Effect of Nitrogen and Potassium Fertilization and Weed Control Treatments on Wheat Productivity and Associated Weeds under Saline Soil Conditions in The Northern Delta of Egypt

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ABSTRACT

Two field experiments were conducted, on a clay saline soil, at El-Serw Agricultural Research Station, Agricultural Research Centre, at Damietta Governorate, Egypt, during 2013/2014 and 2014/2015 winter seasons, to study the effect of nitrogen and potassium fertilization and some weed control treatments on wheat growth, grain and straw yields, photosynthetic pigments, protein of grains and anatomical features of flag leaf of wheat plant (*Triticum aestivum,* L.), Sakha 93 cultivar and associated weeds. The experiments were carried out in a split-split plot design, with four replicates. Main plots were assigned to nitrogen applications (0, 45 and 90 N kg fed^{-1}) (fed = 4200 m^2). The sub-plots were allocated to potassium treatments as follows: 0, 24 and 48 K kg fed^{-1}. While, the sub-sub plots were allocated to weed control treatments [Pallas (pyroxsulam) Atlantis (mesosulfuron), hand-weeding once, at 45 days after sowing and untreated check].

The results showed that increasing nitrogen fertilization rates up to 90 kg N fed^{-1} and potassium rate up to 48 kg K fed^{-1} increased the total dry weight of broadleaved and grass weeds after 60 and 90 days of wheat sowing, wheat plant height (cm), dry weight (g), photosynthetic pigments, grain and straw yields (t fed $^{-1}$) and protein of grains while, using Pallas (pyroxsulam) and, Atlantis (mesosulfuron) herbicides and hand-weeding once, gave the highest results of previous parameters, respectively, except for the total dry weight of broadleaved and grass weeds, which occurred in a high decrease after 60 and 90 days of wheat sowing. On the other hand, the interaction between nitrogen and potassium levels, with weed control treatments, was not significant in all characters of wheat plant and total dry weight of weeds, except for wheat grain and straw yields, which was significantly increased in both seasons, and protein yield of wheat grain in the first season. Also, the study showed that applying 90 kg N fed^{-1} + 48 kg K fed^{-1} + Pallas (Pyroxsulam) herbicide gave the highest wheat grain and straw yields compared to (N_0 + K_0 + untreated check) being (329 and 316%) and (363 and 354%) and for (N90 + K48 + untreated check) to (86 and 87%) and (86 and 87%) in the first and the second seasons, respectively. Thus, it was preferred to use 90 kg N fed^{-1} + 48 kg K^{-1} + Pallas (Pyroxsulam) herbicide to get an economic wheat production with high quality, which was grown in saline soil in the northern Delta of Egypt.

Anatomical study on the flag leaf of wheat plant, after ninety days subjected to high levels of nitrogen and potassium fertilization with weed control treatments gave a big improvement, caused a positive impact on the growth of plants, and improve all traits under study. These results suggest that elimination of weeds by Pallas (pyroxsulam) and, Atlantis (mesosulfuron) herbicides and hand-weeding once could minimize weed competition to wheat plant and consequently improved photosynthetic fluid assimilates in the wheat phloem, on one side and in other side nutrient uptake from soil and consequently promoted the growth of wheat plants.

Keywords: Wheat, Nitrogen, Potassium, Fertilization, weed control, Herbicide.

INTRODUCTION

Wheat (*Triticum aestivum,* L.) is one of the main cereal crops, not only in Egypt, but, also, all-over the world. Because wheat production in Egypt is not enough for domestic consumption, this has led to increase, attention towards increasing production to meet the high demand and reduce the gap between production and consumption of wheat. Therefore, great efforts have been made to achieve the best transactions and cultivar methods to get the maximum productivity of different wheat cultivars with optimal quality properties.

It was necessary to apply fertilizers and / or amendments to supply the appropriate nutrients and to get the maximum yield. Many agricultural experiments, also demonstrated that the efficiency of applied fertilizers should not exceed 50(%) of nitrogen, 10(%) of phosphorus and 40(%) of potassium. Plants, that have high efficiency of nutrient absorption and utilization, greatly enhance the efficiency of the application of fertilizers and reduce the high costs of agriculture and prevent loss of nutrients and thereby reduce the environmental pollution (Baligar *et al.,* 2001).

Plants strongly respond to applications of nitrogen, which is regarded as the mainly factor in the construction of amino acids, proteins and enters in many physiological processes in the plant

(Wilkinson, 2000). Nitrogen fertilization is an important and essential factor, affecting wheat production in all over the world especially in Egypt, because most Egyptian soils contain insufficient nitrogen. Several researches conducted in Egypt proved, that there was a significant effect of nitrogen levels on most of growth characteristics, yield and yield components. The optimum nitrogen fertilizer levels for wheat in Egypt vary widely in amounts; it was ranged between 97.2 and 285.7 kg N ha^{-1}, according to environmental conditions, such as type and properties of soil (Mansour and Bassiouny, 2009).

Among plant nutrients, nitrogen has been considered as a major growth and development element (Nikolic *et al.,* 2012). Optimum availability of N to wheat plant, compared to improperly fertilized plants, results in promoting plant growth (Ahmad *et al.,* 2012) and higher yield (Ali *et al.,* 2012). Nitrogen is responsible for plant growth and protein synthesis (Arduini *et al.,* 2006; Semenov *et al.,* 2007; Pathak *et al.,* 2008 and Acreche and Slafer, 2009).

Antoun *et al.* (2010) and Rahimi (2012) found that nitrogen fertilizer, at the rates of 119.1, 178.6 and 238.1 kg N ha^{-1}, significantly increased yield and its components. While, Seleem and Abd El–Dayem (2013) reported that the addition of 142.9 or 214.3 kg N ha-1 produced the best significant values of grain and straw yields.

Potassium is one of the essential nutrients for plants, which directly helps in the production of the crop and determines its quality. In addition, potassium involved in many physiological processes, such as photosynthesis, enzyme activation, water relations and assimilates transport, where they can have direct consequences on crop productivity. Therefore, potassium deficiency can lead to a reduction in both the number of leaves produced and the size of individual leaves (Pettigrew, 2008). Potassium (K) is the eighth most abundant element (approximately 2.1%) in the earth's crust (Benito *et al.,* 2014) and the second largest amount of macronutrient found in plants after nitrogen (N) (Oosterhuis *et al.,* 2014). Yet, in discordance to the other NPK members, it shows low replenishment rates in arable soils (Römheld and Kirkby, 2010) and K fertilization is often taken as an issue of secondary importance, largely, due to high cost or poor dissemination of research findings to farmers (Römheld and Kirkby, 2010 and Zörb *et al.,* 2014). Being the most abundant cation in the cells, K has a pivotal role in the maintenance of charge balance, preserves cell turgor pressure, resulting in stomata functioning and cell expansion, activates enzymes and regulates protein synthesis, photosynthesis, phloem loading and transport (Szczerba *et al.,* 2009; Römheld and Kirkby, 2010 and Benito *et al.,* 2014).

Baque *et al.* (2006) found that the significantly improved yields, yield contribut,ing characters and N, P and K uptake of wheat was obtained with higher level of potassium (312 kg ha^{-1}). El-Abady *et al.* (2009) reported that foliar application of potassium, at the rate of 2.49 (%) K gave the highest values of growth, yield and its components and grain quality characters, followed by 1.25 (%) K, as compared with the control treatment (without potassium application). Rahimi (2012) indicated that the effect of potassium on grain yield was highly significant. Tababtabaei and Ranjbar (2012) showed that the highest grain and straw yields were obtained by application of 74.7 kg K ha^{-1}.

In the second order, nowadays, major efforts in Egypt, have been made for maximizing wheat productivity to face the wide gap between the consumption and the production. weed control and nitrogen fertilization are among the important factors affecting wheat fields.

When weeds causes a serious problem in wheat fields. When weeds were left without control, 30-50(%) reduction was recorded in wheat yield, as mentioned by Rao (2000), who reported that most of the weed competition with wheat plants occurred during the first 30-40 days after sowing the crop. Controlling wheat weeds with herbicides are cheaper and most efficient the hand-weeding method because, not only some annual weeds germinate continuously, during the season and this requires repeating hand-weeding, but, also, the manual labour is becoming increased due to scarce and expensive. Selective herbicides control of weeds in wheat fields was obtained against annual broadleaved and grassy weeds by herbicides. Rao (2000) reported that the herbicides application in wheat was more effective in controlling weeds and gained more yields than the hand-weeding. Pallas is a new triazolopyrimidine-sulfonamide herbicide and provides broad-spectrum of post-emergence annual grass and broadleaved weed control in wheat. Pyroxsulam contains active ingredient and inhibits the plant enzyme acetolactate synthase (ALS), which is essential in the synthesis of branched-chain amino acids valine, leucine and isoleucine. Inhibition of amino acid production, subsequently, inhibits cell division and causes death in susceptible weeds. Pyroxsulam is a systemic, phloem and xylem mobile herbicide that is absorbed via leaves, shoots and roots (DeBoer *et al.,* 2006 and 2011), as well as, Atlantis, contain active ingredient mesosulfron. Acts by inhibiting biosynthesis of the essential amino acids valine and isoleucine, hence stopping cell division and plant growth. Mefenpyr-diethyl enhances metabolism of the herbicide selectively in cereal crop plants and use for early to mid-post-emergence control of grass and some broadleaved weeds in wheat (Kocher, 2005; Vazan *et al.,* 2011 and Grundy *et al.,* 2011). As well as, emphasizing the importance of weed control for increasing crop utilization from the applied fertilizers. In addition, nitrogen fertilization can increase the susceptibility of weeds and crops to the applied herbicides. Fayed *et al.* (1993) concluded that the interaction between weed control treatments, included herbicides and nitrogen levels, had an insignificant effect on dry weight of wheat weeds, however, more wheat yields were obtained by the applied herbicides when nitrogen level was increased.

The present investigation aimed to evaluate the effect of application of some fertilization levels of nitrogen and potassium, using some weed control treatments on weeds, as well as growth, yield components, yield and grain protein contents, as grain quality parameter of wheat crop.

MATERIALS AND METHODS

Two field experiments were conducted, at El-Serw Agricultural Research Station, Agricultural Research Centre (ARC) at Damietta Governorate, Egypt, during the two successive winter seasons of 2013/2014 and 2014/2015. The objective of these experiments was to improve productivity of wheat (Sakha 93 cultivar) under nitrogen and potassium fertilizations and some weed control treatments.

The experiments were carried out in a split-split plot experimental design with four replicates. The main plots were allocated to three nitrogen treatments, as follows: N_0 (0 kg N fed^{-1}), N_{45} (45 kg N fed^{-1}) and N_{90} (90 kg N fed^{-1}), the nitrogen fertilizer in the form of ammonium nitrate (33.5 (%) N), was applied, at the aforementioned rates in two equal rates prior the first (25 days from sowing) and the second (46 days from sowing) before irrigations. The sub-plots were devoted to three potassium fertilizer levels, as follows: K_0 (0 kg K fed^{-1}), K_{24} (24 kg K fed^{-1}) and K_{48} (48 kg K fed^{-1}), in the form of potassium sulphate (39.8(%) K) Potassium fertilizer was applied broadcasting in one dose before the first irrigation. Each experimental unit was 3 × 3.5 m, occupying an area of 10.5 m^2. The sub-sub plots were the weed control treatments, which were as follows:

1- Pallas (Pyroxsulam 4.5 (%) (OD) at a rate of 160 cm3 fed-1 at the stage of 3-5 leaves of wheat plant.
2- Atlantis (Iodosulfuron 2 g L-1 M.S. + Mesosulfuron 10 g L-1 M.S. 1.2(%) OD) at a rate of 400 cm3 fed-1 at the stage of 2-4 leaves of wheat plant..
3- Hand-weeding, once, at 45 days after sowing.
4- Untreated check (control).

The information the herbicides is shown in Table (1).

All herbicides were applied as post-emergence using knapsack sprayer with two-nozzle boom and spray volume of 200 L fed^{-1}. Calcium superphosphate fertilizer (6.76 (%)P) was added, at the rate of 238 Kg ha^{-1}, as basal for each sub-sub plot before ploughing.

Wheat seeds, Sakha 93 CV., were sown on 18th of November in both seasons. While wheat harvesting was done on April 20th in both seasons.

