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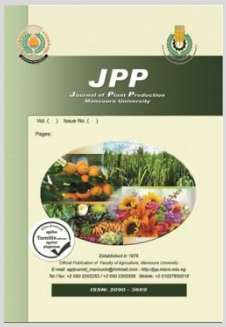
Consequence of Foliar Application Treatments with Npk on Productivity of Bread Wheat

Jazran Jard Kadhim[1*] and S. E. Seadh[2]

[1]Ministry of Education, Department of Vocational Education, Babil, Iraq.
[2]Agronomy Department, Faculty of Agriculture, Mansoura University, Egypt.



ABSTRACT

A field experiment was conducted during 2020/2021 winter season in a special field South of Baghdad in the district of Kothi (Jableh) Al-Hamiri region, North of Babil Governorate, to study consequence of some foliar appliance treatments by way of nitrogen, phosphorus in addition to potassium (NPK) on productivity of bread wheat Ibaa-99 cultivar. The experiment was conducted in a Randomized Complete Block Design (RCBD) in three replications. The considered foliar application treatments were as follows; without spraying, spraying with nitrogen at 4000 mg L^{-1}, phosphorous at 2000 mg L^{-1}, potassium at 4000 mg L^{-1} and the mixture of nitrogen, phosphorous and potassium. Spraying wheat plants with the mixture of nitrogen (4000 mg L^{-1}), phosphorous (2000 mg L^{-1}) and potassium (4000 mg L^{-1}) fertilizers significantly increased growth, yield and its components as compared with other studied foliar application treatments. The second-best foliar application treatment was spraying wheat plants with nitrogen at 4000 mg L^{-1}, go after by spraying plants with K at 4000 mg L^{-1}, then spraying plants with P at 2000 mg $L^{-1}$and lastly control treatment (without foliar application). It may well be decided that spraying wheat plants with the mixture of nitrogen at 4000 mg L^{-1}, phosphorous at 2000 mg L^{-1} and potassium at 4000 mg L^{-1} to improve growth, yield and its components of bread wheat Ibaa-99 cultivar under the environmental conditions of studying area stage under the environmental conditions of studying area.

Keywords: Wheat, foliar application, NPK, productivity.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the major source of food for human nutrition and most widely grown crop in the world with its unique protein characteristics and serves as an important source of food and energy (Abedi *et al.*, 2010). Also, it is easily processed into various types of food like bread, macaroni, biscuit and sweets besides useful as a livestock feed. It is also ranked first in the world in terms of production, where its cultivated area globally reached 219.006 millions hectares produced about 760.925 millions tons and in Iraq reached 2.143 millions hectares produced about 6.238 millions tons (FAO, 2022). The low productivity per unit area is one of the main problems which faces increasing production of wheat and achieving self-sufficiency in this crop in Iraq. Therefore, it is necessary to work on raising the efficiency of production by providing nutrients necessary for germination, using modern technologies, the use of fertilizers and methods of adding and employing them in the agricultural field, which contributes to increasing production and improving its quality.

The leaf is the basis in the process of photosynthesis and most other vital processes, so the deficiency of these elements appears first on the leaves, so the fastest way to address this deficiency is to add nutrients to the areas of deficiency directly, through foliar application. Foliar application is one of the quick ways to compensate the lack of elements, which ensures the distribution of nutrients on the vegetable growth in a more homogeneous manner compared to adding nutrients to the soil, and it is characterized as the fastest and most efficient way to meet the requirements of cereals crops, including wheat, from NPK compared to adding fertilizer to the soil. The vegetative phase requires large quantities of the NPK elements, although the rate of absorption of these elements exceeds the rate of formation of the different parts of the plant and with the completion of the formation of the vegetative growth, the efficiency of the root system decreases in covering the requirements of the newly formed parts of the nutrients necessary in building the developing shoots of the plant, especially in the cereals, including wheat (Hamad and Jumaa, 2000).

