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(Original Article)

Response of Bread Wheat to Foliar Spray by Some Growth Stimulators

Hassan Makarem*; Ibrahim A. El-Far; El-Saady A. Ali and Mohamed T. Said

Department of Agronomy, Faculty of Agriculture, Assiut University, Assiut, Egypt.

*Corresponding author e-mail: makarmhassan@gmail.com
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Abstract

A field experiment was conducted during winter 2020/21 and 2021/22 seasons at the Agronomy Department Farm, Agriculture Faculty, Assiut University, to examine the effect of foliar spray with some growth stimulators on the yield and its attributes of four bread wheat cultivars. The experiment was laid out in randomized complete block design (RCBD) using strip plot arrangement with three replications. Foliar sprays containing distilled water (solvent as a control), Moringa Extract, Humic Acid, Chitosan, and Seaweed Extract (Acadian) at concentrations of 13,000, 4,000, 500 and 2500 ppm, respectively were dispersed horizontally and the bread wheat cultivars Gemmiza-11, Giza-171, Shandaweel-1, and Sids-14 were arranged vertically. Plant height, spike length, grain number spike^{-1}, 1000 grains weight, grains spike weight, and grain yield were significantly affected by foliar spraying treatments with growth stimulators in both seasons. The highest average values of the aforementioned traits were found in wheat plants sprayed with Moringa Extract. Additionally, the traits examined were significantly influenced by the cultivars under study. Gemmiza-11 cultivar produced the greatest values of all examined traits in both seasons. The interaction between some growth stimulators and cultivars affected significantly grain yield fed^{-1} in both seasons. Gemmiza-11 cultivar sprayed with Moringa Extract in both seasons produced the highest grain yield values in both seasons (26.12 and 26.18 ardab fed.$^{-1}$, respectively) for the, which was.

Keywords: *Chitosan, Grain yield and its attributes, Humic Acid, Moringa Extract, Seaweed Extract (Acadian), Wheat cultivars.*

Introduction

The domestication of wheat is intrinsically linked to human efforts to avert starvation and control food resources, marking it one of the most significant agricultural achievements in history. Wheat, particularly bread wheat (*Triticum aestivum*), serves as a staple food globally, providing essential nutrients and energy. (Igrejas and Branlard, 2020).

In Egypt, during the 2023 growing season, approximately 3.21 million feddans (1 feddan = 4200m^2) were cultivated with wheat, yielding a total production of 8.87 million metric tons. However, the country's consumption is about 20.65 million metric tons (USDA, 2024), highlighting a substantial production/consumption gap. Given Egypt's population of over 106 million expected to reach 124 million by 2030 (Central Agency

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for Public Mobilization and Statistics, CAPMAS) the strategic imperative to enhance wheat production is clear.

A primary focus in this endeavor is increasing productivity per unit area. This can be achieved through the cultivation of high-yielding cultivars and the implementation of best agronomic practices. The amount and quality of wheat is influenced by a myriad of factors, including soil type, climate, agronomic management, and varietal responses. Additionally, different wheat genotypes exhibit varying responses to foliar sprays of growth stimulators, which can enhance physiological traits and overall crop efficiency (Igrejas and Branlard, 2020).

Plant growth stimulators (PGS), encompassing both growth regulators and bio stimulants, are organic and inorganic compounds that facilitate plant growth and development. While they are not intended to replace fertilizers, they play a crucial part in enhancing crops and the quality of soil by enhancing root biomass, uptake of nutrients, and enzymatic activity. Bio stimulants are abundant in oligosaccharides, amino acids, minerals, vitamins, and plant hormones, contributing significantly to nutrient cycling, abiotic stress management, and the bioavailability of heavy metals (Bashir *et al*., 2021). These naturally occurring growth enhancers can bolster crop yields by improving resilience to biotic and abiotic challenges and enhancing rhizosphere activity (Jardin, 2015). Common bio stimulants in agriculture include seaweed extracts, protein hydrolysates, humic and fulvic acids, and microbial inoculants (Jardin, 2015 and Glodowska *et al*., 2016).

High-yield agriculture is encouraged by the extensive use of chemical fertilizers, but this practice is also linked to a variety of issues, including low fertilizer utilization rates, soil acidity, and soil salinization. Extensive research has demonstrated that chelated fertilizer can be sprayed on leaves to obtain excellent fertilizer efficiency while lowering the overall amount of fertilizer applied. An efficient way to enhance the soil environment and raise crop yield and trace element concentrations is to apply foliar fertilizer following soil fertilization. However, plants have trouble absorbing and migrating nutrients when inorganic foliar fertilizer is applied. Chelated foliar fertilizers work well to increase crop yield, quality, and element use efficiency. The impact of implementation nutrients is modulated by the chelating agents' physicochemical characteristics, molecular structure, binding strength, and binding rate. (Niu *et al*., 2021).