Soil Analysis:

Surface soil samples (0-30 cm) were taken from the experimental field before the ploughing, then, air-dried and ground to pass through a 2 mm sieve. Soil physical and chemical properties are shown in Table 2. Particle size distribut,ion of the composite sample was determined by hydrometer method. Soluble cations, anions and total soluble salts were estimated in 1:5 soil water extract, while, the organic matter was determined by using Walkley and Black method, but, available potassium was extracted by neutral normal ammonium acetate ($C_2H_3O_2NH_4$) and K was measured by a flame photometer. Soluble SO_4^{-2} was taken as the difference between the summation of soluble cations and anions. The pH values were measured in 1:2.5 soil-water suspensions. Available nitrogen was determined in the soil extracted, using Potassium Sulphate (K_2SO_4) and determined by using macro Kjell-dhal. Available phosphorus was extracted by sodium bicarbonate ($NaHCO_3$) of pH 8.5 and determined colorimetrically. All previous soil physical and chemical properties were carried out according to Klute (1986) and Page *et al.* (1982).

Table (2) shows that the soil of experiments in both seasons is considered saline, according to U.S. Salinity Laboratory Staff (1954) and Soil Survey Staff (2004).

Table 1: Chemical trade name, common name and chemical name of chemical weed control treatments of Pallas and, Atlantis

Trade name	Common name	Chemical name
1 – Pallas 4.5 (%) OD	Pyroxsulam	N-(5, 7- dymethoxy [1, 2, 4] triazol [1,5-a]-pyrimidin-2-yl-2-methoxy-4-(trifluoromethyl) pyridine-3-sulfonamida.
2 –, Atlantis 1.2 (%) OD	Mesosulfuron	Methyl-2-[[[[(4, 6-dimethoxy-2-pyrimidinyl) amino] carbonyl] amino] sulfonyl]-4-[[(methylsulfonyl) amino] methyl] benzoate.

Table 2: Physical and chemical soil characteristics, at the experimental sites during the two seasons

Growing season	Particle size distribut,ion (%)					OM (%)	$CaCO_3$ (%)	C.E.C. (meq /100g soil)	pH	EC, dSm^{-1}
	Coarse sand	Fine sand	Silt	Clay	Texture class					
first	1.52	10.5	21.12	66.86	Clayey	0.76	1.38	43.95	8.0	4.50
second	1.63	10.6	21.23	66.54	Clayey	0.83	1.30	43.42	7.8	4.30

Growing season	Cations and anions in the soil water extract (1:5), meq/100 g soil								NPK available (ppm)		
	Cations				Anions				N	P	K
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}			
first	3.66	3.53	16.07	0.23	---	1.33	16.45	5.71	30	7.96	435
second	3.89	3.5	16.43	0.25	---	1.49	16.63	5.95	32	8.06	465

Survey of Weeds:

Weeds were hand pulled, at 60 and 90 days after sowing in both seasons, weed samples from one square meter were randomly taken from each sub-sub plot. weeds were identified and classified into broadleaved, as well as, grasses. After drying, at 70 C° for 48 hours, dry weight of each group, as well as, total weeds was recorded.

Plant Analysis.

Plant growth parameters and yield:

Wheat plant height (cm), dry weight (g), grain yield (t fed^{-1}) and straw yield (t fed^{-1}) were recorded after wheat harvest.

Photosynthetic pigments determination:

Photosynthetic pigments (chlorophyll a, chlorophyll b and total chlorophyll) were determined, at the booting stage of wheat plants. A 250 mg sample of fresh leaves, which were homogenized with 80 (%) acetone, centrifuged, at 4000 rpm, for 5 minutes. The filtrate was taken out and final the 25 ml volume was made by using 80 (%) acetone. Optical density was read, at 480, 510, 645, 652 and 663 nm, with a spectrophotometer. The chlorophyll content was estimated by the formulae given, by Arnon (1949), which are expressed, as follows:

$$\text{Chl. a } (mg\ g^{-1}) = \left(12.7 \times (OD663) - 2.69 \times (OD645)\right) \times \frac{V}{100 \times W}$$

$$\text{Chl. b } (mg\ g^{-1}) = \left(22.9 \times (OD645) - 4.68 \times (OD6663)\right) \times \frac{V}{100 \times W}$$

Total chl. (mg g^{-1}) = Chl. A + Chl. b

Where, OD= Optical density, V = Final vol. of 80 (%) acetone (25ml) and W = Weight of sample taken (0.25g).

Nitrogen concentration in wheat grains:

Oven-dried samples of wheat grains were ground in a mill using a 50-mesh screen. These samples were digested in H_2SO_4 concentrated and H_2O_2 30 (%), according to Yash (1998). Nitrogen content was determined by using the microkjell-dhll method, according to Jackson (1967).

Protein (%) And Protein Of Grain Yield (Kg $_{Protein}$ Fed^{-1}):

Protein Content In Wheat Grains Was Estimated By The Following Equation:

Protein (%) = N(%) in wheat grains × 5.7

Protein of grain yield (kg $_{protein}$ fed^{-1}) was estimated by the following equation:

$$kg\ protein\ fed^{-1} = \frac{\text{Grain protein\%} \times \text{Grain yield}\ (kg\ fed^{-1})}{100}$$

Anatomical Features:

Specimens were taken from the first season of wheat leaves from the middle of terminal interned of middle portion from the flag leaf blade were taken at the flowering stage, at the age of 90 days. The specimens were killed and fixed in FAA, dehydrated in alcohol series, followed by xylene and embedded in paraffin wax (52-54 C.m.p.). Cross sections, 15-20 µm thick were prepared by a rotary microtome, stained in saffranin-light green combination, cleared in clove oil and mounted in Canada balsam, (Gerlach, 1977). The anatomical features under study were microscopically, by lens (X100); i.e., leaf thickness in the keel region, mesophyll tissue thickness, large V.B. dimension, xylem tissue thickness, phloem tissue thickness and met xylem vessel diameter, respectively. It had been taken in eight cross-sections of the four weed control treatments under high and low rates of nitrogen and potassium

The Statistical Analysis:

Data were collected for statistical analysis according to Snedecor and Cochran (1967). Mean values were compared, at the 5 (%) and 1 (%) levels of significance by using the Least Significance Difference (LSD) test. CoHort Software (2008) was used to statistical analysis for data.

RESULTS AND DISCUSSION

Weeds

The most commonly existed weed species in the experimental fields, through the two growing seasons were: sweet clover (*Melilotus indica*, L.), dentated dock (*Rumex dentatus*, L.), wild beet (*Beta vulgaris*, L.) and lambsquarters (*Chenopodium* *album,* L.), as broadleave weeds, and beard grass (*Polypogon monspeliensis,* L.), canary grass (*Phalaris minor,* Retz.), as grass weeds.

Data, described in Table (3) showed the effect of adding nitrogen and potassium fertilization rates, some weed control treatments and their interaction on total dry weight of weeds (g m^{-2}), associated with wheat plants, at 60 and 90 days from sowing in both seasons.

A- Effect of Nitrogen Rates:

Table (3) shows that increasing nitrogen rates from zero level of nitrogen to 45 and 90 kg N fed^{-1} exerted significant increases in the total dry weight of weeds (g m^{-2}) by (10.1 and 20.6%), respectively, at 60 days from sowing and (10.2 and 20.8%), respectively, at 90 days from sowing in 2013/14 season with respective values of (11.5 and 23.3%), respectively and (11.3 and 23.3%), respectively in 2014/15 season, when non fertilized N was used. Increasing nitrogen fertilizer rates led to increase weed growth, biomass and competition, more than its increases in crop growth. Nutrient level is often important for crop and weed competitive interactions (Lintell-Smith *et al.,* 1992). Soils, which can support the crop growth, are excellent for weed growth, as well, and prolific weed growth indicates the abundance of nutrients in the soil as reported by Fayed *et al.* (1993). Singh (1997) found that weed density in plots, given N (40 or 80 kg ha^{-1}) was 11.7 (%) higher than untreated plots. weed dry matter increased with increasing N rate. Fertilization increases total biomass production in the field and that can occur as either increased crop or weed biomass or both. Many weed species are more effective than crops in capturing nutrients, added as fertilizers (Blackshaw *et al.,* 2003 and DiTomaso, 1995), so addition of many weed species may be more effective in taking up high levels of soil nitrogen than is wheat. On the other hand, in some situations, crops can be more efficient in taking up fertilizers than weeds (Dhima and Eleftherohorinos, 2001 and Jornsgard *et al.,* 1996). Lehoczky *et al.* (2012) found that the effect of increasing N rates was positive on the wheat biomass and on wheat competition to the weeds. Adnan *et al.* (2016 a) reported that N application significantly increased weeds fresh and dry biomass over control. Also, they found that Nitrogen, applied, at the rate of 120 kg ha^{-1} from urea, significantly increased weed fresh and dry biomasses.

B- Effect of Potassium Rates:

The data in Table (3) showed that the effect application of potassium rates only, was significant in total dry weight of weeds (g m^{-2}), after 90 days from sowing in the second season. While, it were not significant in total dry weight of weeds (g m^{-2}), after 60 and 90 days from sowing in the first season, and, at 60 days in the second season. Adding potassium fertilization, significantly increased concrete on total dry weight of weeds (g m^{-2}), where, the rates of increase, when using 24 and 48 kg K fed^{-1} were (2.6 and 4.8%), respectively, at 60 days from sowing and (2.5 and 4.6%), respectively, at 90 days from sowing in the first season, while, the increases in the second season were (3.7 and 7.2%), respectively, at 60 days from sowing and (3.7 and 7.1%), respectively, at 90 days from sowing. This is due to the voracious weeds to fertilization nitrogen than in the potassium fertilization. Therefore, it was noted that the appearance of the effect of adding potassium first was faster and direct for the growth, biomass, and competition for the weeds, while, the effect of adding second would be slow and indirect on weeds.

C- Effect of Weed Control Treatments:

The effect of weed control treatments were significant on total dry weight of weeds (g m^{-2}), associated with wheat plant, at 60 and 90 days from sowing in both seasons (Table 3). The highest reduction values in total dry weight of weeds (g m^{-2}), were obtained by Pallas herbicide (pyroxsulam) Atlantis (mesosulfuron), hand-weeding, once, after 45 days from sowing and untreated control treatment, respectively. It can be stated that the Pallas herbicide (pyroxsulam) had been given highest decrease at 79.3(%), followed by Atlantis herbicide (mesosulfuron) that was given at 70.1(%), followed by hand-weeding once that was given at 65(%), when compared with untreated control treatment, respectively. Here, the most effective chemical treatments, against the total dry weight of weeds (g m^{-2}), were the Pallas herbicide (Pyroxsulam), due to inhibiting the weed plant enzyme acetolactate synthesis (ALS), which is essential for the synthesis of branched-chain amino acids valine, leucine and isoleucine. Inhibits cell division and caused death in susceptible weeds. Pyroxsulam is a systemic, phloem and xylem mobile herbicide that is absorbed via leaves, shoots and roots. Herbicides selectively, enhance metabolism in cereal crop plants. The significant inhibitions in total dry weight of weeds (g m^{-2}), was obtained due to the application of the studied weed treatments ranged from 57.9 – 84.3(%) than unweeded control. Superiority of herbicides and hand-weeding in controlling weeds was reported by Fayed *et al.* (1993); Rasmussen (2002); Kocher (2005); DeBoer *et al.* (2006); Kristensen *et al.* (2008); DeBoer *et al.* (2011); Vazan *et al.* (2011) and Grundy *et al.* (2011).

D- Effect of The Interactions:

Moreover, data in Table (3) showed that the interaction between nitrogen and potassium rates was not significant in total dry weight of weeds (g m^{-2}), after 60 and 90 days of sowing in both seasons. The highest values were obtained by applying 90 kg N fed^{-1} with 48 kg K fed^{-1} in both seasons. These results were, attributed to the role of nitrogen and potassium in increasing plant growth parameters, such as dry weight of broad and grass weeds (g m^{-2}).

The interaction effect was not significant between nitrogen levels and weed control treatments in total dry weight of weeds (g m^{-2}), after 60 and 90 days of sowing in both seasons (Table 3). Data showed that 90 kg N fed^{-1} with untreated check, gave the highest values of total dry weight of weeds (g m^{-2}), after 60 and 90 days of sowing in both seasons.

Table (4) shows the interaction effect between nitrogen, potassium levels and weed control treatments. This interaction indicated that there was no significant in total dry weight of weeds (g m^{-2}) after 60 and 90 days of sowing in both seasons.

