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IMPACT OF CONCENTRATION AND APPLICATION TIME OF DIFFERENT PLANT EXTRACTS ON YIELD AND ITS ATTRIBUTES OF BREAD WHEAT (*Triticum aestivum* L.) AS WELL AS WEED CONTROL

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ABSTRACT
Two filed experiments were carried out in a sandy soil private farm located in Qassasin Ash Sharq, El Husseiniya, Fakous District, Sharqia Governorate, Egypt, during the winter seasons of 2019/2020 and 2020/2021, to study the effect of spraying four plant leaf extracts in addition to spraying with distelled water (*Moringa oleifera* L., *Chinopodium album* L., *Lantana camara* L. and a mixture of the previous three extracts) at three concentrations (50, 75 and 100%) in three different times (40, 80 and 120 days after sowing) on wheat yield and its attributes as well as both grains crude protein and carbohydrates content of wheat cultivar Misr 1, also the influence of the past treatments on both weeds number and dry weight/m^2 were investigated, Split-split plot design in three replicates was used. Results indicated that spraying wheat plants with 75% concentration of *Chinopodium album* leaves extract during early growth stage (tillering) recorded an increment valued as much as 18% in grain yield and a 33% as well as 21% decreasing in weeds number and dry weight/m^2.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most harvested cereal crop globally per annum, known as the king of cereals; due to its role in human daily diet as 12% protein (**Giraldo *et al.*, 2019**). In Egypt, wheat acreage exceeded 1.41 million hectare yielded 9 million ton in 2020 with an average of 6.38 ton/ha (**FAOSTAT, 2020**). Although the highly production capacity, there is a gap between production and consumption reached about 6 million ton (**USDA, 2021**). New sandy soil in Egypt is a great treasure to exploit in order to face the increased need of wheat where the average productivity reached 4.5 ton/ha. (**USDA, 2021**). Newly reclaimed sandy soils are poor in organic matter content and available nutrients, as well their capacity to retain water is low and coordinates with supplying power for nutrients (**Sharpley, 1985**).

Plant extracts are natural source of many substances that possess an operative role mostly on growth and productivity of many crops when foliar sprayed during different growth stages. Several studies were conducted to investigate the efficacy of treating plants with leaf extracts of different plant species, especially weeds and wild species, which are characterized by high ability to adapt to different environmental conditions. Furthermore, juice of fresh leaves of wild plants contains a large number of nutrients, antioxidants, polyphenols and vitamins, which play a role as growth bio-stimulants when used as foliar application (**Halpern *et al.*, 2015**).

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The extract of lantana (*Lantana camara* L.) leaves, which is grown in Egypt as an ornamental plant, contains phenolic substances such as (Pentacylic Triterpenoids, Flavonoids), which play an important role as anti-microbial, anti-bacterial and anti-fungal specially in the resistance of leaf rust of wheat (**Draz *et al.*, 2019; Cavalcante *et al.*, 2020**). In addition, Lantana extract contains moderate proportions of macro and micronutrients such as Phosphorus, Calcium, Magnesium, Sulphur, Potassium, Iron, Zinc and Copper (**Haruna *et al.*, 2015**).

Chinopodium album leaves are rich in proteins (4.2%) with a high proportion of essential amino acids such as lysine, leucine, and isoleucine, and significant amounts of calcium and vitamins A and C (**Guerrero and Isasa, 1997; Gonzalez *et al.*, 2003; Pande and Pathak, 2010**). **Abdulmajeed and Muhammad (2012)** reported that treating wheat plants with leaf extracts at lower concentrations (50% and 25%) caused a significant increase in grain yield and its components as well as yield attributes in comparison to higher concentrations (75% and 100%). Furthermore, *C. album* had an allelopathic effect on control winter weeds growing in winter fields, which reduced total weeds dry weight by 35% (**Shafique *et al.*, 2011**); hence, less competition and higher wheat productivity could be achieved.