Foliar sprays derived from plants like *Moringa oleifera* have been shown to positively influence growth by modulating metabolic processes under diverse environmental conditions (Rady *et al*., 2013 and Khan *et al*., 2017). *Moringa oleifera* stands out as a particularly effective natural growth stimulant due to its high concentration of growth hormones, antioxidants, vitamins, and minerals (Foidl *et al*., 2001 and Yasmeen *et al*., 2013).

Humic acid, a prominent organic compound, significantly impacts plant nutrition by enhancing nutrient uptake and facilitating cell membrane permeability. It also promotes the synthesis of growth regulators, particularly auxins, thereby stimulating essential physiological processes that enhance yield and growth (Olk *et al*., 2018 and Abed and Sallume, 2020).

Chitosan, sometimes referred to as deacetylated chitin, is a naturally occurring biopolymer that is nontoxic, renewable, and biodegradable (Lee *et al*., 2023). It can encapsulate hydrophobic compounds that often have low bioavailability. Additionally, by regulating oxidative stress, metabolism, and immunological signaling in plants, it may control growth and generate stress tolerance. (Attaran *et al*., 2022, Hameed *et al*., 2022 and Stasińska and Hawrylak 2022).

Seaweed, thriving in intertidal and subtidal marine environments, serve as a sustainable resource for food, fuel, and fertilizers (Parthiban *et al*., 2013). One organic source utilized in agricultural production is seaweed extracts, which are meant to be used as a supplement rather than as a replacement for fertilizers (Abdul-Jabar *et al*., 2012 and Agricultural Statistics Directorate 2020).

This study's objective was to gain additional knowledge regarding how different growth stimulators applied as foliar spray affect some traits of four different bread wheat cultivars.

Materials and Methods

A field study took place at Department of Agronomy Experimental Farm, Faculty of Agriculture, Assiut University, Assiut, Egypt (lat 27° 03' N, long 31° 01' and alt 70 m asl) during the growing seasons 2020/21 and 2021/22 to examine the effects of foliar spraying with certain growth stimulators on four bread wheat cultivars' yields. Table 1 displays the experimental soil's mechanical and chemical qualities.

Table 1. The experimental soil's mechanical and chemical properties

Characteristics	2020/21	2021/22
Analytical mechanics:		
Sand	27.00	27.80
Silt	23.00	22.20
Clay	50.00	50.00
Soil texture	Clay	Clay
Analytical chemistry:		
pH	7.63	7.85
Organic matter %	1.80	1.70
Total N%	0.09	0.08

Experiment, treatments and design

The experiment was laid out in randomized complete block design (RCBD) using strip plot arrangement with three replications. Bread wheat cultivars (Gemmiza-11, Giza-171, Shandaweel-1, and Sids-14) were arranged vertically while foliar sprays applied 45 and 60 days after sowing using distilled water (a solvent as a control) and Moringa Extract, Humic Acid, Chitosan, and Seaweed Extract (Acadian) at 13000, 4000, 500, and 2500 ppm were arranged horizontally. The experimental unit was 2 × 3.5 m (7 m^2) and was sown by broadcasting. Grain was sown on December 3rd for the first season and December 6th for the second one. In both seasons, the prior summer crop was maize. Every other recommended agricultural practices for the wheat crop were adhered to.

Measured traits, at harvest:

- Plant height (cm): It was determined from soil surface until the upper tip of plants and average of ten guarded stems which were taken randomly from each experimental unit at harvest.

- Spike length (cm): It was determined as an average of ten random spikes from each experimental unit at harvest.

- Number of kernels spike^{-1}: Average number of kernels spike^{-1} was obtained from ten randomly selected spikes from each experimental unit.

-Thousand grain weight (g): The weight of 1000-kernel represented for each experimental unit was weighed.

-Kernel weight spike^{-1} (g): In each experimental unit, ten random spikes were used to estimate the average grain weight.

-Grain yield (ardab fed.$^{-1}$): Every experimental unit's mature wheat plants were harvested then threshed and grain yield was weighed in kilogram then transferred into ardab per feddan (one ardab = 150 kg).

Analytical Statistics

All obtained data was conducted for analyzed of variance (ANOVA) using SAS program version 9.2 (SAS 2008)'s Proc Mixed, and means were compared using revised Least Significant Difference (RLSD) at a 5% level of significance. (Steel and Torrie, 1981).