Table (4) also, indicated that the lowest values of the total dry weight of weeds (g m^{-2}), after 60 and 90 days from sowing were obtained with Pallas herbicide (Pyroxsulam) followed by Atlantis herbicide (Mesosulfuron) and then hand-weeding once, compared with the untreated check, respectively. While, at high or low levels of nitrogen and potassium fertilization, it was found that the Pallas herbicide (Pyroxsulam) gave the highest decrease in total dry weight of weeds (g m^{-2}) after 60 and 90 days from sowing was by (40.8 and 64.5 g m^{-2}), in the first season and (37.5 and 61.5 g m^{-2}) in the second season, when we used height level of nitrogen and potassium fertilization compared with the unweeded control, which was (171.3 and 271.5 g m^{-2}) in the first season and (157.5 and 258.5 g m^{-2}) in the second season, respectively. While, Pallas herbicide (Pyroxsulam) with the low levels of nitrogen and potassium fertilization gave (26.8 and 42.8 g m^{-2}) in the first season, and (23.5 and 39.5 g m^{-2}) in the second season, compared with the unweeded control which was (154.5 and 245.5 g m^{-2}) in the first season, and (136.3 and 223.5 g m^{-2}) in the second season, respectively.

Photosynthetic Pigments (Mg G^{-1}).

Data, in Tables (5) and (6) showed the response of photosynthetic pigments for wheat, at the booting stage in both seasons to nitrogen fertilization, potassium rates, some weed control treatments and their interactions.

A- Effect of Nitrogen Rates:

Data, in Table (5) showed that there were highly significant effects for nitrogen rates, on chlorophyll a, chlorophyll b and total chlorophyll for wheat in both seasons. The highest values of these parameters were obtained with 90 kg N fed^{-1} in the first and second seasons. Deficiency of nitrogen leads to loss of green colour in the leaves and consequently, decreased leaves area and intensity of photosynthesis. Understanding the processes, which govern N uptake and distribution in wheat plant, are very important, with respect to both environmental concerns and the quality of crop products. Nitrogen uptake and accumulation in crops represent two major components of N cycle in the agro-system (Gastal and Lemaire, 2002). Bojović and Marković (2009) reported that nitrogen content was a close link with chlorophyll content in some wheat cultivars.

B- Effect of Potassium Rates:

Also, data, in Table (5) showed that the effect of potassium rates was significant, at 5(%) level in chlorophyll a, and total chlorophyll in flag leaf of wheat in the first season, but, this effect was not significant in chlorophyll b in the first season and chlorophyll a, chlorophyll b and total chlorophyll for wheat in the second season. The full dose of potassium fertilization (48 kg K fed^{-1}) gave the highest chlorophyll a, chlorophyll b and total chlorophyll for wheat in both seasons, followed by 24 kg K fed^{-1}. Pettigrew (2008) pointed that the importance of potassium, due to its involvement in many physiological processes. Potassium impact on water relations, photosynthesis, assimilate transport and enzyme activation can have direct consequences on crop productivity. Khan and Aziz (2013) indicated that the application of K enhanced the chlorophyll contents in wheat under saline and non-saline conditions. Rahman *et al.* (2014) showed that foliar application of potassium orthophosphate was effective in increasing SPAD value (Measure of leaf chlorophyll content) of all the wheat cultivars under studying.

C- Effect of Weed Control Treatments:

The effect of weed control treatments were highly significant in chlorophyll a, chlorophyll b and total chlorophyll for wheat in first and second seasons (Table 5). The highest value of chlorophyll a, chlorophyll b and total chlorophyll for wheat were obtained by Pallas herbicide (pyroxsulam) Atlantis herbicide (mesosulfuron), hand-weeding once after 45 days from sowing and untreated control treatment, respectively. This can be attributed to the effect of Pallas herbicide to reduce weed competition for wheat plant, led to increasing the availability of nutrients to the plant, such as nitrogen, which led to a positive impact on photosynthetic pigments of wheat.

D- Effect Of The Interactions:

The data, in Table (5), showed that the interaction between nitrogen and potassium fertilization was no significant in chlorophyll a, chlorophyll b and total chlorophyll for wheat in the first and second seasons. The highest values were obtained by applying 90 kg N fed^{-1} with 48 kg K fed^{-1} in both seasons.

Table 3: Effect of nitrogen and potassium fertilization rates, some weed control treatments and their interactions on total dry weight of weeds after 60 and 90 days of wheat sowing in 2013/14 and 2014/15 seasons

Treatments			Total dry weight of broad and grass weeds			
			2013/2014		2014/2015	
N (kg N fed^{-1})	K (kg K fed^{-1})	Weed control	After 60 days	After 90 days	After 60 days	After 90 days
0			68.3	108.4	60.9	99.9
45			75.2	119.4	67.9	111.2
90			82.4	130.9	75.1	123.2
LSD (0.05)			10.5*	4.3**	ns	4.6**
	0		73.5	116.8	65.6	107.6
	24		75.4	119.7	68.0	111.6
	48		77.0	122.2	70.3	115.2
LSD (0.05)			ns	ns	ns	5.7*
		Pallas 160 cm^3 fed^{-1}	33.6	53.4	30.4	49.9
		Atlantis 400 cm^3 fed^{-1}	48.5	77.0	43.8	71.7
		Hand-weeding, at 45 days	56.8	90.2	51.3	84.1
		Untreated check	162.3	257.8	146.5	240.1
LSD (0.05)			7.8**	5.9**	8.2**	8.1**
N × K						
0	0		67.1	106.8	59.3	97.3
	24		68.4	108.5	60.9	100.0
	48		69.3	110.0	62.6	102.5
45	0		73.5	116.8	65.6	107.5
	24		75.4	119.8	68.0	111.4
	48		76.7	121.7	70.0	114.7
90	0		79.8	126.9	72.0	118.1
	24		82.4	130.7	75.1	123.3
	48		85.1	135.0	78.3	128.3
LSD (0.05)			ns	ns	ns	ns
N × weed control						
0		Pallas 160 cm^3 fed^{-1}	27.6	43.9	24.6	40.8
		Atlantis 400 cm^3 fed^{-1}	41.4	65.9	37.0	60.7
		Hand-weeding, at 45 days	48.6	77.0	43.3	70.9
		Untreated check	155.5	246.8	138.8	227.4
45		Pallas 160 cm^3 fed^{-1}	33.5	53.4	30.4	49.6
		Atlantis 400 cm^3 fed^{-1}	49.1	77.8	44.2	72.4
		Hand-weeding, at 45 days	55.5	88.0	50.2	82.2
		Untreated check	162.7	258.4	146.8	240.7
90		Pallas 160 cm^3 fed^{-1}	39.6	62.8	36.1	59.3
		Atlantis 400 cm^3 fed^{-1}	55.1	87.2	50.2	82.1
		Hand-weeding, at 45 days	66.3	105.5	60.4	99.3
		Untreated check	168.8	268.0	153.8	252.3
LSD (0.05)			ns	ns	ns	ns
K × weed control						
	0	Pallas 160 cm^3 fed^{-1}	32.6	52.1	29.1	48.0
		Atlantis 400 cm^3 fed^{-1}	47.1	74.7	42.2	68.9
		Hand-weeding, at 45 days	53.6	85.2	47.8	78.5
		Untreated check	160.7	255.3	143.4	235.1
	24	Pallas 160 cm^3 fed^{-1}	33.5	53.3	30.4	49.8
		Atlantis 400 cm^3 fed^{-1}	48.4	76.8	43.6	71.8
		Hand-weeding, at 45 days	57.2	90.8	51.6	84.6
		Untreated check	162.5	257.8	146.5	240.2
	48	Pallas 160 cm^3 fed^{-1}	34.6	54.8	31.6	51.8
		Atlantis 400 cm^3 fed^{-1}	50.1	79.4	45.6	74.5
		Hand-weeding, at 45 days	59.6	94.6	54.5	89.3
		Untreated check	163.8	260.1	149.5	245.1
LSD (0.05)			ns	ns	ns	ns

* and ** = Significant at 0.05 and 0.01 levels, respectively. ns= Not significant.

Table 4: The interaction effect between nitrogen fertilization, potassium levels and weed control treatments on total dry weight of weeds after 60 and 90 days of wheat sowing in 2013/14 and 2014/15 seasons

Treatments			Total dry weight of broad and grass weeds			
			2013/2014		2014/2015	
N (kg N fed^{-1})	K (kg K fed^{-1})	Weed control	After 60 days	After 90 days	After 60 days	After 90 days
0	0	Pallas 160 cm^3 fed^{-1}	26.8	42.8	23.5	39.5
		Atlantis 400 cm^3 fed^{-1}	40.5	64.5	35.8	58.8
		Hand-weeding, at 45 days	46.8	74.3	41.5	67.5
		Untreated check	154.5	245.5	136.3	223.5
	24	Pallas 160 cm^3 fed^{-1}	27.5	43.5	24.5	40.3
		Atlantis 400 cm^3 fed^{-1}	41.3	65.8	36.8	60.5
		Hand-weeding, at 45 days	49.3	78.0	43.8	71.8
		Untreated check	155.5	246.8	138.8	227.5
	48	Pallas 160 cm^3 fed^{-1}	28.5	45.5	25.8	42.5
		Atlantis 400 cm^3 fed^{-1}	42.5	67.5	38.5	62.8
		Hand-weeding, at 45 days	49.8	78.8	44.8	73.5
		Untreated check	156.5	248.3	141.5	231.3
45	0	Pallas 160 cm^3 fed^{-1}	32.5	52.3	29.3	47.8
		Atlantis 400 cm^3 fed^{-1}	47.3	74.8	42.3	68.8
		Hand-weeding, at 45 days	53.5	84.8	47.5	78.5
		Untreated check	160.8	255.3	143.5	235.0
	24	Pallas 160 cm^3 fed^{-1}	33.5	53.5	30.5	49.5
		Atlantis 400 cm^3 fed^{-1}	48.8	77.5	43.8	72.3
		Hand-weeding, at 45 days	55.8	88.8	50.5	82.5
		Untreated check	163.5	259.5	147.3	241.5
	48	Pallas 160 cm^3 fed^{-1}	34.5	54.5	31.5	51.5
		Atlantis 400 cm^3 fed^{-1}	51.3	81.3	46.5	76.3
		Hand-weeding, at 45 days	57.3	90.5	52.5	85.5
		Untreated check	163.8	260.5	149.5	245.5
90	0	Pallas 160 cm^3 fed^{-1}	38.5	61.3	34.5	56.8
		Atlantis 400 cm^3 fed^{-1}	53.5	84.8	48.5	79.3
		Hand-weeding, at 45 days	60.5	96.5	54.5	89.5
		Untreated check	166.8	265.3	150.5	246.8
	24	Pallas 160 cm^3 fed^{-1}	39.5	62.8	36.3	59.5
		Atlantis 400 cm^3 fed^{-1}	55.3	87.3	50.3	82.5
		Hand-weeding, at 45 days	66.5	105.5	60.5	99.5
		Untreated check	168.5	267.3	153.5	251.5
	48	Pallas 160 cm^3 fed^{-1}	40.8	64.5	37.5	61.5
		Atlantis 400 cm^3 fed^{-1}	56.5	89.5	51.8	84.5
		Hand-weeding, at 45 days	71.8	114.5	66.3	108.8
		Untreated check	171.3	271.5	157.5	258.5
LSD (0.05)			ns	ns	ns	ns

ns= Not significant.

These results were, attributed to role of nitrogen (Bojović and Marković, 2009) and potassium (Pettigrew, 2008) in many physiological processes, such as photosynthesis processes.

Moreover, the interaction effect between nitrogen levels and weed control treatment indicated highly significant effect on chlorophyll a, chlorophyll b and total chlorophyll for wheat in the first and the second seasons (Table 5). Data showed that 90 kg N fed^{-1}, with Pallas herbicide, gave the highest values of chlorophyll a, chlorophyll b and total chlorophyll for wheat in both seasons. This increase could be due to the interaction between the effects of Pallas herbicide to reduce weed competition for wheat with the full rate of nitrogen fertilization effect, resulting in increasing nutrients supply to wheat plant, such as nitrogen, which led to a positive impact on photosynthetic pigments of wheat. Bojović and Marković (2009) reported that nitrogen content was close link with chlorophyll content in some wheat cultivars.