Extract of *Moringa oleifera* leaves is a growth promoter due to its content of ascorbates, carotenoids, phenols, potassium, and calcium (**Foidl *et al.*, 2001**). Antioxidants such as ascorbic acid and glutathione were found at high concentrations in Moringa plant organs (**Noctor and Foyer, 1998**). Moringa leaves are a rich source of total protein, vitamin C, calcium, and potassium (**Dillard and German, 2000; Siddhuraju and Becker, 2003**). **Culver *et al.* (2013)** quoted that spraying wheat plants by Moringa leaves extract significantly increased shoot and root dry weight. **Abdalla (2013)** avowed that plant height, dry weight, chlorophyll a and b, total sugars, ascorbic acid, phenols, nitrogen (N_2), phosphorus, potassium (K), calcium (Ca), magnesium (Mg), and iron (Fe) concentration of rocket plants (*Eruca vesicaria* L.) were increased with foliar spray of 2% Moringa leaf extract. **Merwad and Abdel-Fattah (2017)** motioned that the highest value for each of biological yield, grain yield, wheat grains quality, and nutrient uptake by plants was obtained through treating plants by Moringa extract at 4% concentration.

The study aimed at investigating the effect of different aqueous extracts of leaves from different plant species at different concentrations in three spraying times on growth, yield and quality of a common bread wheat cultivar (Misr 1) and on weed control. The extracts were obtained from fresh leaves of *Chinopodium album*, *Lantana camara*, *Moringa ololiefera* and a mixture of the three extracts at 1:1:1*(V:V:V)*; in addition to distilled water as a check. The concentrations used were 100 %, 75% and 50%; foliar spraying was in three growth stages *q.e.* (40, 80 and 120 days after sowing) which coincide with tillering, elongation and flowering stages in wheat, respectively.

MATERIALS AND METHODS

Two filed experiments were conducted in an experimental field in a private farm located in Qassasin Ash Sharq, El Husseiniya, Fakous District, Sharqia Governorate, Egypt (30°45'36.3"N 32°02'01.6"E) during the winter seasons of 2019/2020 and 2020/ 2021. The study aims to investigate the impact of four plant leaf extracts in addition to foliar spraying with distilled water (check treatment), three spraying times as well as three concentrations for each plant extract on yield and its attributes as well as grains quality (crude protein and carbohydrate content). On the other hand, investigating the effect of the study treatments on weed plants number and dry

weight/m^2. The plant extract treatments included 1. *Chinopodium album* leaf extract, 2. *Lantana camara* leaf extract, 3. *Moringa oleifera* leaf extract, 4. Mixture of the three previous leaf extracts at 1:1:1 (*V:V:V*). Spraying the plant extracts included three treatments which were spraying at 40 days after sowing (DAS) *i.e.* at tillering stage, 80 DAS *i.e.* at elongation stage and 120 DAS *i.e.* at flowering stage. The third factor under study was the plant extract concentration and included three treatments *i.e.* 50%, 75% and 100%.

Statistical Layout and Agricultural Practices

The experiment was carried out using split-split plot design in three replicates included 135 plots, each of 12 m^2 (3×4 m), a distance of 1 m between plots was left to fade the overlapping of treatments. Leaf extract concentrations were laid out in main plots, spraying time treatments were occupying the sub-plots and the plant extract treatments were assigned to the sub-sub plots. Sowing was in rows, 15 cm spacing on Nov. 16th in both seasons at a seeding rate of 60 kg/faddan (faddan= 4200 m^2). All agricultural practices were conducted as recommended under the region conditions. Potassium fertilizer as Potassium sulfate (48% K_2O) and Phosphorus fertilizer as ordinary Super phosphate (15.5% P_2O_5) were applied before planting at level of 50 and 100 kg/fad., respectively. Nitrogen fertilizer as ammonium nitrate (33.5% N) was applied at a level of 200 kg/fad., and it was divided into 3 equal doses supplied at sowing, 15 and 30 DAS. Harvest took place at 165 days after sowing.

Soil Sampling and Analysis

Soil samples from the experimental site were taken from the upper 30 cm soil surface during soil preparation; soil chemical and physical analyses were carried out according to the methodology of **Jackson (1958)** and **Lindsay and Norvell (1978).** As shown in Table 1, soil texture is sandy with pH of 8.22 and soil extract salinity was moderate (0.53). The levels of available N, P and K as essential elements were 49.15, 14.46 and 187.5 ppm, respectively, which indicated that the fertility of soil was good because it was sown by well tillage for many years before.

