Plant Archives Volume 20 No. 1, 2020 pp. 273-278 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF FOLIAR SPRAYINGS OF INDOLE ACETIC ACID ON GROWTH AND YIELD OF DURUM WHEAT GENOTYPES

Ali Raheem Al-Hasany[1], Dhurgham Sabeeh Altai[2*] and Hekmat Basim Alhmadi[3]

[1]Department of Field Crops, College of Agriculture, AL-Muthanna University, Iraq.
[2*]Department of plant protection, College of Agriculture, Misan University, Iraq.
[3]Department of chemistry, College of Medicine, AL-Muthanna University, Iraq.

Abstract

The field of experiment was carried out during the agricultural season 2017/2018 in Al-Rumaitha, AL-Muthanna, Iraq to study the effect of spraying with four concentrations of the Indole-Acetic Acid (0, 20, 40 and 60 mg l^{-1}) on two genotypes (IR65 and IR1229) of growth and yield of durum wheat (*Triticum durum* L.) This experiment was layout in Randomization Completely Blocks Design (RCBD) with three replicates. Foliar spraying with (60 mg l^{-1}) of IAA resulted the highest values of growth and yield attributes and increased chlorophyll content in leaves, number of spikes m^2, grain yield and biological yield by 25.61%, 35.70%, 29.21% and 28.95%, respectively as compared with the control treatment. The results showed that the composition of IR65 and IR1229 have differed significantly in most studied traits such as chlorophyll content in leaves, plant height and spike length. The IR65 also outperformed some of the characteristics of the crop, which exceeded the number of spikes m^2 and gave the highest average of 415.10 spikes m^2 and gave the highest grain yield was 6316 kg h^{-1}. While the composition of IR1229 is superior to the weight of 1000 grains only. The interference between the spraying of (IAA) and the genotypes showed a significant effect on spike length and 1000 grains weight only.

Key words : Indole-Acetic Acid, Foliar spraying, chlorophyll, Grain yield, Biological yield.

Introduction

Durum wheat (*Triticum durum* L.) is an important grain crop and it's one of the two main wheat types in the world. It produces 5% of the total wheat production, occupies about 8% of the cultivated area in the world, and is concentrated in the Mediterranean Basin yielding more than 85% of the world's production (Maccaferri and Manthey, 2005**).** Hard wheat is used primarily for the production of high-quality pasta products such as bulgur, noodles, spaghetti, pasta, as well as pastries, and about half of the world's production of durum wheat is converted into pasta products (Khan *et al.,* 2013). The only difference for soft wheat is the elasticity of gluten and the lack of rubber because of the absence of the chromosome group responsible for the rubber. The high proportion of gluten makes strong flour when kneading, so it extracts the substance of the semolina necessary for the pasta industry (Sayaslan *et al.,* 2012). The relationship between the various stages of plant growth is regulated by some modern scientific technologies, including the use of botanical growth regulators such as dioxins, which play a large role in biological and physiological processes and regulating the growth of plants. Auxins characterized by the biological influence and physiological activity in the plant through its contribution to increasing elongation and growth roots and their branches, increasing the susceptibility of the plant to absorb as much water and nutrients as possible and thus creating favorable conditions to stimulate growth (Egamberdieva, 2009). Indole acetic acid (IAA) also contributes to the increase of contractions and fertilization naturally by delaying flowering. The flowering act of the flower is related to this hormone **(**Mustafa *et al.,* 2018). The adoption of the diversity of plant genetic resources

***Author for correspondence :** E-mail: dhurgham.sabih@uomisan.edu.iq

for all crops is one of the main pillars in breeding and improvement programs because it achieves the possibility of propagating superior varieties and spreading them in record time, thus contributing to the expansion of the genetic base that serves the breeding programs (Yusuf and Janabi, 2001). This study was carried out with the aim of identifying the response of two genotypes of the durum wheat to the sprayed with Indole Acetic Acid (IAA) ethanol to improve and increase production.