Table 5: Effect of nitrogen and potassium fertilization rates, some weed control treatments and their interactions on photosynthetic pigments (mg g^{-1}) for wheat, at booting stage in 2013/14 and 2014/15 seasons

Treatments		Weed control	2013/ 2014			2014/ 2015		
N (kg N fed^{-1})	K (kg K fed^{-1})		Chl. a	Chl. b	Total chl.	Chl. a	Chl. b	Total chl.
0			4.35	2.1	6.45	4.43	2.19	6.62
45			5.33	2.6	7.93	5.45	2.78	8.24
90			5.78	3.08	8.86	5.91	3.22	9.13
LSD (0.05)			0.33**	0.40**	0.71**	0.44**	0.47**	0.85**
	0		4.98	2.52	7.5	5.12	2.65	7.77
	24		5.06	2.56	7.62	5.18	2.72	7.89
	48		5.42	2.7	8.12	5.5	2.83	8.33
LSD(0.05)			0.29*	ns	0.43*	ns	ns	ns
		Pallas 160 cm3 fed-	7.97	4.1	12.07	8.07	4.24	12.31
		Atlantis 400 cm3	6.49	2.81	9.31	6.59	2.93	9.51
		Hand-weeding, at 45	3.73	1.83	5.57	3.86	1.95	5.81
		Untreated check	2.42	1.62	4.04	2.55	1.8	4.35
LSD (0.05)			0.27**	0.16**	0.31**	0.28**	0.18**	0.29**
N × K								
0	0		4.13	2.04	6.17	4.22	2.11	6.33
	24		4.21	2.09	6.3	4.32	2.17	6.49
	48		4.71	2.18	6.89	4.75	2.29	7.04
45	0		5.14	2.55	7.69	5.3	2.74	8.04
	24		5.21	2.58	7.78	5.32	2.78	8.1
	48		5.66	2.67	8.32	5.75	2.83	8.58
90	0		5.68	2.98	8.66	5.85	3.09	8.94
	24		5.77	3	8.77	5.9	3.2	9.09
	48		5.9	3.25	9.15	5.99	3.37	9.36
LSD (0.05)			ns	ns	ns	ns	ns	ns
N × weed control								
0		Pallas 160 cm3 fed-	7.54	3.32	10.86	7.59	3.39	10.98
		Atlantis 400 cm3	5.52	2.36	7.88	5.56	2.45	8.01
		Hand-weeding, at 45	2.43	1.42	3.84	2.53	1.52	4.05
		Untreated check	1.9	1.32	3.23	2.04	1.4	3.44
45		Pallas 160 cm3 fed-	7.97	3.96	11.93	8.13	4.12	12.24
		Atlantis 400 cm3	6.9	2.83	9.73	7.03	3.03	10.06
		Hand-weeding, at 45	4.08	1.87	5.96	4.18	2.09	6.27
		Untreated check	2.38	1.73	4.1	2.47	1.9	4.38
90		Pallas 160 cm3 fed-	8.4	5.03	13.43	8.5	5.2	13.7
		Atlantis 400 cm3	7.06	3.25	10.31	7.16	3.31	10.47
		Hand-weeding, at 45	4.69	2.21	6.9	4.86	2.26	7.12
		Untreated check	2.97	1.82	4.79	3.13	2.11	5.23
LSD (0.05)			0.47**	0.27**	0.53**	0.48**	0.28**	0.51**
K × weed control								
	0	Pallas 160 cm3 fed-	7.79	4.03	11.83	7.91	4.2	12.11
		Atlantis 400 cm3	6.17	2.69	8.86	6.3	2.78	9.08
		Hand-weeding, at 45	3.65	1.76	5.41	3.81	1.87	5.67
		Untreated check	2.31	1.6	3.91	2.47	1.74	4.21
	24	Pallas 160 cm3 fed-	7.9	4.07	11.96	8.03	4.25	12.28
		Atlantis 400 cm3	6.26	2.8	9.06	6.32	2.91	9.23
		Hand-weeding, at 45	3.72	1.81	5.53	3.81	1.93	5.74
		Untreated check	2.37	1.54	3.92	2.55	1.77	4.32
	48	Pallas 160 cm3 fed-	8.23	4.21	12.43	8.28	4.26	12.53
		Atlantis 400 cm3	7.05	2.95	10	7.14	3.09	10.23
		Hand-weeding, at 45	3.84	1.92	5.76	3.96	2.07	6.03
		Untreated check	2.57	1.72	4.29	2.62	1.9	4.52
LSD (0.05)			ns	ns	ns	ns	ns	0.51**

* and ** = Significant at 0.05 and 0.01 levels, respectively.
ns= Not significant.

While, the interaction effect was not significant between potassium levels and weed control treatment, in the first season for chlorophyll a, chlorophyll b and total chlorophyll and chlorophyll a and chlorophyll b for wheat in the second season, but the total chlorophyll for wheat in the second seasons was highly significant (Table 5). Data showed that 48 kg K fed^{-1}, with Pallas herbicide, gave the highest values of wheat chlorophyll a, chlorophyll b and total chlorophyll for wheat in both seasons. This increase could be due to the interaction between the effects of Pallas herbicide to reduce weed competition for wheat, with the full rate of potassium fertilization effect, resulting in increasing nutrients supply to wheat plant, such as potassium, which led to a positive impact on photosynthetic pigments of wheat. Pettigrew (2008) pointed that the importance of potassium due to its involvement in many physiological processes, such as photosynthesis processes.

Table (6) shows that the interaction effect between the three experimental factors, nitrogen levels, potassium rates and weed control. This interaction effect indicates that there was no significant effect in the first and second seasons for chlorophyll a, chlorophyll b and total chlorophyll for wheat.

Plant Growth Parameters.

Data, in Tables 7 and 8 showed the response of wheat plant height (cm) and dry weight (g), at the harvesting stage in both seasons to nitrogen fertilization, potassium rates, some weed control treatments and their interactions.

A- Effect Of Nitrogen Rates:

Data, in Table 7 showed that there was a significant effect, at (5%) level for applied nitrogen rates, on wheat plant height and it was highly significant effect, at (1%) level increase in wheat dry weight in both seasons. The highest values of these parameters were obtained with 90 kg N fed^{-1} in first and second seasons. This could be attributed to the fact that nitrogen promoted plant growth increased the number and length of internodes, which resulted in a progressive increase in plant height. Nikolic *et al.* (2012) indicated that plant growth and development depend on nutrients, such as nitrogen supply and in general, increasing the nutrients enhanced plant growth and development. Adnan *et al.* (2016 b) indicated that nitrogen, used at rate of 150 kg ha^{-1}, significantly improved wheat plant height.

B- Effect Of Potassium Rates:

Table 7 shows also, that the effect of potassium was not significant on wheat plant height but, it was highly significant in dry weight in both seasons. The highest values of wheat plant height and dry weight were obtained with 48 kg K fed^{-1} in both seasons. El-Abady *et al.* (2009) showed that plant growth, such as plant height and dry weight depend on nutrients, such as potassium supply. K application, at 90 kg K_2O ha^{-1}, significantly enhanced plant height by 8 (%) (Adnan *et al.*, 2016 b).

C- Effect Of Weed Control Treatments:

The effect of weed control treatments was highly significant in plant height and dry weight in both seasons (Table 7). The highest values of wheat plant height and dry weight were obtained by Pallas, Atlantis, Hand-weeding and untreated check, respectively. It could be attributed to the effect of Pallas herbicide to reduce weed competition for wheat plant, which led to increasing the availability of nutrients to the plant, which led to a positive impact on the wheat growth parameters.

D- Effect Of The Interactions:

Table (7) shows that the interaction effect between levels nitrogen and potassium fertilization was non significant in wheat plant height, but, dry weight was highly significant in the both seasons. The highest values were obtained by applying 90 kg N fed^{-1} with 48 kg K fed^{-1} in both seasons. These results might be attributed to role of nitrogen and potassium in cell elongation and increasing dry matter in wheat plants.

The interaction effect was not significant between nitrogen levels and weed control treatments in the both seasons for wheat plant height and dry weight (Table 7). Data show that 90 kg N fed-1 with Pallas herbicide, gave the highest values of wheat plant height and dry weight in both seasons.

Also, data, in Table (7) showed the interaction effect between potassium levels and weed control treatments on wheat plant height and dry weight in both seasons. This effect was non significant on wheat plant height and dry weight in both seasons. The highest values of these parameters were obtained when applying 48 kg K fed^{-1}, with Pallas herbicide. This increase could be due to the interaction between the effect of the Pallas herbicide, to reduce weed competition for wheat with the full rate of potassium fertilization effect, resulting increase wheat growth parameters, such as plant height and dry weight.

Table (8) shows the interaction effect between the three experimental factors, levels of nitrogen and potassium and weed control treatments. This interaction was not significant in wheat plant height and dry weight in both seasons.

Grain And Straw Yields (T Fed^{-1}).

Data in Tables (9) and (10) showed the effect of nitrogen fertilization, potassium rates, some weed control treatments and their interactions on wheat grain and straw yield in both seasons.

Table 6: The interaction effect between nitrogen fertilization, potassium levels and weed control treatments on photosynthetic pigments (mg g^{-1}) for wheat, at booting stage in 2013/14 and 2014/15 seasons

Treatments		Weed control	2013/ 2014			2014/ 2015		
N (kg N fed^{-1})	K (kg K fed^{-1})		Chl. a	Chl. b	Total chl.	Chl. a	Chl. b	Total chl.
0	0	Pallas 160 cm3 fed-1	7.21	3.24	10.45	7.26	3.3	10.56
		Atlantis 400 cm3 fed-1	5.14	2.28	7.42	5.18	2.35	7.53
		Hand-weeding, at 45 days	2.37	1.38	3.75	2.46	1.47	3.93
		Untreated check	1.78	1.26	3.04	1.97	1.32	3.29
	24	Pallas 160 cm3 fed-1	7.35	3.29	10.64	7.44	3.36	10.8
		Atlantis 400 cm3 fed-1	5.25	2.39	7.64	5.31	2.48	7.79
		Hand-weeding, at 45 days	2.37	1.4	3.77	2.46	1.5	3.96
		Untreated check	1.86	1.28	3.14	2.07	1.34	3.41
	48	Pallas 160 cm3 fed-1	8.06	3.42	11.48	8.07	3.52	11.59
		Atlantis 400 cm3 fed-1	6.16	2.41	8.57	6.19	2.51	8.7
		Hand-weeding, at 45 days	2.54	1.47	4.01	2.67	1.58	4.25
		Untreated check	2.07	1.43	3.5	2.08	1.53	3.61
45	0	Pallas 160 cm3 fed-1	7.88	3.89	11.77	8.1	4.11	12.21
		Atlantis 400 cm3 fed-1	6.44	2.79	9.23	6.55	2.98	9.53
		Hand-weeding, at 45 days	3.97	1.82	5.79	4.21	2.02	6.23
		Untreated check	2.26	1.69	3.95	2.33	1.85	4.18
	24	Pallas 160 cm3 fed-1	7.93	3.92	11.85	8.15	4.15	12.3
		Atlantis 400 cm3 fed-1	6.49	2.79	9.28	6.6	2.99	9.59
		Hand-weeding, at 45 days	4.07	1.87	5.94	4.08	2.08	6.16
		Untreated check	2.34	1.72	4.06	2.43	1.9	4.33
	48	Pallas 160 cm3 fed-1	8.11	4.07	12.18	8.13	4.09	12.22
		Atlantis 400 cm3 fed-1	7.77	2.9	10.67	7.95	3.12	11.07
		Hand-weeding, at 45 days	4.21	1.93	6.14	4.26	2.16	6.42
		Untreated check	2.53	1.77	4.3	2.66	1.96	4.62
90	0	Pallas 160 cm3 fed-1	8.29	4.97	13.26	8.36	5.2	13.56
		Atlantis 400 cm3 fed-1	6.94	3	9.94	7.17	3	10.17
		Hand-weeding, at 45 days	4.6	2.09	6.69	4.75	2.11	6.86
		Untreated check	2.89	1.85	4.74	3.11	2.05	5.16
	24	Pallas 160 cm3 fed-1	8.41	4.99	13.4	8.51	5.24	13.75
		Atlantis 400 cm3 fed-1	7.03	3.22	10.25	7.04	3.27	10.31
		Hand-weeding, at 45 days	4.71	2.17	6.88	4.88	2.21	7.09
		Untreated check	2.92	1.63	4.55	3.15	2.07	5.22
	48	Pallas 160 cm3 fed-1	8.51	5.13	13.64	8.63	5.16	13.79
		Atlantis 400 cm3 fed-1	7.22	3.53	10.75	7.28	3.65	10.93
		Hand-weeding, at 45 days	4.77	2.37	7.14	4.95	2.46	7.41
		Untreated check	3.1	1.97	5.07	3.12	2.2	5.32
LSD (0.05)			ns	ns	ns	ns	ns	ns

ns= Not significant.