Results and Discussion

1. Plant height (cm)

The application of foliar spray with growth stimulators significantly affected plant height in both seasons ($P < 0.01$), as detailed in Table 2. It's clear from the results that the foliar application of Moringa extract resulted in the tallest wheat plants, measuring (115.82 cm and 115.00 cm in the 1st and 2nd seasons respectively). In contrast, the control treatment produced the shortest plants (111.68 cm and 108.42 cm for the two respective seasons). Moringa extract contains cytokinin which promotes cell division in the apical meristem of wheat seedlings and improves solute metabolism to germinating plumules, which increases plant growth (Khan *et al*., 2020). The current findings align with those of Ali *et al.* (2011) and Abbas *et al.* (2013) who reported increased wheat plant height following the application of moringa leaf extract compared to the control. Additionally, Foidle *et al*. (2001), Jhilik *et al*. (2020) and Sura (2024) demonstrated that spraying moringa leaf extract on various field crops enhances plant strength and promotes vegetative growth.

In addition, the wheat cultivars highly significantly differ in plant height (Table 2). Gemmiza-11 cultivar recorded the maximum plant heights (119.73 cm and 118.11 cm across both seasons), while the Shandaweel-1 cultivar exhibited the shortest plant heights (109.65 cm and 107.82 cm, in the 1st and 2nd seasons, respectively). This may be owing to the genotypic behavior in combination with the environmental factors, which may be more appropriate for the Gemmiza-11 cultivar than the others. These results are in line with those published by Gomaa *et al*. (2018), Zenhom *et al*. (2018), and Saad *et al*. (2022).

The interaction between wheat cultivars and foliar spray treatments had a significant ($P < 0.05$) effect on plant height in the first season only, as indicated in Table 2. Specifically, after treatment with Moringa extract, the Gemmiza-11 cultivar reached a height of 122.00 cm in the 1st season. Conversely, the Shandaweel-1 cultivar, when treated with chitosan, achieved the lowest average height of 107.80 cm in the same season.

2. Spike length (cm)

It's noticed from the data presented in Fig.1 that foliar spray treatments with growth stimulators influenced significantly ($P < 0.01$) spike length across both growing seasons. The highest mean spike lengths values were observed in wheat plants treated with Moringa Extract (13.85 cm and 12.25 cm in the first and second seasons, respectively). In contrast, the shortest spikes were produced by Chitosan treatment in the first season (13.14 cm) and Acadian treatment in the second one (10.42 cm). These significant results may be attributed to the presence of Moringa Extract, which is rich in various nutrients that promote the growth and division of plant cells, thereby contributing to the elongation of the spike axis. These results align with findings by Khan *et al*. (2020) and Sura (2024).

Furthermore, the data in Fig. 1 show that wheat cultivars spike length differed highly significantly in both seasons. Gemmiza-11 cultivar produced the longest spikes (14.71 cm and 12.18 cm in the first and second seasons, respectively). On the other hand, Sids-14 cultivar produced the shortest spikes (12.26 cm and 9.89 cm in the first and second seasons, respectively). Given the combined effects of environmental conditions and genotypic characteristics, the Gemmiza-11 cultivar appears to perform better than the remaining studied cultivars. These findings are consistent with research by Gheith *et al*. (2013), Noureldin *et al*. (2013), Fergani *et al*. (2014), and Solomon and Anjulo (2017).

Additionally, the interaction between cultivars and growth stimulators exhibited a significant ($P \leq 0.05$) and highly significant ($P < 0.01$) effect on the spike length trait in the first and second seasons, respectively. Gemmiza-11 cultivar sprayed with Moringa Extract produced the longest wheat spikes (15.27 and 14.56 cm in the two seasons, respectively). However, Sids-14 cultivar that sprayed by chitosan treatment in the first season and control treatment in the second season produced the shortest spikes (12.07 and 9.22 cm in the first and second seasons, respectively).