Preparation of Plant Extracts

1. Check/control (E1): distilled water was sprayed as control.
2. *Chinopodium album* L. (E2): fresh leaves of *Chenopodium album* were collected from the farm of Faculty of Agriculture, Zagazig University and air dried far from direct sunlight. Dry leaves were crushed in distilled water at 20g/100 ml of distilled water for 48 hours at room temperature (27±2ºC). Solution was filtered through Whatman filter paper No. 1. The filtrate was stored at 5ºC for further use **Abdulmajeed and Muhammad, 2012**).
2. *Moringa oleifera* L. (E3): After collecting young leaves of *Moringa oleifera* and well air dried, it was crushed and 20 g of the powder was mixed with 675 ml of 80% ethanol (≈2.9%) as suggested by **Makkar and Becker (1996**). The suspension was well stirred, and then filtered using Whatman filter paper No.2. The extract was stored at 4ºC for further use.
3. *Lantana camara* L. (E4): Fresh leaves were collected from the garden of Faculty of Agriculture, Zagazig Univ., Egypt, cleaned with distilled water and shade dried, and then it was crushed into powder. The powder was sieved and defatted with petroleum ether (60°C) for 24 hours at room temperature (27± 3ºC by continuous shaking. 50g of the defatted powdered material was extracted at 50°C with a volume of 500 ml (≈ 10%) comprising of two different solvents 1) aqueous and 2) aqueous-methanolic (70: 30 methanol: water) in the soxhlet apparatus for three days. The extract was dried at 60°C in the oven and kept at 4°C for further use. That methodology was developed by **Harborne (1973)** as well as **Kumar and Maneemegalai (2008)**.

Table 1. Physical and chemical properties of the experimental site before sowing

Soil particles distribution	
Sand (%)	89.34
Silt (%)	5.32
Clay (%)	5.34
Soil texture	Sandy
Organic matter, (g kg^{-1})	4.10
pH*	8.22
EC, (dSm^{-1}) **	0.53
Chemical properties	
Soluble cations and anions, (mmol L^{-1})**	
Total N, (g kg^{-1})	3.70
Total P, (g kg^{-1})	0.12
Total K, (g kg^{-1})	1.6
Available N, (mg kg^{-1}soil)	49.15
Available P, (mg kg^{-1}soil)	14.46
Available K, (mg kg^{-1}soil)	187.5

* Soil-water suspension 1: 2.5 ** Soil water extract 1: 5

Extracts of *Chinopodium album* L., *Moringa olleifera* L. and *Lantana camara* L. were 20, 2.9 and 10% concentrations, respectively, to prepare three-quarters% (15, 2.1 and 7.5%, respectively) and half% concentrations (10, 1.45 and 5%, respectively); extracts were diluted by distilled water until the needed volume based on percentage, which gives the required concentration.

Studied Characters

Number of tillers per plant was measured as the mean of ten plants counted, Leaf area (cm^2) was calculated at 150 DAS using formula (Length x maximum width x 0.79) according to **Voldeng and Simpson (1967)**, No. of spikes/m^2 was counted manually at harvest, No. of grains/spike was recorded as the mean of 5 spikes, 1000-grain weight (g), spikes yield of 1 m^2 from each plot was threshed, and its grain yield was weighted; then, it is mathematically converted to grain yield (kg/fad.), one faddan is 4200 m^2, and harvest index (%) was estimated according to **Donald (1962)** as follows:

$$\text{Harves index} = \frac{\text{Grain yield (Kg/fad)}}{\text{Biological yield (Kg/fad)}} \times 100$$

Crude protein content (%) was measured in grain sample from each plot which was dried at harvest at 70º C for 24 hours using a colorimeter method according to **Jackson (1967)** through multiplying N uptake by 5.75 to obtain grain protein content (%) according to **AOAC (1990)**, total carbohydrates content (%): It was determined according to **Bernfeld (1955)** and **Miller (1959).**

Weed Plants Measurements

An area of 1 m^2/each plot was randomly chosen at 135 days after sowing (DAS) to count the number of weed plants (any grown plants other than wheat plants), then weeds dry weight (g/m^2 was recorded after oven dried at 70º C for 24 hours.