Table 7: Effect of nitrogen and potassium fertilization rates, some weed control treatments and their interactions on plant height (cm) and dry weight (g), for wheat in 2013/14 and 2014/15 seasons

N (kg N fed-1)	K (kg K fed-1)	Weed control	2013/ 2014		2014/ 2015	
			Plant height	Dry weight	Plant height	Dry weight
0			70.9	12.8	76	14.9
45			75.4	16.6	80	18.6
90			78.9	17.4	82.1	19.2
LSD (0.05)			5.4*	1.2**	5.1*	1.3**
	0		73.7	14	75.3	15.4
	24		75.1	16	79.3	17.9
	48		76.4	16.8	83.5	19.4
LSD (0.05)			ns	0.6**	ns	0.7**
		Pallas 160 cm3 fed-1	82.9	18.3	86.6	20
		Atlantis 400 cm3 fed-1	79.8	16.6	83.7	18.5
		Hand-weeding, at 45 days	71.2	14.5	75.9	16.5
		Untreated check	66.4	13.1	71.3	15.2
LSD (0.05)			4.9**	0.4**	5.1**	0.5**
N × K						
0	0		69.7	8.6	71.5	10.2
	24		71	14	76	15.9
	48		71.9	15.9	80.4	18.5
45	0		74.6	16.4	76.7	17.8
	24		75	16.5	79.6	18.5
	48		76.5	16.8	83.6	19.4
90	0		76.8	17	77.8	18.1
	24		79.1	17.5	82.2	19.2
	48		80.7	17.8	86.4	20.2
LSD (0.05)			ns	1.0**	ns	1.1**
N × weed control						
0		Pallas 160 cm3 fed-1	78.5	15.1	82.8	16.9
		Atlantis 400 cm3 fed-1	75.5	13.7	80.1	15.7
		Hand-weeding, at 45 days	67.1	11.9	72.6	14
		Untreated check	62.5	10.7	68.4	12.9
45		Pallas 160 cm3 fed-1	83.2	19.4	87.3	21.2
		Atlantis 400 cm3 fed-1	80.1	17.6	84.4	19.6
		Hand-weeding, at 45 days	71.5	15.4	76.5	17.5
		Untreated check	66.7	13.9	71.8	16
90		Pallas 160 cm3 fed-1	86.9	20.3	89.6	21.9
		Atlantis 400 cm3 fed-1	83.7	18.5	86.6	20.2
		Hand-weeding, at 45 days	74.9	16.2	78.5	18
		Untreated check	69.9	14.6	73.7	16.5
LSD (0.05)			ns	ns	ns	ns
K × weed control						
	0	Pallas 160 cm3 fed-1	81.4	16.4	82.2	17.5
		Atlantis 400 cm3 fed-1	78.3	14.9	79.5	16.2
		Hand-weeding, at 45 days	69.9	13	72	14.5
		Untreated check	65.2	11.7	67.6	13.3
	24	Pallas 160 cm3 fed-1	82.9	18.8	86.5	20.4
		Atlantis 400 cm3 fed-1	79.8	17.1	83.6	18.9
		Hand-weeding, at 45 days	71.2	14.9	75.8	16.8
		Untreated check	66.4	13.4	71.1	15.5
	48	Pallas 160 cm3 fed-1	84.3	19.7	91	22.1
		Atlantis 400 cm3 fed-1	81.2	17.9	88	20.4
		Hand-weeding, at 45 days	72.4	15.6	79.8	18.2
		Untreated check	67.5	14.1	75.1	16.7
LSD (0.05)			ns	ns	ns	ns

* and ** = Significant at 0.05 and 0.01 levels, respectively.
ns= Not significant.

Table 8: The interaction effect between nitrogen fertilization, potassium levels and weed control treatments on protein (%) in plant height (cm) and dry weight (g), for wheat in 2013/14 and 2014/15 seasons

N (kg N fed^{-1})	K (kg K fed^{-1})	Weed control	2013/2014		2014/2015	
			Plant height	Dry weight	Plant height	Dry weight
0	0	Pallas 160 cm^3 fed^{-1}	77.2	10.2	78.0	11.6
		Atlantis 400 cm^3 fed^{-1}	74.2	9.2	75.4	10.7
		Hand-weeding, at 45 days	66.0	7.9	68.4	9.6
		Untreated check	61.4	7.1	64.2	8.9
	24	Pallas 160 cm^3 fed^{-1}	78.6	16.5	82.9	18.2
		Atlantis 400 cm^3 fed^{-1}	75.6	15.0	80.2	16.8
		Hand-weeding, at 45 days	67.3	13.0	72.7	15.0
		Untreated check	62.6	11.7	68.2	13.8
	48	Pallas 160 cm^3 fed^{-1}	79.6	18.6	87.5	21.1
		Atlantis 400 cm^3 fed^{-1}	76.5	16.9	84.7	19.5
		Hand-weeding, at 45 days	68.1	14.7	76.7	17.4
		Untreated check	63.4	13.3	72.8	16.0
45	0	Pallas 160 cm^3 fed^{-1}	82.4	19.2	83.7	20.4
		Atlantis 400 cm^3 fed^{-1}	79.3	17.5	80.9	18.8
		Hand-weeding, at 45 days	70.8	15.2	73.4	16.8
		Untreated check	66.0	13.7	68.9	15.4
	24	Pallas 160 cm^3 fed^{-1}	82.8	19.3	86.9	21.1
		Atlantis 400 cm^3 fed^{-1}	79.7	17.6	84.0	19.5
		Hand-weeding, at 45 days	71.2	15.3	76.2	17.4
		Untreated check	66.4	13.8	71.5	16.0
	48	Pallas 160 cm^3 fed^{-1}	84.4	19.7	91.2	22.2
		Atlantis 400 cm^3 fed^{-1}	81.2	17.9	88.2	20.5
		Hand-weeding, at 45 days	72.5	15.6	79.9	18.2
		Untreated check	67.7	14.1	75.0	16.7
90	0	Pallas 160 cm^3 fed^{-1}	84.6	19.8	84.8	20.6
		Atlantis 400 cm^3 fed^{-1}	81.5	18.0	82.1	19.0
		Hand-weeding, at 45 days	72.9	15.8	74.4	17.0
		Untreated check	68.0	14.2	69.8	15.6
	24	Pallas 160 cm^3 fed^{-1}	87.2	20.5	89.7	22.0
		Atlantis 400 cm^3 fed^{-1}	84.0	18.6	86.7	20.3
		Hand-weeding, at 45 days	75.1	16.3	78.6	18.1
		Untreated check	70.1	14.7	73.7	16.6
	48	Pallas 160 cm^3 fed^{-1}	89.0	20.8	94.3	23.1
		Atlantis 400 cm^3 fed^{-1}	85.7	18.9	91.2	21.3
		Hand-weeding, at 45 days	76.6	16.6	82.6	19.0
		Untreated check	71.6	15.0	77.5	17.4
		LSD (0.05)	ns	ns	ns	ns

ns= Not significant

A- Effect Of Nitrogen Rates:

Data, in Table (9) showed that there were highly significant effects for nitrogen application rates, on wheat grain and straw yields in both seasons. The highest values of these parameters were obtained with 90 kg N fed^{-1}, followed by 45 kg N fed^{-1} in both seasons. The study also, indicated that previous treatments had led to higher yields from control treatment (N_0) by (81.65 and 18.35%) and (75.42 and (16.10%) for wheat grain yield in the first and second seasons, respectively and (95.04 and 23.40%) and (90.07 and 20.53%) for wheat straw yield in the first and second seasons, respectively. This could be attributed to the fact that nitrogen promotes plant growth, which results in a progressive increase in wheat yield. Antoun *et al.* (2010) and Rahimi (2012) stated that nitrogen fertilizer application, at the rates of 119.1, 189.6 and 238.1 kg N ha^{-1}, significantly increased yields and its components of wheat. Increasing of nitrogen fertilization led to increased production of the wheat yield, due to a strong respond to additions of nitrogen, which is regarded as the main factor in the construction amino acids, proteins and enters in many physiological processes in the plant (Wilkinson, 2000).

B- Effect Of Potassium Rates:

Table (9) also, shows that the effect of potassium was highly significant on wheat grain and straw yields in both seasons. The full rate of potassium fertilization (48 kg K fed^{-1}) gave the highest wheat grain and straw yields in both seasons followed by 24 kg K fed^{-1}. The study also, indicates that these treatments had led to higher yields for than the control treatment (K_0) by (40.00 and 24.17%) and (38.28 and 22.66%) for wheat grain yield in the first and second seasons, respectively and (42.5 and 39.62%) and (39.18 and 23.39%), for wheat straw yield in the first and second seasons, respectively. Baque *et al.* (2006) and Rahimi (2012) obtained similar results when they treated wheat plant with potassium levels. Wheat grain and straw yields were increased by increasing potassium fertilizer up to 48 kg K fed^{-1}. This could be due to the limited of the potassium supply slows plant growth and decreases biomass production. Thus, increasing potassium fertilization cause consequently to increase production of grain and straw. These interpretations are matching to Hermans *et al.* (2006) and Rengel and Damon (2008). Pettigrew (2008) pointed that the importance of potassium due to its involvement in many physiological processes. Potassium impact on water relations, photosynthesis, assimilate transport and enzyme activation could have direct consequences on crop productivity.

C- Effect Of Weed Control Treatments:

The effect of weed control treatments were highly significant in grain and straw yields of wheat in both seasons (Table 9). The highest values of wheat yield was obtained by Pallas, Atlantis and hand-weeding, respectively. The study, also, indicates that previous treatments had led to higher yields for than the control treatment (untreated cheek) by (69.52, 48.57 and 35.24%) and (65.79, 44.74 and 30.70%) for wheat grain yield in the first and second seasons, respectively and (67.83, 47.55 and 34.27%) and (63.64, 43.51 and 29.22%) for wheat straw yield in the first and second seasons, respectively. It could be attributed to the effect of Pallas herbicide to reduce weed competition for wheat plant led to increasing the availability of nutrients to the plant, which led to a positive impact on the wheat growth parameters, therefore, increasing wheat yield.

d- Effect Of The Interactions:

Also, data, in Table (9) showed that the interaction was highly significant between nitrogen and potassium fertilization on wheat grain and straw yields in both seasons. The highest values were obtained by applying 90 kg N fed^{-1} with 48 kg K fed^{-1} in both seasons. These results could be attributed to role of nitrogen and potassium in increasing plant growth parameters, therefore, increasing yield. Adnan *et al.* (2016 b) concluded that N application, at the rate of 150 kg ha^{-1}, in combination with 90 kg K_2O ha^{-1}, were optimum for achieving higher yield of wheat.

Furthermore, the interaction effect between nitrogen levels and weed control treatments was highly significant in both seasons for wheat grain and straw yield, (Table 9). Data shows that 90 kg N fed^{-1}, with Pallas herbicide, gave the highest values of wheat grain and straw yields in both seasons. This increase might be due to the interaction between the effects of Pallas herbicide to reduce weed competition for wheat with the full rate of nitrogen fertilization effect, resulting increasing wheat growth parameters, therefore, increasing wheat yield.

Also, data, in (Table 9) showed the interaction effect between potassium fertilization and weed control treatments on wheat grain and straw yields during the two seasons. This interaction effect was significant, at the (5%) level on wheat grain yield in both seasons. While, it was significant on wheat straw yield in both seasons. The highest values of these parameters were obtained when applying 48 kg K fed^{-1} with Pallas herbicide. This increase might be due to the interaction between the effects of the herbicide Pallas to reduce weed competition for wheat with the full rate of potassium fertilization effect resulting increase wheat growth parameters, therefore, increasing wheat yield.

Table (10) shows the interaction effect between the three experimental factors, nitrogen and potassium and weed control treatments. This interaction effect indicates that there is a significant effect on wheat grain and straw yields in both seasons. While, data in Figs 1 and 2, showed that the applying of the following treatments: N_{90}×K_{48}×Pallas, N_{90}×K_{48}×Atlantis, N_{90}×K_{24}×Pallas, N_{90}×K_{48}×Hand-weeding, N_{90}×K_{24}× Atlantis, and N_{90}×K_{24}× Hand-weeding, respectively gave the highest values of wheat grain (Fig. 1, A1 and A2) and straw (Fig. 2, A1 and A2) yield in the first and second seasons, respectively. The study, also, indicates that these treatments had led to higher yields for than the control treatment (N_0×K_0×untreated) by (329 and 316%), (284 and 268%), (283 and 267%), (252 and 233%), (238 and 224%) and (203 and 184%), for wheat grain yield in the first and second seasons, respectively and (363 and 354%), (315 and 301%), (311 and 300%), (280 and 263%), (263 and 254%) and (226 and 209%), for wheat straw yield in first and second seasons respectively. On the other hand, the study also indicates that previous treatments had led to higher yields for N_{90}×K_{48}×untreated by (86 and 87%), (67 and 65%), (66 and 65%), (53 and 50%), (47 and

46%) and (31 and 28%), for wheat grain yield in the first and second seasons, respectively and (86 and 87%), (67 and 65%), (66 and 65%), (53 and 49%), (46 and 45%) and (31 and 27%), for wheat straw yield in the first and second seasons respectively. These results indicates that superiority of Pallas herbicide, following by Atlantis herbicide over the other treatments of weed control for led to strong growth parameters of wheat, therefore increasing wheat yield. These results could be due to the large impact of interactive fertilize nitrogen and potassium on raising growth parameters and thus, a reflection of this effect on the crop, especially, with Pallas herbicide, which reduced weed competition to wheat plants in obtaining nutrients from the soil, such as nitrogen and potassium.