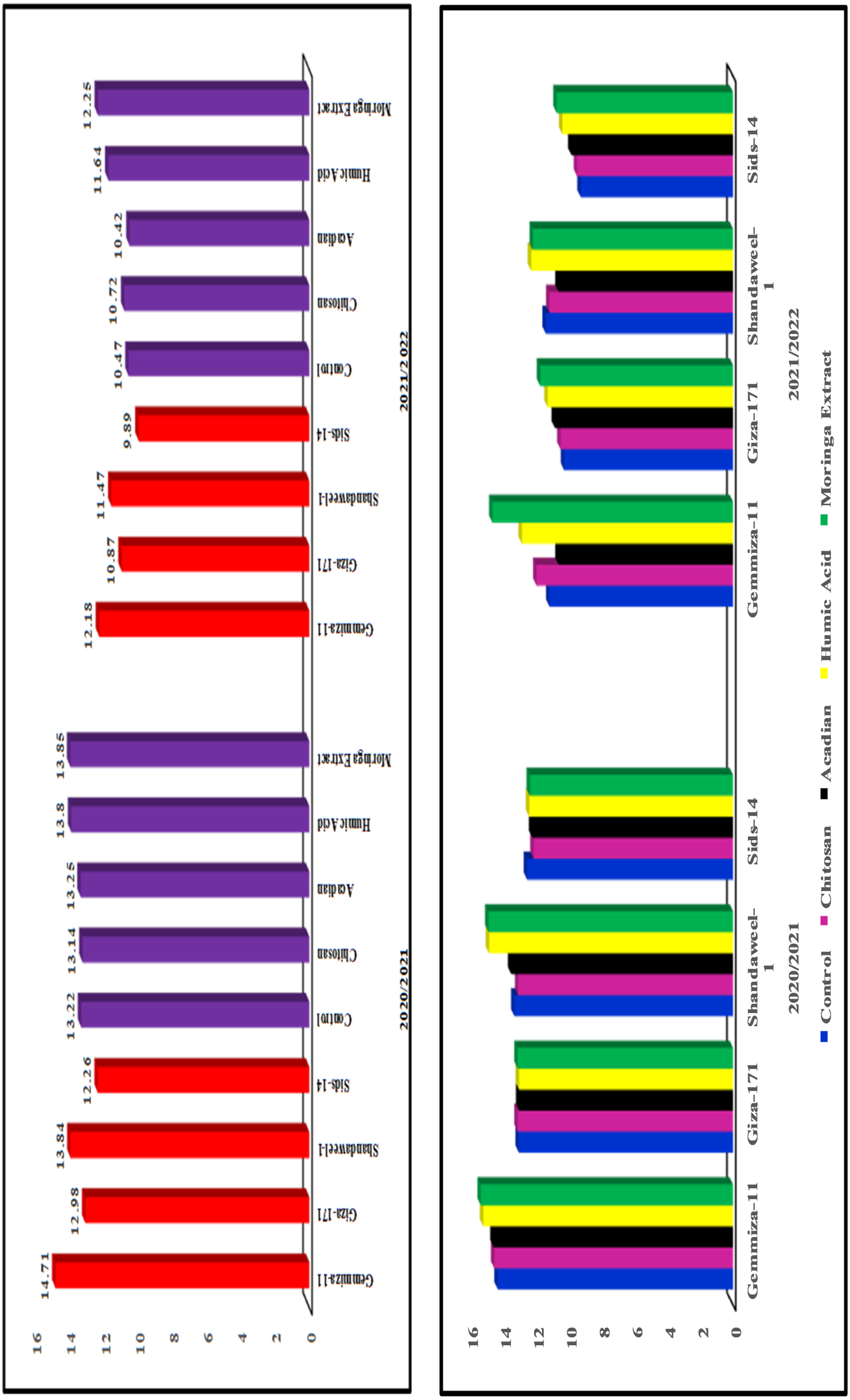

Figure 1. Means of spike length (cm) of wheat as affected by some growth stimulators, cultivars and their interaction in 2020/21 and 2021/22 seasons.

3. Number of kernels spike^{-1}

The results shown in Table 3 indicate that foliar spray treatment with some growth stimulators had a significant ($P < 0.01$) effect on the number of kernels spike^{-1} in both seasons. The maximum kernels number spike^{-1} were produced by wheat plants which sprayed with Moringa Extract (54.82 and 63.52 kernels spike^{-1} in the two seasons, respectively). In both seasons, the control treatment produced the lowest mean values of kernels number spike^{-1}, (45.94 and 45.04, respectively). The reason for this could be because the same treatment produced the longest spike, in addition to fecundity, which increased the number of kernels spike^{-1}. These findings align with the research conducted by Jhilik *et al*. (2017) and Khan *et al*. (2020) who also observed similar results.

The collected data in Table 3 further reveal that the number of kernels spike^{-1} in the first and second seasons was significant ($P \leq 0.05$) and highly significantly ($P \leq 0.01$) influenced by the tested bread wheat cultivars. The highest mean kernel number spike^{-1} values were produced by the Gemmiza-11 cultivar in both seasons (56.49 and 58.06 kernel spike^{-1}, respectively). The Sids-14 cultivar exhibited the lowest mean values for kernel number per spike (39.30 and 49.44 kernels per spike in the two respective seasons). Considering the combined influence of environmental conditions and genotypic characteristics, the Gemmiza-11 cultivar seems to outperform the other cultivars examined in this study. These results are consistent with the study carried out by EL Hag and Shahein, (2017) and Gomaa *et al*. (2018).