Statistical Analysis

Data recorded from each plot were subjected to the analysis of variance (ANOVA) of The split-split plot design according to **Gomez and Gomez (1984)** using COSTAT-Statistics Software 6.400

package as described by **Cardinali and Nason (2013)**, available at https://cran.r-project.org/web/packages/costat/citation.html. The error mean squared of split-split plot design were homogenous (Bartlett's test), so the combined analysis was calculated for all the studied characters in both seasons.

RESULTS AND DISCUSSION

Results presented in Tables 2, 3, 4, 5, 6 show the effect of foliar spraying with leaf extract of three plant species and their mixture in addition to distilled water as control; as well as three different concentrations during the three different growth stages on wheat yield and its attributes, both grains crude protein and total carbohydrates content (%), as well as weeds number and dry weight/m^2.

Effect of Plant Extract Concentrations

Raising the concentration of the plant extract from 50% to 75% or 100 % was affectless and insignificantly impacted each of No. of tillers/plant, flag leaf area/cm^2 (Table 2), No. of spikes/m^2 in both seasons and their combined (Table 3)and both weeds number and dry weight (Table 6-combined results).. Wheat plants treated with the moderate leaf extract concentration (C_2) recorded the highest No. of grains/spike (40.84) and the highest 1000 grain weight (40.55 g) as shown from the combined analysis (Table 3).

The combined analysis in Tables 4 and 5 showed that the grain yield kg/fad., harvest index and total carbohydrates (%) were at bar under spraying with 75% or 100% concentration; these two treatments outbrave spraying with the low concentration (50%) regarding the past traits.

Referring to crude protein content (Table 5), results from combined analysis indicated that the highest crude protein content (14%) was attained due to spraying wheat plants with the highest extract concentration (C_3). In other words, each raising in leaf extract concentration was accompanied by raising crude protein content (%). That result might be due to the higher level of nutrients provided through the higher concentration of sprayed plant extract.

Effect of Spraying Time

According to the results presented in Tables 2, 3, 4 and 5, spraying time had a significant influence on wheat yield and most attributes. Foliar spraying of different plant extracts at tillering stag S_1 (40 DAS) recorded the highest values in each of No. of spikes/m^2 (376.14), No. of grains/spike (42.03) and 1000-grain weight (39.43 g), and consequently the highest grain yield (2327.21 kg/fad.) as combined. Spraying the tested extracts at flowering stage (120 DAS) recorded low yield components, thus the lowest grain yield (2220.07 kg/fad.) was obtained. In addition, spraying at tillering stage (S_1) led to the highest crude protein content (13.69%). There was insignificant difference among spraying times in No. of tillers/plant, flag leaf area and total carbohydrates content (combined results).

Results in Table 6 indicate that spraying time of the tested extracts highly and significantly affected on both weeds number and dry weight/m^2. Spraying at tillering stage S_1 (40 DAS) recorded the lowest number of weeds/m^2 (28.55) and the lowest dry weight (82.36 g/m^2); while spraying at flowering stage S_3 (120 DAS) recorded the highest number of weeds/m^2 (33.58), and consequently the highest weeds dry weight (86.86 g/m^2). It is known that the critical period to control weeds is the early growth stages from 3 to 6 weeks after sowing (**Agostinetto *et al.*, 2008**), so that the obtained results were expected; because in early growth stages, the efficacy of controlling weeds is higher due to the high physiological activity.