Wheat crop is incredibly susceptible to insufficient nitrogen and awfully receptive to nitrogen fertilization (David *et al.*, 2005). Phosphorus fertilizer is noteworthy for plant growth, particularly in the untimely jointing stages and for attractive grain yield (Marschner, 1995). Potassium is imperative plant nutrient to maintain towering productivity and quality, in symmetry with supplementary essential plant nutrients (Yu-ying and Hong, 1997), so it is imperative to make sure sufficient NPK for wheat. Taaban (2002) found that spraying with N and K fertilizers after 30, 70 and 90 days of planting achieved significant increases in the amount of NPK absorbed at full maturity and dry grain weight. Abd El-Ghany*et al.* (2013) indicated that the foliar application of macronutrients caused a significant consequence on some of growth parameters and yield components during the two growing seasons. In addition, some nutrient of wheat grains content*i.e.* potassium, zinc, manganese and cupper were significantly increased due to foliar application of macronutrients. Seadh *et al.* (2015)

* **Corresponding author.**
E-mail address: jazranjr98@gmail.com
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showed that foliar with 10.0 ml potassium silicate L^{-1} was the best treatment, which significantly increased growth, productivity and grain quality of wheat under newly reclaimed sandy saline soils conditions. Foliar spraying with nitrogen and potassium fertilizers contributes to delaying the aging of wheat plants, as spraying these two fertilizers on the vegetative system contributes effectively to keeping its leaves active in the photosynthesis process until reaching full maturity, as well as, on regulating the movement of mobile elements, especially nitrogen, phosphorous and potassium between the old and new leaves in a balanced way, while enhancing the ability of the roots to absorb these elements from the soil solution (Coskun *et al*., 2019).

Consequently, this examination was established to decide the consequence of some foliar appliance treatments with NPK on productivity of bread wheat Ibaa-99 cultivarunder the ecological circumstances of North of Babil Governorate, Iraq.

MATERIALS AND METHODS

A field experiment was performed during the agricultural winter season of 2020/2021in a special field south of Baghdad in the district of Kothi (Jableh) Al-Hamiri region, North of Babil Governorate, to revise the consequence of some foliar appliance treatments with nitrogen, phosphorus along with potassium (NPK) on productivity of bread wheatIbaa-99 cultivar. The experiment was conducted in asilty mixture of soil, where its physical and chemical properties are shown in Table 1.

Table 1. Physical and chemical soil characteristics of the experimental site during 2020/2021 season.

Physical characteristics						
Properties Seasons	Sand(gkg^{-1} soil)		Silt(g kg^{-1} soil)	Clay(g kg^{-1} soil)		Soil texture
2021/2022	332.0		578.5	90.0		Silty mixture
Chemical characteristics						
Properties	pH soil	EC	Organic matter	Available nutrients (mg kg^{-1} soil)		
Seasons	paste	dSm^{-1}	(g kg^{-1} soil)	N	P	K
2021/2022	7.15	3.32	6.25	28.11	8.52	82.65

The research was carried out in a randomized complete block design (RCBD) in three replications. The studied foliar appliance treatments with nitrogen, phosphorus and potassium (NPK) and its symbols were as pursues;

C- Without spraying (control treatment).

N- Spraying with nitrogen (urea "46.0 % N" fertilizer) at a concentration of 4000 mg L^{-1}.

P- Spraying with phosphorous (triple calcium superphosphate "20-24 % P_2O_5" fertilizer) at a concentration of 2000 mg L^{-1}.

K- Spraying with potassium (potassium sulphate "41.5 % K_2O" fertilizer) at a concentration of 4000 mg L^{-1}.

NPK- Spraying with the mixture of nitrogen, phosphorous and potassium fertilizers in the same aforementioned forms and concentrations.

The spraying was accomplished by back sprinkler size 16 liter pending dissemination point two times later than 35 and 50 days from sowing in the early morning on the vegetative growth and a drop of Al-Zahi detergent was added to reduce tension as a diffuser to the solution to get the full wetness of the plant.