According to the findings in Table 3, the number of spikes in kernels was significantly ($P \leq 0.01$) affected by the interaction between bread wheat cultivars and foliar spray by growth stimulators in both seasons. The highest mean values of kernels number spike^{-1} were produced by the Gemmiza-11 cultivar, which was sprayed with Moringa Extract (62.67 and 66.77 kernel spike^{-1} in the two growing seasons).

4. Thousand grain weight (g)

The data presented in Fig.2 indicate that the 1000-kernel weight in both seasons were highly significantly affected ($P < 0.01$) by foliar spray treatments with growth stimulators. Foliar spraying with Moringa Extract produced the highest mean 1000-kernel weight values (56.85 and 55.90 g in the first and second seasons, respectively,). Moringa leaves are a good source of plant nutrition since they are high in calcium, potassium, magnesium, manganese, phosphorus, zinc, sodium, copper, and iron. They are also nutrient-rich and include important vitamins A, C, and E which cause wheat grains to grow and become full and gain weight. These results are consistent with the study carried out by Merwad and Abdel-Fattah (2017), Merwad (2019) and Merwad (2020), who likewise noted comparable outcomes.

Table 2. Means of plant height (cm) of wheat as affected by some growth stimulators, cultivars and their interaction in 2020/21 and 2021/22 seasons.

Season	2020/2021					2021/2022				
Cultivar (C) Growth Stimulators (GS)	Gemmiza-11	Giza-171	Shandaweel-1	Sids-14	Mean	Gemmiza-11	Giza-171	Shandaweel-1	Sids-14	Mean
Control	119.73	108.87	108.67	109.47	**111.68**	115.22	106.78	103.33	108.33	**108.42**
Chitosan	117.73	114.60	107.80	112.73	**113.22**	118.44	112.22	109.33	111.89	**112.97**
Acadian	118.60	112.60	109.93	113.07	**113.55**	116.00	106.78	109.67	110.22	**110.67**
Humic Acid	120.60	113.20	111.27	113.73	**114.70**	119.22	113.89	108.00	111.67	**113.19**
Moringa Extract	122.00	114.40	110.60	116.27	**115.82**	121.67	112.22	108.78	117.33	**115.00**
Mean	**119.73**	**112.73**	**109.65**	**113.05**		**118.11**	**110.38**	**107.82**	**111.89**	
F test and LSD	**F test**			**LSD 0.05**		**F test**			**LSD 0.05**	
GS	**			**1.62**		**			**2.07**	
C	**			**4.71**		**			**1.87**	
GS × C	*			**2.72**		NS			**-**	

Where: NS, * and ** mean non-significant and significant at 5 and 1% level of probability, respectively.

Table 3. Means of kernels number spike^{-1} of wheat as affected by some growth stimulators, cultivars and their interaction in 2020/21 and 2021/22 seasons.

Season	2020/2021					2021/2022				
Cultivar (C) Growth Stimulators (GS)	Gemmiza-11	Giza-171	Shandaweel-1	Sids-14	Mean	Gemmiza-11	Giza-171	Shandaweel-1	Sids-14	Mean
Control	55.35	46.90	47.50	34.00	**45.94**	48.75	40.45	46.55	44.40	45.04
Chitosan	55.45	52.65	50.47	35.50	**48.52**	52.70	48.23	58.25	44.93	51.03
Acadian	53.40	49.93	48.63	42.65	**48.65**	58.50	44.35	55.50	44.70	50.76
Humic Acid	55.60	56.93	54.95	40.80	**52.07**	63.60	60.25	53.75	53.10	57.68
Moringa Extract	62.67	59.25	53.85	43.53	**54.82**	66.77	64.33	62.95	60.05	63.52
Mean	**56.49**	**53.13**	**51.08**	**39.30**		**58.06**	**51.52**	**55.40**	**49.44**	
F test and LSD	**F test**			**LSD 0.05**		**F test**			**LSD 0.05**	
GS	**			**2.34**		**			**3.22**	
C	**			**2.20**		*			**3.42**	
GS × C	**			**3.42**		**			**4.58**	

Where: * and ** mean significant at 5 and 1% level of probability, respectively.