Table 2. Number of tillers/plant and flag leaf area (cm^2) as affected by leaf extracts, concentrations, spraying time and plant extracts in both seasons and their combined

Main effects and interaction	No. of tillers/plant			Flag leaf area (cm^2)		
	2019/20	2020/21	Comb.	2019/20	2020/21	Comb.
Concentrations (C)						
50 % (C_1)	2.17	2.45	2.35	25.43	28.67	27.05
75 % (C_2)	2.62	2.32	2.42	30.50	25.99	28.24
100 % (C_3)	2.45	2.38	2.41	27.33	26.92	27.12
F test	NS	NS	NS	NS	NS	NS
Spraying time (S)						
40 DAS/ at tillering (S_1)	2.70	2.37	2.50	30.36	25.16	27.76
80 DAS/ at elongation (S_2)	2.30	2.36	2.33	26.28	28.38	27.33
120 DAS/ at flowering (S_3)	2.24	2.42	2.33	26.60	28.02	27.31
F test	NS	NS	NS	NS	NS	NS
Plant extracts (E)						
Check/ distilled water (E_1)	2.27 c	1.93 c	2.10 b	27.37 b	23.31 c	25.34 c
Chinopodium album (E_2)	2.70 a	2.81 a	2.67 a	27.79 b	30.41 a	29.10 a
Lantana camara (E_3)	2.40 b	2.58 ab	2.50 ab	26.39 b	28.54 b	27.46 b
Moringa olifera (E4)	2.59 ab	2.30 b	2.50 ab	30.76 a	26.20 b	28.48 a
E2 + E3 + E4 (E5)	2.10 c	2.30 b	2.20 ab	26.46b	27.48 b	26.97 b
F test	*	*	*	*	*	*
Interaction effects						
C × S	NS	NS	NS	NS	NS	NS
C × E	*	*	*	*	*	*
S × E	NS	NS	NS	NS	NS	NS

* and ** indicate significant at 5% and 1% levels of probability; NS indicate not significant.

Table 3. Number of spikes/m^2, No. of grains/spike and 1000 grain weight (g) as affected by concentrations, spraying time and plant extracts in both seasons and their combined

Main effects and interaction	No. of spikes/ m^2			No. of grains/spike			1000 grain weight (g)		
	2019/20	2020/21	Comb.	2019/20	2020/21	Comb.	2019/20	2020/21	Comb.
Concentrations (C)									
50 % (C_1)	340.05	392.00	366.02	33.63 c	37.93 b	35.78 c	34.63 c	40.17 a	37.90 b
75 % (C_2)	402.49	341.49	371.99	43.62a	38.06 ab	40.84 a	43.79 a	37.31 b	40.55 a
100 % (C_3)	383.08	368.06	375.57	40.77 b	39.17 a	39.97 b	39.32 b	37.78 b	38.55 b
F test	NS	NS	NS	**	**	**	*	*	*
Spraying time (S)									
40 DAS/ at tillering (S_1)	406.23 a	346.05 a	376.14 a	45.45 a	38.61	42.03 a	42.58 a	36.14 b	39.43 a
80 DAS/ at elongation (S_2)	369.00 b	375.79 b	372.39 b	37.12 b	39.12	38.12 b	38.20 b	40.12 a	39.07 ab
120 DAS/ at flowering (S_3)	350.39 b	379.69 b	365.04 b	35.44 c	37.40	36.42 b	36.96 c	39.00 a	38.50 b
F test	*	*	*	*	NS	*	*	*	*
Plant extracts (E)									
Check/ distilled water (E_1)	382.65 b	335.97 d	359.31 d	37.95 c	33.23 d	35.59 d	38.24 bc	32.58 d	36.51 d
Chinopodium album (E_2)	365.88 c	396.36 a	381.12 a	39.57 b	42.87 a	41.22 a	39.68 b	44.09 a	41.51 a
Lantana camara (E_3)	361.66 c	391.80 a	376.73 b	37.80 c	40.96 b	39.38 b	37.16 c	40.26 b	38.71 c
Moringa olifera (E4)	407.82 a	345.75 c	376.85 b	44.84 a	37.34 c	41.09 ab	43.00 a	36.81 c	40.01 b
E2 + E3 + E4 (E5)	358.02 c	366.04 b	362.03 c	36.55 c	37.50 c	37.02 c	38.16 bc	38.36 c	38.26 c
F test	*	*	*	*	**	**	*	*	*
Interaction effects									
C × S	NS	NS	NS	*	*	*	*	*	*
C × E	NS	NS	NS	*	*	*	*	*	*
S × E	*	*	*	*	*	*	*	*	*

* and ** indicate significant at 5% and 1% levels of probability; NS indicate not significant.