Protein Percentage And Yield (Kg $_{\text{Gain Protein}}$ Fed^{-1}) Of Wheat Grains.

Data, in Tables (9) and (10) showed the effect of nitrogen fertilization, potassium rates, some weed control treatments and their interactions on protein (%) and protein yield of wheat grains in both seasons.

A- Effect Of Nitrogen Rates:

Data, in Table (9) showed that there were no significant effects for nitrogen application rates on protein (%), but, it was highly significant on grain protein yield in both seasons. The highest values of these parameters were obtained with 90 kg N fed^{-1}. Increasing nitrogen fertilization led to increased production of the wheat yield due to a strong respond to additions of nitrogen, which is regarded as the main nutrient in the construction amino acids, proteins and enters in many physiological processes in the plant (Wilkinson, 2000). (Asseng and Milroy, 2006; Pathak *et al.*, 2008 and Acreche and Slafer, 2009) reported that nitrogen element is responsible for protein synthesis in plants.

B- Effect Of Potassium Rates:

Also, data, in Table 9 showed that the effect of potassium rates was not significant on protein (%) but, highly significant on grain protein yield in both seasons. The highest values of these parameters were obtained with 48 kg K fed^{-1}. This effect might be attributed to potassium element is being the most abundant cation in the cells, K has a pivotal role in the protein synthesis (Szczerba *et al.*, 2009; Römheld and Kirkby, 2010 and Benito *et al.*, 2014).

C- Effect Of Weed Control Treatments:

The effect of weed control treatments were not significant on protein (%), but, it was highly significant on grain protein yield per feddan in both seasons (Table 9). The highest values of protein (%) and grain protein yield were obtained by Pallas, Atlantis, hand-weeding and untreated check, respectively. It could be attributed to the effect of Pallas herbicide to reduce weed competition with wheat plants, and led to increasing the availability of nutrients to the plant, such as nitrogen, which led to a positive impact on protein content in wheat grains.

D- Effect Of The Interactions:

Also, data, in Table (9) showed that the interaction was not significant between nitrogen and potassium fertilizations for protein (%) in wheat grain, while protein yield of wheat grains was highly significantly increased by this effect in the first and second seasons. The highest values of protein (%) and protein yield of wheat grains were obtained by applying 90 kg N fed^{-1} with 48 kg K fed^{-1} in both seasons.

The interaction effect between nitrogen levels and weed control treatments indicates no significant effect in protein (%), but, it was highly significant in grain protein yield in the first and the second seasons. Data showed that 90 kg N fed^{-1}, with Pallas herbicide, gave the highest values of protein (%) and protein yield of wheat grains in both seasons (Table 9).

Also, the data, in Table (9) showed that the interaction effect was not significant between potassium fertilization and weed control treatments on protein (%) and protein yield of wheat grains during both seasons. The highest values of these parameters were obtained when applying 48 kg K fed^{-1} with Pallas herbicide.

Moreover, Table 10 shows the interaction effect between the three experimental factors, nitrogen, potassium and weed control treatments. This interaction indicates that there is no significant effect on protein (%) in both seasons, but, it was significant, at (5%) level. Also, it was not significant in grain protein yield in both season. Also, data showed that applying the following treatments: N_{90}×K_{48}×Pallas, N_{90}×K_{48}× Atlantis, N_{90}×K_{48}×Hand-weeding, N_{45}×K_{48}×Pallas, N_{90}×K_{24}×Pallas and N_{45}×K_{48}×Atlantis, respectively gave the highest values of protein (%) of wheat grains in the first and second seasons, respectively. While, the highest values of protein yield of wheat grains in both seasons were obtained with the following treatments: N_{90}×K_{48}×Pallas, N_{90}×K_{48}×Atlantis, N_{90}×K_{24}× Pallas, N_{90}×K_{48}×Hand-weeding, N_{90}×K_{24}×Atlantis and N_{90}× K_{24}×Hand-weeding in the first and second seasons, respectively. These results indicate the superiority of Pallas herbicide followed by Atlantis over the other treatments of weed control for protein content in wheat grains. These results might be due to the large impact of interactive nitrogen and potassium fertilizers on increasing protein contents in wheat grains, thus, a reflection of this effect on the crop quality, especially with Pallas herbicide, which reduce of weed competition to plant wheat in obtaining nutrients from the soil, such as nitrogen and potassium.

Table 9: Effect of nitrogen fertilization, potassium rates, some weed control treatments and their interactions on grain and straw yields (t fed^{-1}), protein (%) in grain and grain protein yield (kg Protein fed^{-1}) for wheat in both seasons for wheat in 2013/14 and 2014/15 seasons

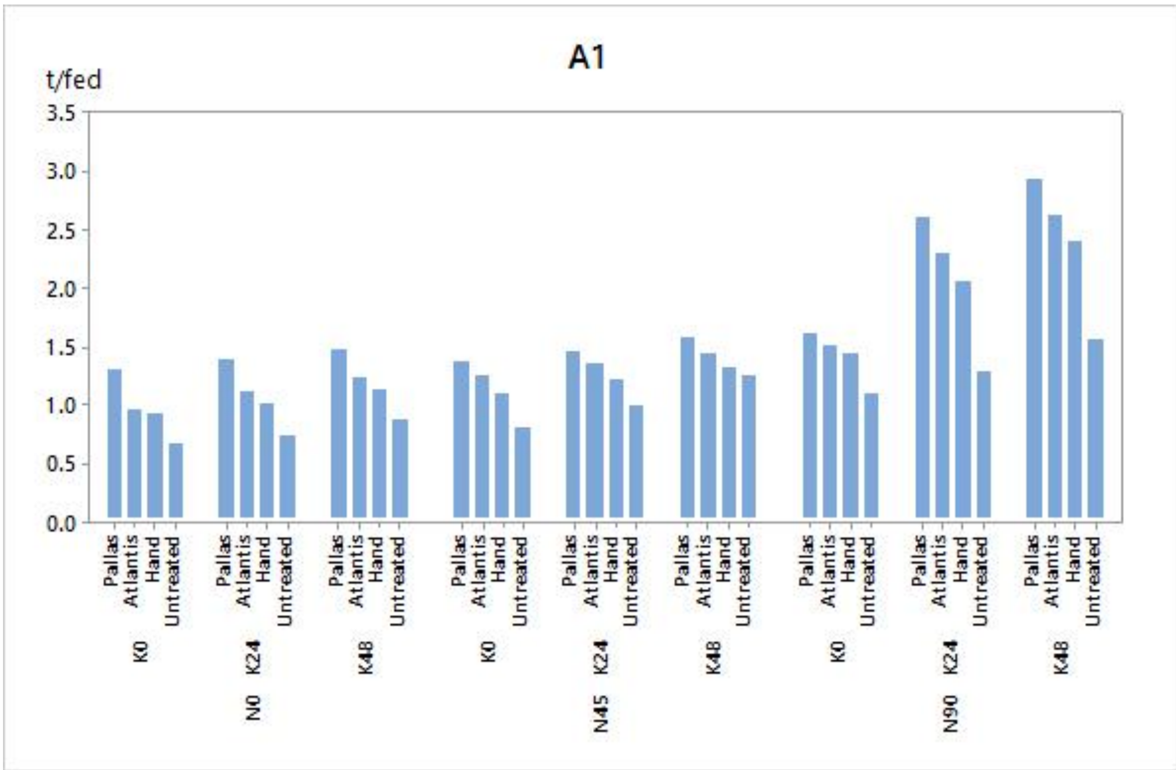
Treatments		Weed control	2013/ 2014				2014/ 2015			
N (kg N fed^{-1})	K (kg K fed^{-1})		Grain yield	Straw yield	Grain protein (%)	Protein yield	Grain yield	Straw yield	Grain protein (%)	Protein yield
0			1.09	1.41	10.31	114.5	1.18	1.51	10.35	123.2
45			1.29	1.74	10.73	139.2	1.37	1.82	10.77	147.4
90			1.98	2.75	11.08	221.6	2.07	2.87	11.12	232.1
LSD (0.05)			0.25**	0.60**	ns	41.8**	0.06**	0.76**	ns	84.8**
	0		1.2	1.6	10.48	127.4	1.28	1.71	10.51	136
	24		1.49	2.02	10.66	160.7	1.57	2.11	10.71	169.3
	48		1.68	2.28	10.98	187.2	1.77	2.38	11.02	197.2
LSD (0.05)			0.06**	0.15**	ns	30.5**	0.08**	0.20**	ns	35.0**
		Pallas 160 cm3 fed-1	1.78	2.4	10.98	197.6	1.89	2.52	11.02	209.2
		Atlantis 400 cm3 fed-1	1.56	2.11	10.81	170.9	1.65	2.21	10.85	180
		Hand-weeding, at 45 days	1.42	1.92	10.65	154.7	1.49	1.99	10.68	161.5
		Untreated check	1.05	1.43	10.38	110.6	1.14	1.54	10.43	119.4
LSD (0.05)			0.10**	0.11**	ns	18.4**	0.11**	0.13**	ns	22.0**
N × K										
0	0		0.99	1.27	10.13	104	1.07	1.36	10.14	112
	24		1.09	1.41	10.31	112.8	1.17	1.48	10.34	120.5
	48		1.2	1.56	10.49	126.6	1.3	1.69	10.55	137
45	0		1.16	1.55	10.49	121.9	1.25	1.66	10.51	131.2
	24		1.28	1.74	10.65	137	1.35	1.81	10.7	144.8
	48		1.43	1.93	11.06	158.8	1.5	1.99	11.09	166.1
90	0		1.44	1.99	10.82	156.3	1.52	2.11	10.86	164.9
	24		2.09	2.91	11.04	232.3	2.19	3.02	11.07	242.7
	48		2.41	3.35	11.39	276.2	2.51	3.47	11.43	288.6
LSD (0.05)			0.11**	0.26**	ns	52.8**	0.13**	0.34**	ns	60.6**
N × weed control										
0		Pallas 160 cm3 fed-1	1.42	1.84	10.51	149.6	1.53	1.95	10.57	161.4
		Atlantis 400 cm3 fed-1	1.13	1.46	10.36	117.3	1.23	1.59	10.4	127.6
		Hand-weeding, at 45 days	1.04	1.34	10.23	110.2	1.11	1.42	10.26	117.4
		Untreated check	0.78	1.01	10.13	80.8	0.83	1.08	10.14	86.3
45		Pallas 160 cm3 fed-1	1.51	2.02	11.08	167.1	1.6	2.12	11.1	176.8
		Atlantis 400 cm3 fed-1	1.38	1.86	10.87	150.6	1.46	1.93	10.89	157.6
		Hand-weeding, at 45 days	1.23	1.65	10.66	131.4	1.29	1.71	10.67	138.3
		Untreated check	1.04	1.42	10.32	107.9	1.13	1.52	10.41	116.7
90		Pallas 160 cm3 fed-1	2.42	3.35	11.36	276.1	2.53	3.5	11.39	289.3
		Atlantis 400 cm3 fed-1	2.17	3.02	11.21	244.7	2.26	3.12	11.25	254.8
		Hand-weeding, at 45 days	2	2.77	11.08	222.5	2.05	2.83	11.11	228.8
		Untreated check	1.34	1.85	10.68	143	1.45	2.01	10.74	155.3
LSD (0.05)			0.17**	0.19**	ns	31.8**	0.20**	0.23**	ns	38.1**
K × weed control										
	0	Pallas 160 cm3 fed-1	1.46	1.95	10.71	156.8	1.57	2.08	10.73	167.4
		Atlantis 400 cm3 fed-1	1.27	1.71	10.58	135.1	1.33	1.77	10.62	141.4
		Hand-weeding, at 45 days	1.17	1.57	10.36	125.8	1.24	1.65	10.39	132.2
		Untreated check	0.88	1.17	10.25	91.9	0.99	1.32	10.28	103.1
	24	Pallas 160 cm3 fed-1	1.85	2.5	10.93	204.2	1.96	2.62	10.97	215.6
		Atlantis 400 cm3 fed-1	1.62	2.19	10.75	175.9	1.71	2.3	10.78	185.5
		Hand-weeding, at 45 days	1.45	1.96	10.6	155.3	1.49	2	10.62	160.1
		Untreated check	1.03	1.41	10.37	107.4	1.11	1.51	10.46	116.2
	48	Pallas 160 cm3 fed-1	2.03	2.75	11.31	231.7	2.13	2.86	11.36	244.5
		Atlantis 400 cm3 fed-1	1.8	2.44	11.11	201.7	1.9	2.57	11.15	213.2
		Hand-weeding, at 45 days	1.64	2.23	11	183	1.73	2.31	11.03	192.3
		Untreated check	1.25	1.7	10.51	132.4	1.32	1.78	10.55	139
LSD (0.05)			0.17*	0.19**	ns	ns	0.20*	0.23**	ns	ns

* and ** = Significant at 0.05 and 0.01 levels, respectively.
ns= Not significant.