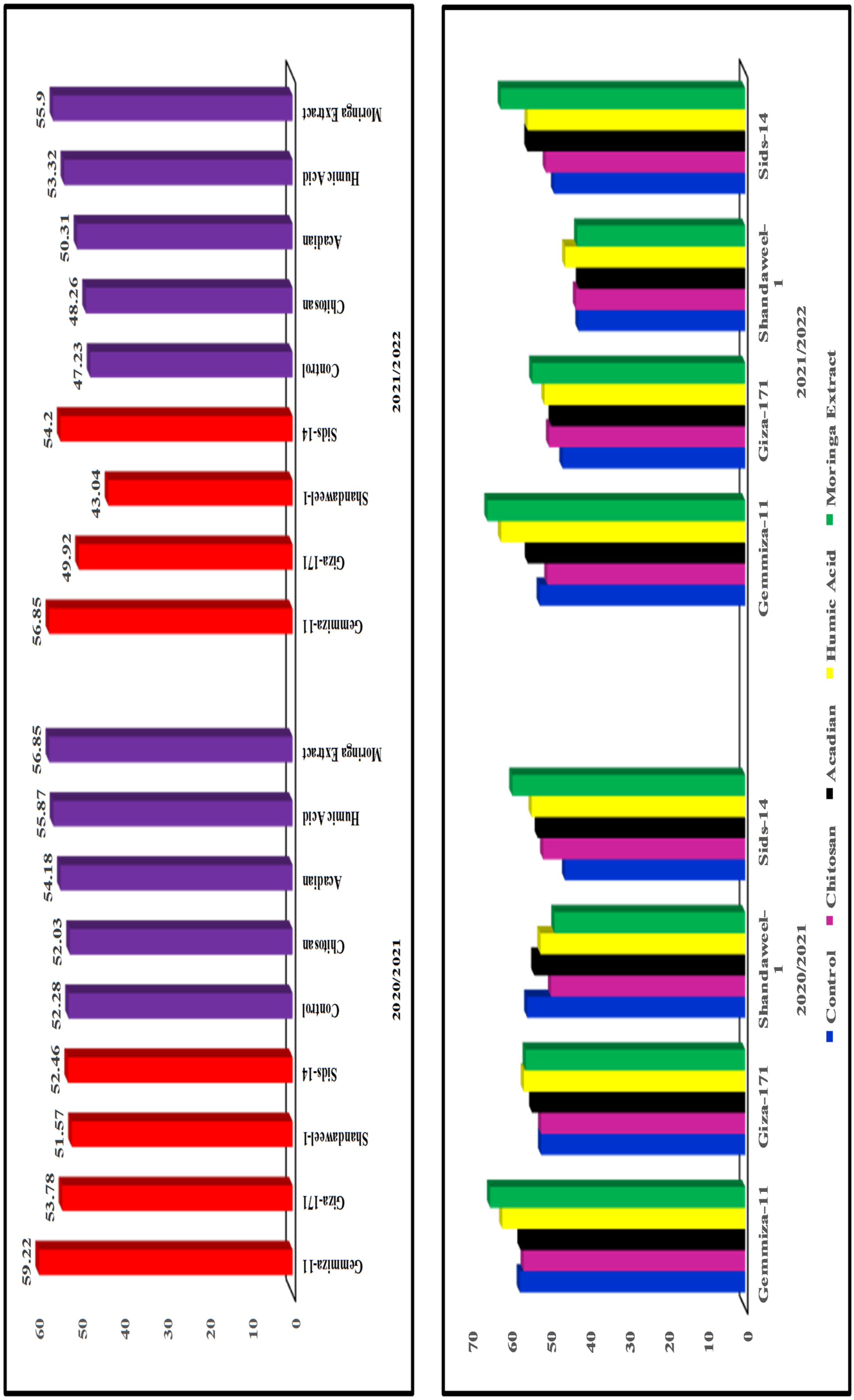

Figure 2. Means of 1000- kernel weight (g) of wheat as affected by some growth stimulators, cultivars and their interaction in2020/21 and 2021/22 seasons.

Furthermore, the data presented in Fig.2 show that the studied bread wheat cultivars had a significant ($P \leq 0.05$) and highly significant ($P < 0.01$) response of 1000-kernel weight in the first and second seasons. The greatest mean values of 1000 kernel weight in both seasons (59.22 and 56.85 g, respectively) were obtained by Gemmiza-11 cultivar. On the other hand, the Shandaweel-1 cultivar had the lowest mean 1000-kernel weight values in both seasons (51.57 and 43.04 g, respectively). This could be as a result of the Gemmiza-11 cultivar's genotypic behavior and environmental conditions being more appropriate for it than for the other cultivars. A comparable trend was seen by Solomon and Anjulo (2017), Farag *et al.* (2018), and Gebrel *et al.* (2019).

The interaction between bread wheat cultivars and growth stimulators, foliar spray, had a highly significant ($P \leq 0.01$) impact on 1000-kernel weight in both seasons (Fig. 2). Gemmiza-11 cultivar sprayed with Moringa Extract in both seasons, had the highest mean values of 1000-kernel weight (64.57 and 65.27 g in the two respective seasons).