Table 4. Grain yield (kg/fad/) and harvest index (%) as affected by concentrations, spraying time and plant extracts in both seasons and their combined

Main effects and interaction	Grain yield (kg/fad.)			Harvest index (%)		
	2019/20	2020/21	Comb.	2019/20	2020/21	Comb.
Concentrations (C)						
50 % (C_1)	1929.07 c	2175.33 b	2065.64 b	33.96 b	38.30 a	36.13 b
75 % (C_2)	2553.41 a	2349.95 a	2464.82 a	40.05 a	36.96 b	38.50 a
100 % (C_3)	2307.11 b	2315.31 a	2284.94 ab	39.10 a	39.24 a	39.17 a
F test	*	*	**	*	*	*
Spraying time (S)						
40 DAS/ at tillering (S_1)	2216.48 b	2397.93 a	2327.21 a	38.25 a	41.21 a	39.73 a
80 DAS/ at elongation (S_2)	2281.92 a	2274.53 b	2268.14 b	35.12 b	35.62 b	35.37 b
120 DAS/ at flowering (S_3**)**	2291.19 a	2168.11 c	2220.07 c	39.72 a	37.68 b	37.70 ab
F test	*	*	*	*	*	*
Plant extracts (E)						
Check/ distilled water (E_1)	1964.16 d	2127.84 b	2046.00 d	33.22 c	36.84 b	35.03 c
Chinopodium album (E_2)	2363.56 b	2460.04 a	2411.80 a	40.27 a	41.91 a	41.09 a
Lantana camara (E_3)	2163.65 c	2439.86 a	2301.75 bc	34.85 c	39.44 a	37.15 bc
Moringa olifera (E4)	2456.59 a	2188.41 b	2322.50 b	42.55 a	37.73 b	40.14 ab
E2 + E3 + E4 (E5)	2368.03 b	2185.87 b	2276.95 c	37.61 b	34.91 c	36.26 c
F test	*	*	**	*	*	**
Interaction effects						
C × S	*	*	*	*	*	*
C × E	*	*	*	*	*	*
S × E	*	*	*	*	*	*

* and ** indicate significant at 5% and 1% levels of probability; NS indicate not significant.

Table 5. Grain protein and total carbohydrates content as affected by concentrations, spraying time and plant extracts in both seasons and their combined

Treatments	Crude protein content (%)			Total carbohydrates (%)		
	2019/20	2020/21	Comb.	2019/20	2020/21	Comb.
Concentrations (C)						
50 % (C_1)	9.77 c	11.40 c	10.75 c	63.63 c	69.49 b	66.41 b
75 % (C_2)	14.02 a	13.12 a	13.74 b	73.32 a	67.25 b	70.28 a
100 % (C_3)	14.49 ab	14.18 a	14.00 a	69.49 b	71.48 a	70.48 a
F test	*	*	**	*	*	*
Spraying time (S)						
40 DAS/ at tillering (S_1)	12.82	14.56 a	13.69 a	69.35 c	72.05 a	68.70
80 DAS/ at elongation (S_2)	12.77	12.20 b	12.48 b	68.82 b	69.65 b	68.23
120 DAS/ at flowering (S_3**)**	12.71	11.94 b	12.33 b	72.77 a	66.22 b	69.25
F test	NS	*	*	*	*	NS
Plant extracts (E)						
Check/ distilled water (E_1)	8.91 d	9.72 c	9.32 c	63.52 c	68.82 b	66.17 d
Chinopodium album (E_2)	13.78 b	14.34 a	14.06 a	71.00 b	73.90 a	72.45 a
Lantana camara (E_3)	13.39 c	15.09 a	14.24 a	64.08 c	72.26 ab	68.17 c
Moringa olifera (E4)	14.63 a	12.97 b	13.80 a	74.34 a	65.92 c	70.13 b
E2 + E3 + E4 (E5)	13.12 c	12.38 b	12.75 b	71.10 b	65.64 c	68.37 c
F test	*	*	**	*	*	*
Interaction effects						
C × S	*	*	*	*	*	NS
C × E	*	*	*	*	*	*
S × E	*	*	*	*	*	*

* and ** indicate significant at 5% and 1% levels of probability; NS indicate not significant.