Table 10: The interaction effect between nitrogen fertilization, potassium rates and weed control treatments on Grain and straw Yield (t fed^{-1}), protein (%) in grain and grain protein yield (kg Protein fed^{-1}) for wheat in 2013/14 and 2014/15 seasons

N (kg N fed^{-1})	K (kg K fed^{-1})	Weed control	2013/2014				2014/2015			
			Grain yield	Straw yield	Grain protein (%)	Protein yield	Grain yield	Straw yield	Grain protein (%)	Protein yield
0	0	Pallas 160 cm^3 fed^{-1}	1.32	1.70	10.23	135.2	1.46	1.86	10.26	148.7
		Atlantis 400 cm^3 fed^{-1}	0.99	1.28	10.19	101.0	1.06	1.35	10.21	108.0
		Hand-weeding, at 45 days	0.94	1.21	10.08	105.7	0.99	1.26	10.09	109.6
		Untreated check	0.69	0.89	10.01	74.0	0.75	0.95	10.01	81.5
	24	Pallas 160 cm^3 fed^{-1}	1.43	1.85	10.52	150.7	1.53	1.95	10.58	161.2
		Atlantis 400 cm^3 fed^{-1}	1.14	1.47	10.35	118.0	1.25	1.59	10.39	129.8
		Hand-weeding, at 45 days	1.03	1.33	10.22	105.4	1.08	1.37	10.25	110.5
		Untreated check	0.76	0.98	10.13	77.2	0.80	1.02	10.15	80.7
	48	Pallas 160 cm^3 fed^{-1}	1.51	1.96	10.78	162.8	1.60	2.04	10.88	174.3
		Atlantis 400 cm^3 fed^{-1}	1.26	1.64	10.54	132.8	1.37	1.82	10.61	145.1
		Hand-weeding, at 45 days	1.15	1.49	10.39	119.5	1.27	1.62	10.44	132.0
		Untreated check	0.89	1.16	10.24	91.2	0.95	1.26	10.27	96.6
45	0	Pallas 160 cm^3 fed^{-1}	1.41	1.88	10.86	153.1	1.52	2.01	10.89	164.8
		Atlantis 400 cm^3 fed^{-1}	1.28	1.71	10.65	136.3	1.33	1.76	10.67	141.2
		Hand-weeding, at 45 days	1.11	1.48	10.29	114.2	1.20	1.59	10.30	122.8
		Untreated check	0.83	1.11	10.15	84.2	0.96	1.27	10.19	96.2
	24	Pallas 160 cm^3 fed^{-1}	1.49	2.00	10.99	163.7	1.59	2.11	11.02	174.9
		Atlantis 400 cm^3 fed^{-1}	1.39	1.87	10.72	149.1	1.46	1.94	10.74	155.4
		Hand-weeding, at 45 days	1.23	1.65	10.56	129.9	1.27	1.68	10.58	135.1
		Untreated check	1.02	1.42	10.32	105.2	1.09	1.51	10.47	113.7
	48	Pallas 160 cm^3 fed^{-1}	1.62	2.18	11.39	184.5	1.68	2.23	11.40	190.7
		Atlantis 400 cm^3 fed^{-1}	1.48	1.99	11.25	166.6	1.58	2.09	11.26	176.3
		Hand-weeding, at 45 days	1.35	1.82	11.12	150.1	1.41	1.87	11.12	157.0
		Untreated check	1.28	1.72	10.49	134.2	1.34	1.78	10.57	140.4
90	0	Pallas 160 cm^3 fed^{-1}	1.65	2.28	11.05	182.1	1.72	2.38	11.05	188.7
		Atlantis 400 cm^3 fed^{-1}	1.54	2.13	10.91	168.0	1.59	2.20	10.99	175.1
		Hand-weeding, at 45 days	1.47	2.03	10.71	157.5	1.53	2.11	10.77	164.2
		Untreated check	1.11	1.51	10.59	117.5	1.25	1.73	10.64	131.6
	24	Pallas 160 cm^3 fed^{-1}	2.64	3.66	11.29	298.2	2.75	3.80	11.31	310.6
		Atlantis 400 cm^3 fed^{-1}	2.33	3.23	11.18	260.5	2.43	3.36	11.20	271.2
		Hand-weeding, at 45 days	2.09	2.90	11.03	230.6	2.13	2.94	11.03	234.5
		Untreated check	1.31	1.83	10.66	139.8	1.44	1.99	10.75	154.4
	48	Pallas 160 cm^3 fed^{-1}	2.96	4.12	11.75	347.8	3.12	4.31	11.81	368.6
		Atlantis 400 cm^3 fed^{-1}	2.65	3.69	11.53	305.6	2.76	3.81	11.57	318.0
		Hand-weeding, at 45 days	2.43	3.38	11.49	279.5	2.50	3.45	11.53	287.8
		Untreated check	1.59	2.21	10.79	171.8	1.67	2.31	10.82	180.0
		LSD (0.05)	0.29^{**}	0.32^{**}	ns	55.1^{*}	0.34^{**}	0.39^{**}	ns	ns

* and ** = Significant at 0.05 and 0.01 levels, respectively.
ns= Not significant.



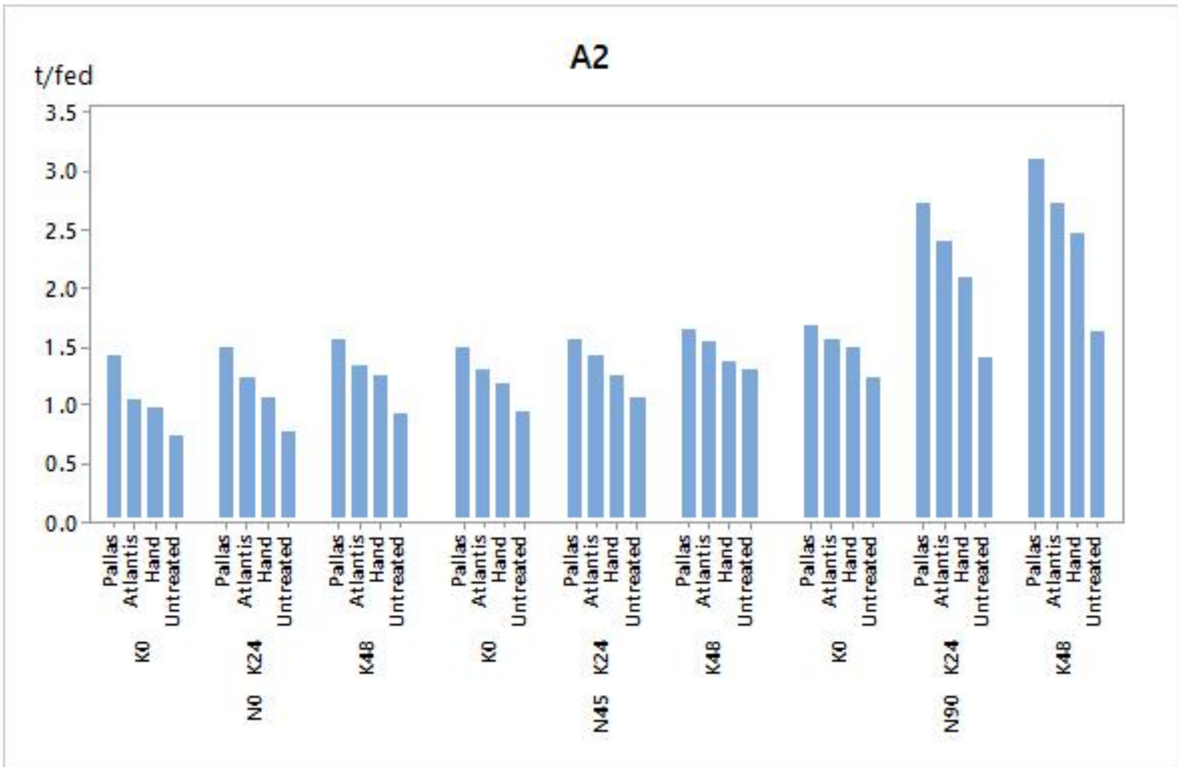
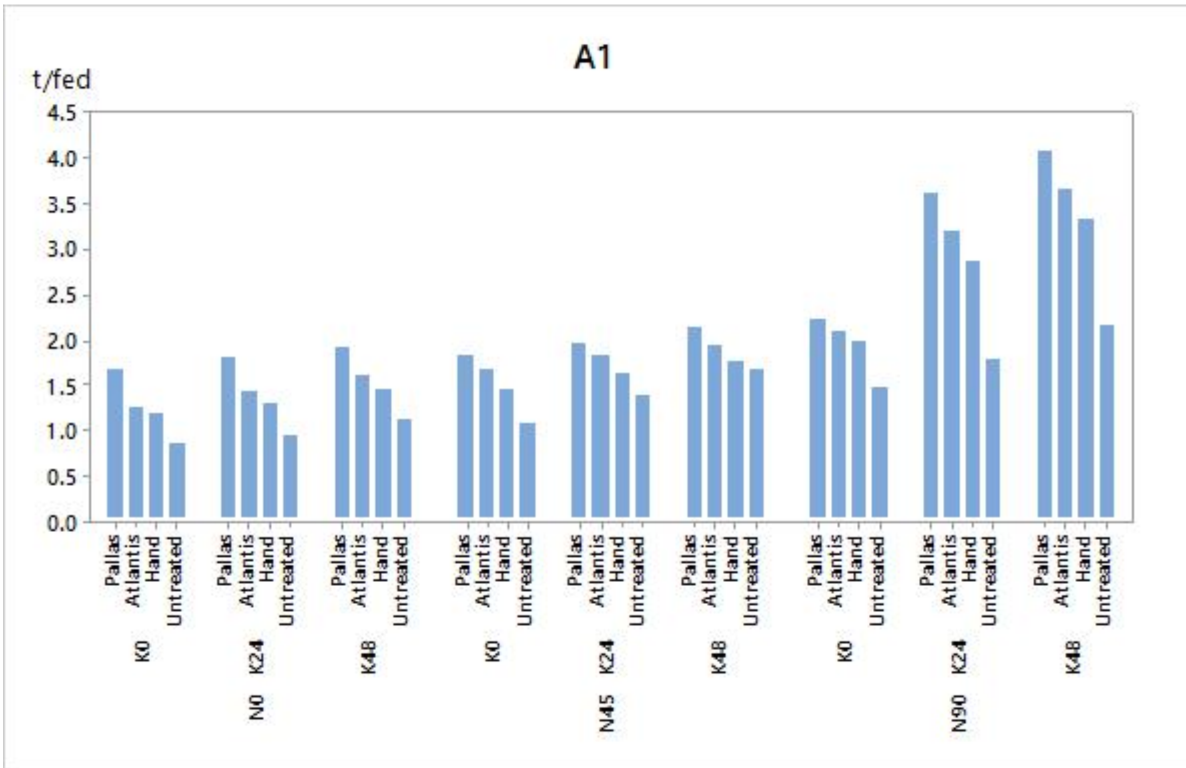


Fig. 1: Interaction effect between nitrogen fertilization, potassium levels and weed control treatments on wheat grain yield (t fed^{-1}) in 2013/2014 (A1) and 2014/2015 (A2) seasons.