5. Kernel weight spike^{-1} (g)

Illustrated data in Table 4 reveal that the foliar spray treatment with growth stimulators had a significant ($P < 0.05$) and highly significant ($P \leq 0.01$) effect on kernel weight spike^{-1} in the first and second seasons, respectively. Wheat plants sprayed with Moringa Extract produced the highest mean values of kernel weight spike^{-1} in both seasons (3.03 and 3.59 g in the 1st and 2nd seasons, respectively). On the other hand, the control treatment produced the lowest mean kernel weight spike^{-1} values in both seasons (2.49 and 2.25 g, respectively). This is logic since the same treatment produced the highest mean values for 1000-kernel weight (Fig. 2) and, consequently, the highest mean values for kernel weight spike^{-1}. There was a similar pattern observed by Rehman *et al.* (2017).

Additionally, Table 4 demonstrated that the studied wheat cultivars had a highly significant effect on kernel weight spike^{-1} during the growing seasons. As a result, Gemmiza-11 cultivar produced the highest mean values of kernel weight spike^{-1} (3.23 g and 3.42 g in the two respective seasons). Conversely, the lowest average values of kernel weight spike^{-1} were produced by the Sids-14 cultivar in both seasons (2.14 and 2.43 g in the first and second seasons, respectively). A comparable trend was seen by Gheith *et al.* (2013), Noureldin *et al.* (2013) and Seleem and Abd El –Dayem (2013).

Kernel weight spike^{-1} trait was not affected in both seasons by the interaction between cultivars and growth stimulators.

6. Grain yield (ardab fed.$^{-1}$)

The data in Table 5 show that the foliar spray treatment had a significant ($P < 0.05$) and highly significant ($P \leq 0.01$) effect on grain yield in the first and second seasons, respectively. Applying Moringa Extract produced the highest grain yield (24.12 and 24.04 ardab fed.$^{-1}$ in the 1st and 2nd seasons, respectively). Conversely, the control treatment produced the lowest mean grain yield values (21.39 and 21.16 ardab fed.$^{-1}$ in the first and second seasons, respectively). Given that the kernels weight spike^{-1} showed a similar trend, this is to be expected. The same trend was seen by Brockman and Brennan (2017), Merwad and Abdel-Fattah (2017), Khan *et al.* (2020), Merwad (2020) and Sura and Al-Hilfy (2022).

Table 4. Means of Kernel weight spike^{-1} (g) of wheat as affected by some growth stimulators, cultivars and their interaction in 2020/21 and 2021/22 seasons

Season	2020/2021					2021/2022				
Cultivar (C) Growth Stimulators (GS)	Gemmiza-11	Giza-171	Shandaweel-1	Sids-14	Mean	Gemmiza-11	Giza-171	Shandaweel-1	Sids-14	Mean
Control	2.88	2.73	2.23	2.11	2.49	2.70	2.18	2.02	2.09	2.25
Chitosan	2.86	3.10	2.61	1.83	2.60	3.20	2.60	2.30	2.24	2.58
Acadian	3.02	2.92	2.24	2.12	2.57	2.99	2.58	2.41	2.32	2.58
Humic Acid	3.37	3.22	2.62	2.23	2.86	3.71	3.22	2.64	2.41	2.99
Moringa Extract	4.03	3.24	2.42	2.42	3.03	4.49	3.72	3.08	3.07	3.59
Mean	3.23	3.04	2.42	2.14		3.42	2.86	2.49	2.43	
F test and LSD	F test			LSD 0.05		F test			LSD 0.05	
GS	*			0.33		**			0.32	
C	**			0.31		**			0.22	
GS × C	NS			-		NS			-	

Where: NS, * and ** mean non-significant and significant at 5 and 1% level of probability, respectively.

Table 5. Means of grain yield (ardab fed.$^{-1}$) of wheat as affected by some growth stimulators, cultivars and their interaction in 2020/21 and 2021/22 seasons

Season	2020/2021					2021/2022				
Cultivar (C) Growth Stimulators (GS)	Gemmiza-11	Giza-171	Shandaweel-1	Sids-14	Mean	Gemmiza-11	Giza-171	Shandaweel-1	Sids-14	Mean
Control	22.42	22.02	20.63	20.49	21.39	22.22	21.87	19.87	20.69	21.16
Chitosan	23.08	21.75	21.14	21.19	21.79	23.72	22.86	20.38	21.25	22.05
Acadian	22.80	21.96	21.76	20.62	21.79	23.80	23.87	21.98	21.12	22.69
Humic Acid	24.02	22.44	22.12	22.49	22.77	24.83	22.64	22.66	22.03	23.04
Moringa Extract	26.12	25.17	22.60	22.51	24.12	26.18	24.13	23.42	22.44	24.04
Mean	23.69	22.67	21.65	21.46		24.15	23.07	21.66	21.51	
F test and LSD	F test			LSD 0.05		F test			LSD 0.05	
GS	*			1.15		**			0.78	
C	**			0.75		*			2.07	
GS × C	*			2.74		*			2.30	

Where: * and ** mean significant at 5 and 1% level of probability, respectively.