Materials and Methods

The field of experiment was carried out during the agricultural season 2017/2018 in Al-Rumaitha, AL-Muthanna, Iraq to study the effect of spraying with four concentrations of the Indole-Acetic Acid (IAA) (0, 20, 40 and 60 mg l^{-1}) on two genotypes (IR65 and IR1229) of growth and yield of durum wheat (*Triticum durum* L.) This experiment was layout in Randomization Completely Blocks Design (RCBD) with three replicates. The soil samples were taken to form a random compound sample. The depth of taken was (0-30) cm from different places of each repeater and is mixed together to represent the field of experiment before planting. A number of chemical and physical analyzes were performed for the experiment field (Table 1). The soil operations were carried out by plowing, smoothing and settling. The land was then divided according to the design used. Then the seed was planted on December 1 (Alaajibi, 2014). The nitrogen fertilization was carried out with a quantity of 120 kg N/h in the form of urea fertilizer (46% N). The first one was after planting (15) days. The second after 40 days of the first batch. The phosphate fertilization was carried out in the form of 80 kg P_2O_5 h^{-1} in the form of superphosphate (46% P_2O_5) (Al-Abidi, 2011). The irrigation and weeding operations were carried out whenever needed. The farming was done on lines. The distance between the line and the last one is 20 cm. The experimental unit is a panel ($2 \times 2 = 4$ m^2). The spraying process was done with an indole Acetic acid twice. Each time adding half of the concentration, the first in the elongation phase and the second in the ventricle stage. The data were statistically analyzed according to the design used and the mathematical averages were compared according to the L.S.D test under the probabilistic level of 5% (Al-Rawi and Khalaf Allah, 2000).

Table1 : Some physical and chemical characteristics of the experiment field before planting.

Attribute		Value	Unit
pH		7.4	
E.C		4.7	$dS.m^{-1}$
CEC		23.2	Cm kg+ $^{-1}$
Nitrogen ready		19	Mg kg^{-1} soil
Phosphorus ready		7	Mg kg^{-1} soil
Potassium ready		180	Mg kg^{-1} soil
Analysis of minute volumes	Sand	240	Mg kg^{-1}
	Silt	425	
	Clay	335	
Soil texture		Mixture of clay	

Results and Discussion

The content of the leaves of chlorophyll

The results in table 2 showed a significant increase in leaf content of chlorophyll with an increase in the concentration of IAA in the spray solution. The concentration of 60 mg l^{-1} gave the highest mean of 239.30 mg m^2 while the non-spray treatment (control) gave the lowest average of 174.10 mg m^2. The concentration of 60 mg l^{-1} gave the highest mean of 239.30 mg m^2 while the non-spray treatment (control) gave the lowest average of 174.10 mg m^2. The increase in chlorophyll may lead to the role of IAA in the activity of many enzymes in addition to increasing the plant's ability to photosynthesis and thus increasing the content of the leaves of chlorophyll. This result was agreed with **(**Gemici *et al*., 2002). The results in Table 2 showed that the IR65 genotype was superiority in leaf content than chlorophyll, which gave the highest mean of 226.10 mg m^2 while the IR1229 gene gave the lowest average of this value was 183.70 mg m^2. This may be due to genetic variation of the genotypes, this finding was consistent with what was obtained (Alaajibi, 2014), which showed the different genotypes of coarse wheat among them in the content of leaves of chlorophyll. No significant differences were observed between the spraying of the IAA and the genotypes in leaf content of chlorophyll (Table 2).

Plant height (cm)

The results showed that spraying of (IAA) with the highest concentration of 60 mg l^{-1} resulted in an increase in plant height, which gave an average of 82.72 cm and a significant difference from the non-spray treatment (control), which gave a mean average of 75.23 cm (Table 3).

It's believed that the reason for increased plant height with increased concentration of IAA may be due to the physiological activity and its biological influence in the plant, which contributes to increase the efficiency of photosynthesis and the transfer of their products from

Table 2: Chlorophyll contents (mg m^2) as affected by IAA and genotypes as well as their interactions.

