grain yield ton/fed.	Straw yield ton/fed.	Biological yield ton/fed.	Weeds fresh weight (g/m^2)	Weeds dry weight(g/m^2)
0	0	70	59.2 Q	2.3 H	7.6 O	12.3 M	39.6 LM	222.7 H	0.40 P	0.60 Q	1.00 T	84.7 A	18.9 A
		80	63.9 P	2.3 H	8.4 MW	13.0 L	39.3 M	170.9 I	0.50 O	0.80 P	1.30 S	82.9 B	18.5 B
		90	65.8 P	2.3 H	9.2 JK	13.7 K	38.7 N	269.1 GH	0.70 N	1.10 O	1.80 R	80.2 C	17.9 C
	80	70	79.1 L	3.7 E	8.9 KL	15.3 HI	43.1 F	409.1 F	1.33 J	2.30 K	3.63 N	78.9 D	17.6 D
		80	82.6 K	3.3 EF	9.4 IJ	16.0 GH	42.6 G	419.3 F	1.46 I	2.50 J	3.96 M	76.3 E	17.0 E
		90	88.1 IJ	3 FG	10.2 EF	16.7 G	42.5 G	431 EF	1.56 H	2.70 H	4.26 K	72.0 F	16.3 F
	100	70	83.9 K	4.3 D	9.6 HI	15.3 HI	43.3 F	431.7 EF	1.53 H	2.60 I	4.13 L	69.6 H	15.5 H
		80	87.7 J	3.3 EF	10.1 FG	16.7 G	43.2 F	438.7 DEF	1.56 H	2.70 H	4.26 J	59.1 N	13.1 O
		90	90.1 I	3 FG	11.1 D	18.0 DE	42.5 G	478.7 CDE	1.70 G	2.90 G	4.60 I	62.2 L	13.8 M
15.5	0	70	68.2 O	3.3 EF	8.3 N	14.3 J	40.3 IJ	260.3 GH	0.73 N	1.10 N	1.83 Q	80.1 C	17.9 C
		80	70.4 N	2.7 GH	8.5 MN	14.7 IJ	40.1 JK	274.3 G	0.86 M	1.30 M	2.16 P	72.8 F	16.2 F
		90	75.3 M	2.3 H	9.4 IJ	15.7 H	39.8 KL	285.1 G	0.93 KL	1.40 LM	2.33 OP	64.5 J	14.4 K
	80	70	95.6 H	5.7 C	10.3 EF	16.3 G	45 D	475.7 CDE	1.90 F	2.80 G	4.70 H	71.6 G	16.0 G
		80	99.8 FG	4.7 D	10.5 E	17.3 F	44.8 D	486.9 CD	1.93 F	2.90 G	4.83 G	62.5 KL	13.9 LM
		90	103.2 DE	3.7 E	11.2 CD	18.7 CD	43.8 E	497.1 BC	2.06 D	3.10 E	5.16 E	54.8 P	11.8 K
	100	70	79.9 GH	6.3 B	10.9 D	16.7 G	45.6 BC	492.3 BC	2.00 E	3.00 F	5.00 F	66.7 I	14.9 I
		80	102.1 EF	5.7 C	11.4 C	17.7 EF	45.4 C	500.7 BC	2.03 DE	3.10 E	5.13 E	62.2 L	13.8 M
		90	105.2 CD	4.3 D	12.2 B	19 C	44 E	404.9 BC	2.16 C	3.20 D	5.36 O	56.8 O	12.4 P
31	0	70	70.5 N	3.7 E	8.7 LM	15.3 HI	40.9 H	275.4 G	0.90 LM	1.30 M	2.20 P	76.5 E	17.1 E
		80	73.6 M	3.3 EF	8.9 KL	15.3 HI	40.6 HI	285.9 G	0.90 LM	1.40 LM	2.30 OP	69.5 H	15.5 H
		90	78.4 L	2.3 H	9.8 GH	16.3 G	40 JK	297.2 G	1.00 K	1.40 L	2.40 O	62.8 KL	13.8 LM
	80	70	97.7 GH	6.7 B	10.3 EF	18.0 DE	46.4 A	500.8 BC	2.03 DE	3.10 EF	5.13 E	69.4 H	15.5 H
		80	104.4 CD	5.7 C	11.2 CD	18.7 CD	45.8 B	516.8 ABC	2.13 C	3.20 D	5.33 D	65.2 J	14.5 J
		90	110.1 B	4.7 D	12.5 B	20.0 B	44.8 D	524.3 ABC	2.26 B	4.40 B	6.66 B	61.3 M	13.5 N
	100	70	100.5 F	7.3 A	11.2 CD	18.7 CD	46.4 A	524.3 ABC	2.16 C	3.20 D	5.36 D	63.2 K	14.0 L
		80	105.8 C	6.7 B	12.3 B	20.0 B	46.3 A	541.4 AB	2.23 B	3.30 C	5.53 C	56.0 O	12.3 Q
		90	113.3 A	5.7 C	13.5 A	21.0 A	45.6 BC	557.9 A	2.40 A	3.60 A	6.00 A	46.9 Q	10.0 S

*** Seed index as 1000 grain weight (g).**
Means having the same capital letters in the same row are not significantly differed at P≥ 0.05