The investigational field was well prepared and separated into the experimental units. The investigational unit area was 10.5 m^2 (3 × 3.5 m). Triple Calcium Superphosphate (20-24 % P_2O_5) was practical as soil application during soil grounding (after determining the experimental units) at 350 kg ha^{-1}. The sowing date was 15th November. Nitrogen (Urea "46.0 % N" fertilizer) was applied at 190 kg N ha^{-1} in two equivalent doses previous the 1st and the 2nd irrigations. Potassium (Potassium Sulphate "41.5 % K_2O" fertilizer) was applied at 60 kg K_2O ha^{-1} in one dose before the 1st irrigation. At the harvest time, 1m^2 was haphazardly chosen from every plot to estimation the following traits;

Growth:

- Dry weight of vegetative growth (g plant^{-1}). To verify dry weight of vegetative growth, every plant portions were air-drying, then oven drying at 70 °C.
- Flag leaf area (cm^2) was premeditated by the subsequent formula *i.e.* a = L × W × 0.75, where; a = Flag leaf area, L = Length of flag leaf and W = Maximum width of flag leaf (Gardner *et al.*, 1985).
- Plant height (cm).

Yield components:

- Number of spikes/m^2.
- Number of grains/spike.
- 1000-grain weight (g).

Yields:

- Grain yield in tons per hectare.
- Biological yield in tons per hectare.

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the RCBD as outlined by Gomez and Gomez (1984) using means of "GenStat" computer software package. LSD method was used to test the differences among treatment means at 5 % level of probability as explained by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Growth characters:

Data in Table 2 showed that the consequence of foliar appliance treatments by way of nitrogen, phosphorus and potassium (NPK) on augmentation characters (dry weight of vegetative growth plant^{-1}, flag leaf area "FLA" and plant height)was significant as compared to the control treatment(without foliar application) during 2020/2021 season.Spraying wheat plants with the mixture of nitrogen (4000 mg L^{-1}), phosphorous (2000 mg L^{-1}) and potassium (4000 mg L^{-1}) fertilizers significantly increased vegetative growth traits, as well produced the highest values of 15.23 g, 53.94 cm^2 and 108.1 cm, respectively. The second-best foliar application treatment was spraying wheat plants with nitrogen at 4000 mg L^{-1}, which recorded 12.14 g, 50.48 cm^2 and 100.9 cm and followed by spraying wheat plants with potassium at 4000 mg L^{-1}, which verified 11.65 g, 49.24 cm^2 and 101.3 cm, then spraying wheat plants with phosphorus at 2000 mg L^{-1},

that registered 11.10 g, 49.60 cm^2 and 98.6 cm of vegetative growth $plant^{-1}$, flag leaf area and plant height, respectively. The lowest vegetative growth $plant^{-1}$, flag leaf area and plant height (9.96 g, 37.66 cm^2 and 98.3 cm) means were outcomed from without foliar appliance during 2020/2021 season. This may be due to the fact that foliar feeding with NPK led to a significant consequence on plant growth by regulating the action of cytokinins and auxins, which led to an increase in meristematic cell division, which reflected positively on the size of the vegetative group and an increase in the size of the root system, which contributed to the increase in the absorption of important soil nutrients and made them available to the plant, especially potassium and phosphorous, as well as leads to an increase in the efficiency of the plant in consuming water and resisting the stresses it was exposed to due to external conditions, which leads to delaying the aging of the plant by prolonging the growth period (Ivanova *et al.*, 2007).

Table 2. The averages of vegetative growth traits as influenced by foliar appliance treatments with NPK during 2020/2021 season.

Characters Treatments	Dry weight of plant (g)	Flag leaf area (cm^2)	Plant height (cm)
C. Without	9.96	37.66	98.3
N. Nitrogen at 4000 mg L^{-1}	12.14	50.48	100.9
P. Phosphorous at 2000 mg L^{-1}	11.10	49.60	98.6
K. Potassium at 4000 mg L^{-1}	11.65	49.24	101.3
NPK	15.23	53.94	108.1
F. test	*	*	*
LSD at 5 %	1.76	5.52	3.5

Yield components:

The obtained results that found in Table 3 cleared that the studied yield components (number of spikes/m^2, number of grains/spike and 1000-grain weight) were significantly affected by foliar application treatments with nitrogen, phosphorus and potassium (NPK) as compared to the control treatment (without foliar application) during 2020/2021 season.The highest values of number of spikes/m^2, number of grains/spike and 1000-grain weight (385.3 spikes/m^2, 46.8 grains/spike and 38.10 g, respectively) were formed from sprinkling the wheat plants through the combination of nitrogen (4000 mg L^{-1}), phosphorous (2000 mg L^{-1}) and potassium (4000 mg L^{-1}) fertilizers as compared with other studied foliar application treatments. Sprinkling plants with nitrogen at 4000 mg L^{-1} ranked secondly after the mixture of NPK treatment, which documented349.0 spikes/m^2, 38.8 grains/spike and 31.70 g and go behind by sprinkling plants with K at 4000 mg L^{-1}, which substantiated336.3 spikes/m^2, 38.4grains/spike and 31.50 g, then spraying wheat plants with phosphorus at 2000 mg L^{-1}, that listed334.6 spikes/m^2, 37.7 grains/spike and 29.90g of number of spikes/m^2, number of grains/spike and 1000-grain weight, respectively. Alternatively, the lowest values of number of spikes/m^2, number of grains/spike and 1000-grain weight (323.3, 35.0 and 29.00 g) were outcomed from without foliar appliance during 2020/2021 season. The reason for this is that the foliar feeding helped regulate the work of plant hormones, which led to an increase in the number of cell division and thus an increase in the number of branches that bear flowering and fertile spikes (Taaban, 2002and Khairu, 2003). Also, the reason for the increase in the number of grains in the spike is due to an increase in the regularity of the work of plant hormones in the formation of flowers and an increase in the efficiency of the work of growth regulators and an increase in the number of flowers and an increase in the efficiency of pollination and fertilization to form the largest number of grains for each spike (Al-Moussawi, 2020).The reason for increase 1000-grain weightis that the foliar feeding helped the efficiency of the photosynthesis process and the process of transferring the products of the construction process from leaves to their storage in the grains, increasing the production of ATP energy, building proteins and sugars, and building and forming nucleic acids and lipids that are stored in grains, which leads to increase the weight of the grains (Al-Tahir, 2005).

Table 3. The averages of wheat yield components as influenced by foliar appliance treatments with NPK during 2020/2021 season.

Characters Treatments	Number of spikes/m^2	Number of grains /spike	1000-grain weight (g)
C. Without	323.3	35.0	29.00
N. Nitrogen at 4000 mg L^{-1}	349.0	38.8	31.70
P. Phosphorous at 2000 mg L^{-1}	334.6	37.7	29.90
K. Potassium at 4000 mg L^{-1}	336.3	38.4	31.50
NPK	385.3	46.8	38.10
F. test	*	*	*
LSD at 5 %	21.4	3.96	3.19

Yields:

The data listed in Table 4 revealed that yieldsof wheat (biological and grain yields ha^{-1}) were significantly influenced by foliar appliance treatments with NPK as compared to the control treatment (without foliar application) during 2020/2021 season. The highest biological and grain yields of wheat (4.510 and 10.420 ton ha^{-1}, respectively) were obtained when sprinkling wheat plants by way of the combination of nitrogen (4000 mg L^{-1}), phosphorous (2000 mg L^{-1}) and potassium (4000 mg L^{-1}) fertilizers as compared with other studied foliar application treatments. Sprinkling the plants o0f wheat with nitrogen at 4000 mg L^{-1} ranked secondly after the mixture of NPK treatment, which recognized 3.717 and 9.300tonha^{-1} and tag along by sprinkling plants with K at 4000 mg L^{-1}, which proved3.641 and 8.870 ton ha^{-1}, then spraying wheat plants with phosphorus at 2000 mg L^{-1}, that scheduled3.544 and 7.430 ton ha^{-1} of biological and grain yields ha^{-1}, respectively. Alternatively, the lowest biological and grain yields (3.390 and 6.930 tonha^{-1}) values were created from without foliar appliance during 2020/2021 season.

Table 4. The averages of wheat yield as influenced by foliar appliance treatments with NPK during 2020/2021 season.