Average of Genotypes	IAA Concentrations				IAA Genotypes
	60	40	20	0	
226.10	256.60	244.00	205.50	198.10	IR65
183.70	222.0	195.10	167.80	150.00	IR1229
	239.30	219.60	186.60	174.10	Average of IAA
Genotypes × IAA			IAA	Genotypes	L.S.D
N.S			19.58	13.85	

Table 3: Plant height (cm) as affected by IAA and genotypes as well as their interactions.

Average of Genotypes	IAA Concentrations				IAA Genotypes
	60	40	20	0	
82.78	86.70	83.73	82.00	87.67	IR65
75.07	78.73	76.97	72.77	71.80	IR1229
	82.72	80.35	77.38	75.23	Average of IAA
Genotypes × IAA			IAA	Genotypes	L.S.D
NS			2.68	1.90	

Table 4: Spike Length (cm) as affected by IAA and genotypes as well as their interactions.

Average of Genotypes	IAA Concentrations				IAA Genotypes
	60	40	20	0	
6.91	7.53	7.16	6.90	6.06	IR65
5.84	6.10	5.96	5.80	5.50	IR1229
	6.81	6.56	6.35	5.78	Average of IAA
Genotype × IAA			IAA	Genotype	L.S.D
0.41			0.29	0.20	

Table 5: Number of spikes in m^2 as affected by IAA and genotypes as well as their interactions.

Average of Genotypes	IAA Concentrations				IAA Genotypes
	60	40	20	0	
415.10	481.00	423.00	393.30	363.00	IR65
365.90	430.30	380.3	344.3	308.70	IR1229
	455.70	401.70	368.80	335.80	Average of IAA
Genotype × IAA			IAA	Genotype	L.S.D
N.S			25.15	17.79	

Table 6: Number of grain $spike^{-1}$ as affected by IAA and genotypes as well as their interactions.

Average of Genotypes	IAA Concentrations				IAA Genotypes
	60	40	20	0	
53.60	61.30	54.80	52.90	45.50	IR65
54.20	59.80	57.20	51.50	48.30	IR1229
	60.60	56.00	52.20	46.90	Genotypes
Genotypes × IAA			IAA	Genotypes	L.S.D
N.S			9.06	N.S	

the source to the active areas downstream in the plant, which contributed to increase the growth of the plant in general Including plant height, and this result was consistent with what (Faisal and Abdel-Tayeb, 2013) pointed out to the increase in plant height of wheat plants by increasing the concentration of spray with IAA.

The results showed that in the table 3, IR65 was superior to the height of the plant, with the highest mean of 82.72 cm, significantly different from the IR1229, which gave the lowest average plant height of 75.07 cm, and perhaps due to the superiority of the genotype IR65 to the superiority of the original content in the leaves of chlorophyll table 2, which means an increase in the rates of production and representation of dry matter, which encouraged growth and reflected on the increase of plant height, and agreed with this conclusion (Francesco *et al.,* 2007) and (Al-Fahdawi, 2013), whereas the overlap between sprays and the genotypes showed no significant differences in plant height (Table 3).

Length of spike (cm)

The results showed that spraying the IAA with a higher concentration of 60 mg l^{-1} resulted in an increase in the length of the spike, which gave the highest mean of 6.81 cm, which did not differ significantly from the concentration of 40 mg l^{-1}, which gave an average of 6.56 cm, while the comparison treatment gave (Control 0) the mean length of the spike was 5.78 cm (Table 4). The increase in IAA concentrations in the spray solution may have increased the efficiency of photosynthesis and also increased the production of dry matter, which contributed to the spike length increase. This result is consistent with Chrouqi *et al.,* (2017). The results in Table 4 show that the IR65 gene is superior to the length of the spike, giving the highest mean of 6.91 cm, while the IR1229 genotype gave the mean average of this characteristic 5.84 cm. The differences in spike length may be due to the genetic nature of each genotype structure, this result is with (Al-Fahdawi, 2013), which shows the different genotypes of coarse wheat among them in the length of the spike. As for the effect of the interaction between the IAA and genotype structures, the length of the spike was significantly affected by the difference in the length of the spike according to the different IAA concentrations. The higher concentration of the

Table 7: Weight of 1000 grain as affected by IAA and genotypes as well as their interactions.