Moreover, the tested bread wheat cultivars had a highly significant ($P < 0.01$) and a significant ($P \leq 0.05$) effect on grain yield fed.$^{-1}$ in both seasons, respectively. According to the findings reported in Table 5 Gemmiza-11 cultivar produced the highest grain yield values in both seasons (23.69 and 24.15 ardab fed.$^{-1}$, respectively). Other than that, Sids-14 yielded the lowest mean values of grain yield in both seasons (21.46 and 21.51 fed^{-1} in the 1st and 2nd seasons, respectively). Higher grain yield was demonstrated by the Gemmiza-11 bread wheat cultivar because of its advantage in kernel weight spike^{-1}. Observing the same pattern by Gheith *et al.* (2013), Fergani *et al.* (2014), El hag (2017) and Farag *et al.* (2018).

The interaction exhibited a significant effect on grain yield in both seasons. The Gemmiza-11 cultivar, which received Moringa Extract spraying in both seasons produced the highest mean grain yield values in this instance as well (26.12 and 26.18 ardab fed.$^{-1}$ in the two respective seasons).

Conclusion

Gemmiza-11 cultivar produced the greatest values of all examined traits in both seasons. The interaction between some growth stimulators and cultivars affected significantly grain yield fed^{-1} in both seasons. Gemmiza-11 cultivar sprayed with Moringa Extract in both seasons produced the highest grain yield values in both seasons (26.12 and 26.18 ardab fed.$^{-1}$, respectively)

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استجابة قمح الخبز للرش الورقي ببعض محفزات النمو

حسن مكارم*، إبراهيم عبد الباقي رزق الفار، السعدى عبد الحميد على، محمد ثروت سعيد

قسم المحاصيل، كلية الزراعة، جامعة أسيوط، اسيوط، مصر.

الملخص

تم إجراء تجربة حقلية خلال شتاء موسمي 21/2020، 22/2021 في مزرعة قسم المحاصيل البحثية، كلية الزراعة – جامعة أسيوط لدراسة تأثير الرش الورقي ببعض محفزات النمو على محصول الحبوب ومساهماته لأربعة أصناف من قمح الخبز. نُفِذت التجربة بتصميم القطاعات كاملة العشوائية بترتيب الشرائح المتعامدة المنشقة حيث تم وضع معاملات الرش الورقي بماء مقطر(كنترول) والرش الورقي بمستخلص المورينجا، الهيوميك أسيد، الشيتوزان بمستخلصات الطحالب بمعدل 13000، 4000، 500، 2500 جزء في المليون على الترتيب أفقياً بينما رُتِبت أصناف قمح الخبز (جميزه 11 وجيزه 171 وشندويل 1 وسدس 14) رأسياً. أوضحت النتائج التي تم الحصول عليها أن معاملات الرش الورقى ببعض محفزات النمو كان لها تأثير معنوي على صفات ارتفاع النبات (سم) وطول السنبلة (سم) وعدد حبوب السنبلة ووزن الألف حبة (جم) ووزن حبوب السنبلة (جم) ومحصول الحبوب للفدان (أردب) في كلا موسمي الزراعة. وأعطت نباتات القمح التي رُشت بمستخلص المورينجا أعلى المتوسطات للصفات سابقة الذكر، علاوة على ذلك فإن الأصناف محل الدراسة كان لها تأثير معنوي على كل الصفات التي تم دراستها. بالإضافة إلى أن صنف جميزه 11 أعطى أعلى متوسطات لقيم الصفات التي تمت دراستها خلال موسمي الزراعة.

كما كان للتفاعل بين الرش الورقي ببعض محفزات النمو وأصناف قمح الخبز تأثير معنوي في كلا الموسمين على صفة محصول الحبوب للفدان، حيث تم الحصول على أعلى متوسطات لقيم هذه الصفة والتي بلغت 26.12، 26.18 أردب للفدان في كلا موسمي الزراعة الأول والثاني على الترتيب عند زراعة الصنف جميزه 11 والتي تم رشه ورقياً بواسطة مستخلص المورينجا.

الكلمات المفتاحية: *أصناف القمح، شيتوزان، محصول الحبوب ومساهماته، مستخلصات الطحالب البحرية (أكاديان)، مستخلص المورينجا، هيوميك اسيد*