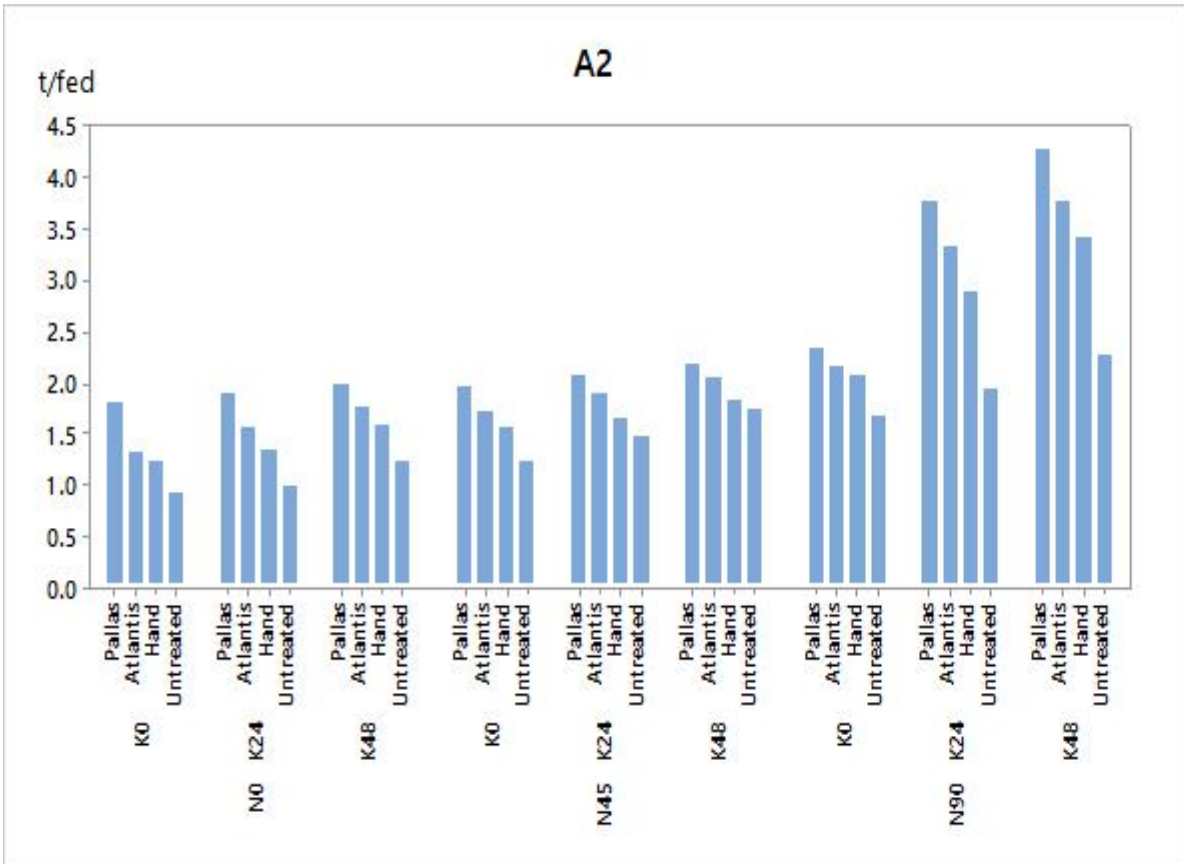


Fig. 2: Interaction effect between nitrogen fertilization, potassium levels and weed control treatments on wheat straw yield (t fed^{-1}) in 2013/2014 (A1) and 2014/2015 (A2) seasons.

Anatomical features

Data, in Table (11) and Fig. (3) showed that there were significant effects of N90 + K48 fertilization with weed control treatments on flag leaf anatomical features of wheat plant after 90 DFS. N90 + K48 fertilization with Pallas herbicide exceeded the rest of the other weed practices for enhancing leaf thickness in the keel region, mesophyll tissue thickness, large vascular bundle dimension (length and width), xylem tissue thickness and metaxylem vessel diameter, respectively. N90 + K48 fertilization and Atlantis herbicide come in the second rank, followed by that of N90 + K48 fertilization with hand-weeding once after 45 days from sowing. While, N90 + K48 fertilization with Pallas and Atlantis herbicides exceeded the rest of other weed practices for enhancing phloem tissue thickness, (Figure 3) clarified the differences between the anatomical sectors.

On the other hand, the unweeded treatment gave the lowest values of previous characters. These results suggest that elimination of weeds by Pallas, Atlantis and hand-weeding once can minimize weed competition and consequently, improve photosynthetic fluid assimilates in the phloem on one side and in the other side, nutrient uptake from soil and consequently, enhance source and sink apparatus of wheat plant. Many researchers mentioned that flag leaf was considered as one main source of assimilate in this situation for carbohydrate storage in grains and finally, increasing productively.

CONCLUSION

It could be concluded that the important role of nitrogen and potassium with weed control in wheat production. Applying of 90 kg N fed^{-1} + 48 kg K fed^{-1} + herbicide Pallas (Pyroxsulam) gave the highest wheat grain and straw yield from (N0 + K0 + untreated check) by (316 to 329%) and (354 to 363 %), respectively and from (N90 + K48 + untreated check) by (86 to 87%) and (86 to 87%), respectively. It is therefore preferable to use 90 kg N fed^{-1} + 48 kg K fed^{-1} with Pallas herbicide for economic crop of wheat especially in saline soil.

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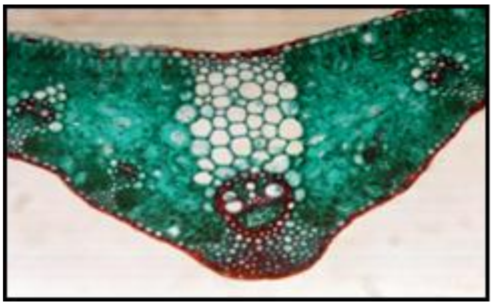
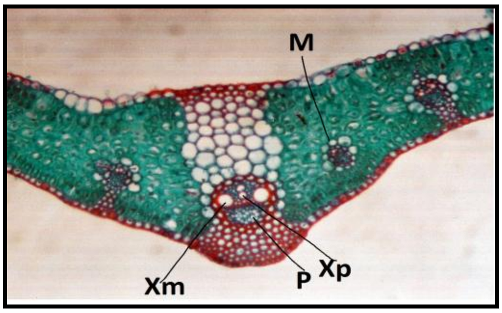
Table 11: Effect of nitrogen levels, potassium fertilization and weed control treatments on anatomical studies the flag leaf blade of wheat plants after 90 DAS during 2014/2015 season

Treatments Characters	Leaf thickness in the keel region (mm)	Mesophyll tissue thickness (mm)	Large V.B. dimension (mm)		Xylem tissue thickness (mm)	Phloem tissue thickness (mm)	Met xylem vessel diameter (mm)
			Length	Width			
1 - N90 + K48 with Pallas herbicide	624	588	178	180	96	82	54
2 – N0 + K0 with Pallas herbicide	530	504	176	170	92	84	46
3 – N90 + K48 with Atlantis herbicide	566	510	174	172	94	80	50
4 - N0 + K0 with Atlantis herbicide	516	496	166	160	84	82	42
5 – N90 + K48 with hand-weeding once	492	468	158	160	80	78	40
6 - N0 + K0 with hand-weeding once	410	380	152	148	82	70	36
7 – N90 + K48 with unweeded control	382	350	150	110	78	72	32
8 - N0 + K0 with unweeded control	360	320	144	90	78	66	30
LSD (0.05)	26.49	11.52	7.66	7.91	8.25	7.14	5.78



1- N_{90} + K_{48} with Pallas herbicide



2- N_0 + K_0 with Pallas herbicide

3- N_{90} + K_{48} with Atlantis herbicide

4- N_0 + K_0 with Atlantis herbicide

5- N_{90} + K_{48} with hand-weeding once

6- N_0 + K_0 with hand-weeding once

7- N_{90} + K_{48} with unweeded control

8- N_0 + K_0 with unweeded control

Figure 3: Cross sections in the leaves of wheat plants with which N_{90}+K_{48} and N_0+K_0 fertilization with weed control treatments by the herbicides of Pallas, Atlantis and hand-weeding once (1, 2,3,4,5 and 6) compared with N_{90}+K_{48} and N_0+K_0 fertilization with Unweeded control (7 and 8). M, mesophyll; P, phloem; Xm, metaxylem; Xp, protoxylem; X, xylem. All, X100.

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الملخص العربي

تأثير التسميد النتروجيني والبوتاسي ومعاملات مكافحة الحشائش علي انتاجية القمح والحشائش المصاحبة له تحت ظروف الأراضى الملحية بشمال دلتا مصر

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أقيمت تجربتان حقليتان علي تربة طينية ملحية، بمحطة البحوث الزراعية بالسرو، مركز البحوث الزراعية بمحافظة دمياط – مصرخلال الموسمين الشتويين ٢٠١٤/٢٠١٣ و٢٠١٥/٢٠١٤ لدراسة تأثير التسميد المعدنى النيتروجينى والبوتاسى وبعض معاملات مكافحة الحشائش على نمو القمح والمحصول وصبغات البناء الضوئى ومحتوى حبوب القمح من البروتين وكذلك على الدراسة التشريحة لورقة العلم لنبات القمح (صنف سخا٩٣) وكذلك على الحشائش المصاحبة. أقيمت التجربتين فى تصميم القطع المنشقة مرتين مع أربع مكررات. واشتملت القطع الرئيسية على معاملات التسميد المعدنى النيتروجينى (٠، ٤٥ و٩٠ كجم ن فدان$^{-١}$). واشتملت القطع المنشقة على معاملات التسميد المعدنى البوتاسى (٠، ٢٤ و٤٨ كجم بو فدان$^{-١}$). بينما اشتملت القطع التحت تحت رئيسية على معاملات مكافحة الحشائش (مبيد بلاس (بيروكسلام)، مبيد أتلانتس (ميزوسلفرون)، النقاوة اليدوية (مره واحدة) عند ٤٥ يوم من الزراعة ومعاملة المقارنة).

أوضحت النتائج ان ارتفاع مستوى التسميد المعدنى النيتروجينى الى ٩٠ كجم ن فدان$^{-١}$ والتسميد المعدنى البوتاسى الى ٤٨ كجم بو فدان–١ أعطت أعلى القيم للوزن الجاف الكلى للحشائش العريضة الأوراق والنجيلية بعد ٦٠ و ٩٠ يوم من زراعة القمح، وكذلك أعطت أعلى القيم لارتفاع النبات (سم) والوزن الجاف لنبات القمح (جم) ومحتوى اوراق القمح من صبغات البناء الضوئى ومحصول الحبوب والقش للقمح (طن فدان$^{-١}$) وكذلك محتوى الحبوب من البروتين. بينما أعطى إستخدام مبيد الحشائش بلاس (بيروكسلام)، مبيد أتلانتس (ميزوسلفرون) و النقاوة اليدوية (مرة واحدة) أعطت أعلى النتائج في المؤشرات السابقة ما عدا الوزن الجاف الكلى للحشائش العريضة الأوراق والنجيلية التي حدث فيها انخفاض عالي بعد ٦٠ و٩٠ يوم من زراعة القمح علي التوالي. ومن ناحية أخرى كان تأثير التفاعل بين مستويات التسميد المعدنى النيتروجينى والبوتاسى مع معاملات مكافحة الحشائش كان غير معنوي لكل الصفات لنبات القمح والحشائش العريضة الأوراق والنجيلية ما عدا محصول حبوب وقش القمح حيث زادت زيادة معنوية في الموسمن، أيضا محصول بروتين حبوب القمح زادت معنويا فى الموسم الأول. أيضا بينت الدراسة ان معاملة ٩٠ كجم ن فدان–١ +

٤٨ كجم بو فدان−١ + مبيد حشائش بلاس (بيروكسلام) أعطت أعلى القيم من محصول حبوب وقش القمح عن معاملة (٠ كجم ن فدان−١ + ٠ كجم بو فدان−١ + غير المعاملة) بـ (٣٢٩ و٣١٦%) و(٣٦٣ و٣٥٤%) وعن معاملة (٩٠ كجم ن فدان−١ + ٤٨ كجم بو فدان−١ + الغير معاملة) بـ (٨٦ و٨٧%) و(٨٦ و٨٧%) فى الموسم الأول والثانى على التوالى. لهذا يفضل استخدام ٩٠ كجم ن فدان$^{-١}$ + ٤٨ كجم بو فدان$^{-١}$ + مبيد حشائش بلاس (بيروكسلام) للحصول على انتاج اقتصادى من القمح مع جودة حبوب عالية عند زراعتة فى الأراضى المتأثرة بالأملاح بشمال دلتا مصر.

أكدت الدراسة التشريحية لنبات القمح علي ورقة العلم بعد ٩٠ يوم من الزراعة باستخدام المستوي الأعلي للتسميد المعدنى النيتروجينى والبوتاسى مع معاملات مكافحة الحشائش كانت أعطت تحسنا كبيرا وتاثيرها إيجابى على نمو النباتات وتحسين جميع الصفات تحت الدراسة. وتشيرهذه النتائج إلى أن القضاء على الحشائش الضارة بواسطة مبيد الحشائش مبيد بلاس (بيروكسلام)، مبيد أتلانتس (ميزوسلفرون) والنقاوة اليدوية مره واحدة يمكن معها تقليل منافسة الحشائش لنبات القمح وبالتالى تحسين حركة العصارة فى الأوعية اللحائية لنبات القمح من جانب ومن جانب آخر امتصاص العناصر الغذائية من التربة وبالتالى تعزيز نمو نبات القمح.