Average of Genotypes	IAA Concentrations				IAA Genotypes
	60	40	20	0	
43.88	44.83	43.67	43.20	43.83	IR65
45.08	44.47	45.23	44.97	45.67	IR1229
	44.65	44.45	44.08	44.75	Rate IAA
Genotypes × IAA			IAA	Genotypes	L.S.D
1.14			N.S	0.57	

Table 8: Grain yield as affected by IAA and genotypes as well as their interactions.

Average of Genotypes	IAA Concentrations				IAA Genotypes
	60	40	20	0	
6238	7040	6443	6073	5395	IR65
5006	5592	5309	4723	4400	IR1229
	6316	5876	5398	4898	Average of IAA
Genotypes × IAA			IAA	Genotypes	L.S.D
N.S			280.8	198.6	

Table 9: Biologic yield as affected by IAA and genotypes as well as their interactions.

Average of Genotypes	IAA Concentrations				IAA Genotypes
	60	40	20	0	
13710	16060	13090	12780	12100	IR65
12663	14680	13377	11737	10860	IR1229
	15370	13638	12258	11480	Average of IAA
Genotypes × IAA			IAA	Genotypes	L.S.D
N.S			892.2	631.1	

IAA (60 mg l^{-1}) with the genotype IR65 gives the mean average of this characteristic was 7.53 cm, on other hand the combination (IR1229 × 0) was the lowest mean length of the spike length of 5.50 cm.

Number of spikes m^{-2}

The results in table 5 indicate a significant effect of the IAA spray in increasing the number of spike in m^2. The concentration of 60 mg l^{-1} gave the highest mean of this characteristic at 455.70 m^2 while the comparison treatment control gave the lowest average number of spikes of 335.80 spike m^2, and this result was agreed with (Faisal and Abdel-Tayeb, 2013). The IR65 gene gave the highest average number of spikes at 415.10 m^2, while the genotype IR1229 gave a mean average of 365.90 m^2 (Table 5). The genetic nature of each hereditary structure may be due to this (Khan *et al.*, 2013) who demonstrated the different genotypes of coarse wheat in the number of spikes per square meter for different genetic composition.

Number of grain $Spike^{-1}$

The result in table 6 showed that spraying with IAA resulted in a significant increase in the number of grains with spike. The highest concentration of 60 mg l^{-1} gave the highest mean of 60.60 grain $spike^{-1}$, while the non-spray treatment gave a mean average of 46.90 grain $spike^{-1}$, The reason for this is that the IAA increases the number of grains by means of its contribution to increasing the efficiency of the transfer of photosynthesis products from their manufacturing sites to the rest of the plant in general and the spike in particular, which led to an increase in the number of grains in it (Haji, 2014), which indicated an increase in the number of spike grains when sprayed with IAA on Wheat Soft and coarse. (Table 6) showed no significant differences between the genotypes and the interaction between the IAA and the genotypes in the number of grain $spike^{-1}$.