Characters Treatments	Grain yield (tons ha^{-1})	Biological yield (tons ha^{-1})
C. Without	3.390	6.930
N. Nitrogen at 4000 mg L^{-1}	3.717	9.300
P. Phosphorous at 2000 mg L^{-1}	3.544	7.430
K. Potassium at 4000 mg L^{-1}	3.641	8.870
NPK	4.510	10.420
F. test	*	*
LSD at 5 %	0.390	1.270

The reason for this is due to the increase in the efficiency of the transport and storage process of carbohydrates and proteins in the grains, as well as the metabolic processes and vital functions within the plant

and the regulation of control over the basic activities of nutrients and the prolongation of the period of filling the grain, and the increase in the efficiency of converting light energy into chemical energy and transferring the products of photosynthesis from leaves to storage in grains (Al-Tahir, 2005).

CONCLUSION

From the attained results in this investigation, it may well be decided that sprinkling wheat plants by combination of nitrogen at 4000 mg L^{-1}, phosphorous at 2000 mg L^{-1} and potassium at 4000 mg L^{-1} two times after 35 and 50 days from sowing to improve growth, yield and its components of bread wheat Ibaa-99 cultivar under the ecological circumstances of studying area.

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تأثير بعض معاملات الرش الورقي بالنيتروجين والفوسفور والبوتاسيوم على إنتاجية قمح الخبز

جزران جرد كاظم[١] وصالح السيد سعده[٢]

[١]وزارة التربية ـ قسم التعليم المهني ـ بابل – العراق.

[٢]قسم المحاصيل، كلية الزراعة، جامعة المنصورة، مصر.

الملخص

نفذت تجربة حقلية في قضاء الكوثي (جبلة) شمال محافظة بابل – العراق، في تربة مزيجة طينية غرينية في الموسم الشتوى ٢٠٢١/٢٠٢٢ لدراسة تأثير بعض معاملات الرش الورقي بالنيتروجين والفوسفور والبوتاسيوم (NPK) على إنتاجية قمح الخبز صنف إباء-٩٩. أجريت التجربة في تصميم القطاعات كاملة العشوائية في ثلاث مكررات. حيث كانت معاملات الرش الورقي المدروسة على النحو التالي؛ بدون رش ورقي (معاملة المقارنة) ، الرش الورقى بالنيتروجين بتركيز ٤٠٠٠ مجم لتر-١ ، الفوسفور بتركيز ٢٠٠٠ مجم لتر-١ ، البوتاسيوم بتركيز ٤٠٠٠ مجم لتر-١ وخليط من النيتروجين والفوسفور والبوتاسيوم بنفس التراكيز السابقة لكل منهم. أدى الرش الورقى لنباتات القمح بخليط من النيتروجين (٤٠٠٠ مجم لتر-١) والفوسفور (٢٠٠٠ مجم لتر-١) والبوتاسيوم (٤٠٠٠ مجم لتر-١) إلى زيادة معنوية في صفات النمو والمحصول ومكوناته بالمقارنة مع معاملات الرش الورقي الأخرى المدروسة. وكانت ثاني أفضل معاملة رش ورقي هي رش نباتات القمح بالنيتروجين بتركيز ٤٠٠٠ ملجم لتر-١ ،يليها الرش الورقى لنباتات القمح بالبوتاسيوم بتركيز ٤٠٠٠ ملجم لتر -١، ثم رش نباتات القمح بالفوسفور بتركيز ٢٠٠٠ ملجم لتر -١وأخيرًا معاملة المقارنة (بدون رش ورقي) خلال موسم ٢٠٢١/٢٠٢٠. من النتائج التي تم الحصول عليها في هذه الدراسة، يمكن التوصيةبرش نباتات القمح بخليط من النيتروجين (٤٠٠٠ مجم لتر -١) والفوسفور (٢٠٠٠ مجم لتر -١) والبوتاسيوم (٤٠٠٠ مجم لتر -١) لتحسين صفات النمو والمحصول ومكوناته لقمح الخبز صنف إباء- ٩٩ تحت الظروف البيئية لمنطقة الدراسة.