Table 6. No. of weeds/m^2 and weeds dry weight (g/m^2) as affected by concentrations, spraying time and plant extracts in both seasons and their combined

Treatments	No. of weeds/m^2			Weeds dry weight (g/m^2)		
	2019/20	2020/21	Comb.	2019/20	2020/21	Comb.
Concentrations (C)						
50 % (C_1)	33.20 a	29.44 b	31.32	93.68	79.94	86.81
75 % (C_2)	30.87 b	32.15 a	31.52	83.89	87.69	85.79
100 % (C_3)	29.99 b	32.49 a	31.24	81.93	88.75	85.34
F test	*	*	NS	NS	NS	NS
Spraying time (S)						
40 DAS/ at tillering (S_1)	27.54 c	29.54 c	28.55 c	79.07 b	85.65 b	82.36 c
80 DAS/ at elongation (S_2)	32.68 b	31.24 a	31.97 b	90.49 a	86.95 a	88.72 a
120 DAS/ at flowering (S_3)	35.83 a	33.31 a	33.58 a	89.94 a	83.79 c	86.86 b
F test	*	*	*	*	*	*
Plant extracts (E)						
Check/ distilled water (E_1)	42.45 a	39.22 a	40.84 a	101.17 a	97.58 a	99.44 a
Chinopodium album (E_2)	26.64 d	28.13 d	27.38 c	78.94d	78. 07 c	78.57 c
Lantana camara (E_3)	33.55 b	31.04 c	32.29 b	96.17 b	91.80 b	93.70 b
Moringa olifera (E4)	30.74 c	33.22 b	31.98 b	90.88 c	90.89 a	90.45 b
E2 + E3 + E4 (E5)	23.41 e	25.21 d	24.31 d	65.33 e	70.01 d	67.74 d
F test	*	*	*	*	*	*
Interaction effects						
C × S	*	*	NS	NS	NS	NS
C × E	*	*	*	*	*	*
S × E	*	*	NS	NS	NS	NS

* and ** indicate significant at 5% and 1% levels of probability; NS indicate Not significant.

The obtained results regarding the effect of spraying time of the plant extracts are almost due to the early applying of plant extracts, which maximize its efficacy during early growth periods. These results are in harmony with those obtained by **Ibrahim *et al.* (2007).**

Effect of Plant Extract

From the presented results in Tables 2, 3, 4, 5 and 6, it was found that there were high significant effects due to spraying wheat plants with the leaf extract of the different spices on all recorded characters. Referring to the combined analysis, spraying wheat plants with *Chinopodium album* extract (E_2) produced more tillers per plant than check treatment, No. of tillers/plant was at par under any leaf extract treatment (E_2, E_3, E_4 and E_5). No. of tillers/plant under spraying *Chinopodium album* extract apt to outnumber other leaf extract spraying treatments.

The promoter effect of *Chinopodium album* extract as foliar spray on wheat plants was appreciable in each of flag leaf area (29.10 cm^2), No. of spikes/m^2 (381.12), No. of grains/spike (41.22) and 1000-grain weight (41.51 g). Superiority of *C. album* in the previous traits paved the way for its supremacy in grain yield/fad. (2411.80 kg/fad). It is reported that the higher flag leaf area, the higher contribution in grain filling, where flag leaf provides more than 20.1% of dry matter accumulated in spike grains (**Khalik *et al.*, 2008**).

M. oleifera extract (E_4) recorded a flag leaf area (28.48 cm^2) and No. of grains/ spike (41.09) as significant as *C. album* but

it ranked second in values of No. of spikes/m^2 (376.85), 1000 grain weight (40.01 g) and grain yield/fad. (2322.5 kg/fad.). Spraying wheat plants with either *L. camara* extract (E_3) or the mixture of the three extracts (E_5) recorded the lowest values in most traits studied.

Results in Table 4 allude to high values of harvest index due to foliar spraying each of *C. album*, *L. camara* and *M. oleifera*. These results display that these extracts stimulate dry matter translocation from the source to the sink.