Weight of 1000 grain

The result in table 7 showed no significant differences between the spray and the non-spraying of the IAA in the weight of 1000 grain. The results showed in table 7 significant differences in the structure of the genotype in the weight of 1000 seeds, given that the genotype IR1229, the highest mean of this attribute was 45.08 g while the genotype gave IR65 the average weight of 1000 grain was 43.88 g, may be due to the superiority of genetic makeup IR1229 table 6, which resulted in a greater chance of accumulation of nutrients in the grain due to the lack of competition within the spike. This result was consistent with the findings of both (Kouchaksaraei, 2012 ; Al-Ajaji, 2014). The effect of the interaction between the IAA and the genotypes was significantly affected by the weight of the 1000 grain. The non-spray treatment of the IAA (control) with the genotype (IR1229) and the combination of IR1229 × 0 (mean height of 45.67 g). The irradiation treatment was given in the second concentration of IAA (20 mg l^{-1}) with the genotype (IR65). The combination (IR65 × 20 mg l^{-1}) was the mean length of the spike was 43.20 g (Table 7).

Grain yield (kg h^{-1})

The grain yield was increased with increasing the concentration of IAA in the spray solution. The highest concentration of 60 mg l^{-1} gave the highest mean of the grain yield of 6316 kg h^{-1} recording a significant superiority over the rest of the concentrations and gave the treatment

of non-spraying less average for this capacity was 4898 kg h^{-1} table 8 and perhaps due to the important role of IAA in accelerating the transfer of photosynthesis products from source to downstream, which led to an increase in the downstream size by increasing the spike length table 4 and increasing the number of spikes in m^2 table 5 and (Table 6). This was reflected in the increase in grain yield (Haji, 2014**).** The results showed in table (8) that the genotype superiority of IR65 was significantly higher in the grain yield. The highest mean was 6238 kg h^{-1} while the IR1229 gene gave the lowest mean of 5006 kg h^{-1} and the reason for the superiority of the genotype of IR65 to the superiority of the original in the number of spike in m^2 table 5 and the superiority in the number of grain spike table 6 and this increase led to an increase in the grain, and this result agreed what happened (Hamdan *et al*., 2015: Mehdi and Tubal, 2018). Who showed the different genotypes of coarse wheat among them in the grain.

Biologic yield (kg h^{-1})

The effect of spraying of the solvent is significant in the biologic yield. The higher concentration of 60 mg l^{-1} was higher than the highest mean of this grade of 15370 kg h^{-1}. While the non-spray treatment 0 (control) gave a mean average of 11480 kg h^{-1} (Table 9). This result was agreed with Haji (2014), which showed a significant increase in wheat yield when spraying with IAA. The results of table 9 are superior to the IR65 genotype in the highest mean of this status of 13710 kg h^{-1}, while IR 1229 gave the lowest mean of the biologic yield of 12663 kg h^{-1}, and perhaps the reason for the superiority of the genotype of the IR65 in this capacity to the difference of genetic nature and suitability to the environmental conditions prevailing in the region, and agreed this result with (Hussain *et al*., 2004).

References

Abdul Hussein, M. and A. Topal (2018). Determination of Yield and Agronomic Characteristics of Some Durum Wheat Genotypes in Turkey and Iraq Conditions. *Tikrit Journal for Agricultural Sciences*, **18(1):** 1-12.

Al-Abidi, J.A. (2011). Directory of Chemical and Organic Fertilizers in Iraq. State Company for agricultural supplies, Ministry of Agriculture, Iraq, **38(1):**1-21.

Alaajibi, N.A.D. (2014). Response of wheat genotypes (*Triticum durum* L) to planting dates. M. Sc. Thesis, in Agron., Fac. of Agric. University of Muthanna.

Al-Fahdawi, H.M.M. (2013). Effect of seedling rates on growth and yield of Wheat genotypes (*Triticum durum* L.) planted in two locations. *Iraqi journal of desert studies*, **1(5):** 115-122.

Al-Rawi, K.M. and A.M. Khalaf-Allah (2000). Design and Analysis of Agricultural Experiments. (in Arabic). University of Al Mosul, 488.

Chrouqi, L., L. Ouahmane, I. Jadrane, T. Koussa and M.N. Al feddy (2017). Effects of plant growth promoting rhizobacteria (PGPRs) product IAA on the growth of two Moroccan wheat varieties (*Triticum durum* Desf.). *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, **8(3):** 2296-2303.

Egamberdieva, D. (2009). Alleviation of salt stress by plant growth regulators and IAA producing bacteria in wheat. *Acta Physiologiae Plantarum*, **31(4):** 861-864.

Faisal, M.S. and S.M. Abdel-Tayeb (2013). Response of two varieties of wheat to the IAA growth regulator under drought conditions. *Tikrit Journal for Agricultural Sciences*, **13(1):** 111-120.

Francesco, G., R. Motzo and G. Pruneddu (2007). Trends since 1900 in the yield potential of Italian-bred durum wheat cultivars. *European Journal Agronomy*, **27:** 12-24.

Gemici, M., L.Y. Aktas, B. Turkylmaz and A. Guven (2002). The Effects of the Boron Application on Indole-3-Acetic Acid Levels in *Triticum durum* Desf. cv. Gediz Seedlings. *Fen Bilimleri Dergisi*, **23(2):**17-24.

Haji, M.A. (2014). Effect of growth regulator indole acetic acid IAA in growth and yield and its componets of bread Wheat (*Triticum aestivum* L.) and Durum Wheat (*Triticum durum* DESF). *Journal of Mesopotamia*, **42(1):** 153-160.

Hamdan, M.I.H., O.M. Ayoob, K.H. Imad, H.M. Atheer and A.S. Khudair (2015). Evaluation of entered durum wheat (*Triticum durum*) genotypes under middle conditions of Iraq. *Anbar journal of agricultural sciences*, **13(2):**180-188.

Hussain, A., M.R. Chaudhry, A. Wajid, A. Ahmed, Rafiq, M.M. Ibrahim and A.R. Goheer (2004). Influence of water stress on growth, yield and radiation use efficiency of various wheat cultivars. *International journal of agricultural and Biology*, **6(6):** 1074-1079.

Khan, A.A., M.A. Alam, M.K. Alam, M.J. Alam and Z.I. Sarker (2013). Genotypic and phenotypic correlation and path analysis durum wheat (*Triticum turgidum* L. var. durum). *Bangladesh journal agricultural Research*, **38(2):**219-225.

Kouchaksaraei, H.N., H. Martyrusian and G. Nematzadeh (2012). Evaluation of tolerance to heat stress in new varieties of durum wheat (*Triticum durum* L.). *International journal agriculture Research and Review*, **2(6):** 744-750.

Maccaferri, M., M.C. Sanguineti, P. Donini, E. Porceddu and R. Tuberosa (2005). A molecular dissection of the Italian adapted durum wheat germ plasm based on microsatellite analysis. In: Royo C, Nachit MM, Di Fonzo N, Araus JL, Pfeiffer WH, Slafer GA (eds) Durum wheat breeding: current approaches and future strategies. The Hayworth Press, New York, USA, 105-152.

Maccaferri, E.M. and F.A. Manthey (2005). End products. In: Royo, C., M.N. Nachit, N. Di fonzo, J.L. Araus, W.H. Pfeiffer and G.A. Slafer (eds.) Durum wheat breeding. Current approaches and future strategies. New York: Food Academic Press, The Haworth Press, 63-86.

Mustafa, A., M. Imran, M. Ashraf and K. Mahmood (2018). Perspectives of Using L-Tryptophan for Improving Productivity of Agricultural Crops: A Review. *Soil and Environmental Sciences Division, Nuclear Institute for Agriculture and Biology*, **28(1):** 16-34.

Sayaslan, A., M. Koyuncu, A. Yildirim, T.E. Gulec, O.A. Sonmezoglu and N. Kandemir (2012). Some quality characteristics of selected durum wheat(*Triticum durum*) landraces. *Turkish Journal of Agriculture and Forestry*, **36(2):** 749-756.

Yousuf, D.B. and K.K. Al Janabi (2001).Genetic variation and the exchange of hereditary materials and their role in improving cereal crops and breaking the determinants of productive energy. *Journal of Agriculture and Development in the Arab World*, **20(2):**16-30.