Concerning the effect of plant extracts on wheat grains quality (protein and total carbohydrates content), results in Table 5 purported that foliar spray with each of *L. camara*, *C. album* and *M. oleifera* sensibly produced the highest protein content *i.e.* 14.24%, 14.06 % and 13.8 %, in the same respective order. Spraying *C. album* led to the highest total carbohydrates content (72.45%) and *M. oleifera* was in the second rank (70.13%). Distilled water as a check treatment recorded the lowest values in all measured characters.

Regarding the influence of spraying plant extracts on weed suppression through the allelopathic effects, it was found that there was a highly significant difference among plant extract treatments. Results of both number and weight of weeds/m^2 in Table (6) developed the role of plant leaf extract to hamper weed growth. The lowest No. of weeds/m^2 (24.31) as well as the lowest weed dry weight/m^2 (67.74 g) were achieved due to the foliar spray with the mixture of the three plant extracts.

Both No. of weeds/m^2 and dry weight (g/m^2) went to the utmost limit under check treatment. Spraying *C. album* ranked second followed by spraying with either *L. camara* or *M. oleifera* in weed control.

The achieved results divulged the versatile role of plant leaves extract as growth stimulators and confirms the necessity to use it as a new approach to reduce the reliance on mineral expensive fertilizers as well as the pollutant chemical growth exhibitors and nutrients. In addition, vantages of bio-extracts as allelopathic substances make it a new approach in weeds control with low costs, especially in the case of organic farming.

Effect of Interactions

Number of grains/spike, 1000 grain weight, grain yield/fad., harvest index and crud protein content were significantly affected by the interaction between leaf extract concentration and spraying time (C×S) as shown from the consolidated analysis (Tables 3,4 and 5). The interaction efficacy (C×S) was of no avail on the other traits under study. It is worth to mention that the main factors of the affected traits under C×S interaction were likened to its manner under the main factors under study, so results were not exposed.

The interaction between leaf extract concentration and plant extract type (C×E) was efficient on all studied traits with the exception of No. of spikes/m^2. The effect of the interaction (C×E) was analogous to the effect of main factors on those traits; accordingly, results were not shown.

The interaction between spraying time and the plant extract used (S×E) exhibited operative act on all traits under study with the exception of No. of tillers/plant, flag leaf area (cm^2), No. of weeds/m^2 and weeds dry weight (g/m^2) (Tables 2, 3, 4, 5 and 6). It is great moment to note that the response of the studied traits under both (S×E) interaction and the main factors was on a par, so results of the interactions were un tabled.

Conclusion

Using plant extracts is a new approach as an alternative for the pollutant expensive manufactured fertilizers and herbicides. Plant extracts obtained from fresh leaves are extremely source of many nutrients, anti-oxidants and anti-biotic supplements, in addition to the allelopathic properties for weeds control. This study aimed to investigate the effect of spraying three plant extracts solo and their mixture at three concentrations in three different growth stages on grain yield and its attributes of bread wheat (*Triticum aestivum* L.). It was resulted that spraying plant extracts at 75% concentration during early growth stage (tillering) led to higher grain yield by 18 % and a reduction in weeds number and dry weight reached to 33 and 21%, respectively through maximizing the role of yield components. It is important to think seriously about the production of plant extracts on a large scale commercially at low prices for clean sustainable agriculture and higher productivity.

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الملخص العربي

تأثير تركيز وميعاد إضافة مستخلصات نباتيه مختلفة على المحصول ومساهماته لقمح الخبز وعلى مكافحة الحشائش

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تم إجراء تجربتين حقليتين فى أرض رملية بمزرعه خاصه تقع فى منطقة قصاصين الشرق، الحسينية، مركز فاقوس، محافظة الشرقيه، مصر خلال الموسمين الشتويين 2020/2019 و2021/2020؛ لدراسة تأثير رش أربعة مستخلصات نباتية لأوراق (الزربيح - المورينجا - اللانتانا - مخلوط من الثلاثه السابقين بنسبة حجميه 1:1:1، بالإضافة إلى الماء المقطر كمعاملة مقارنة) بثلاثة تركيزات مختلفه (50% و75% و100%). تم استخدام تصميم القطع المنشقه مرتين فى ثلاث مكررات. أشارت النتائج إلى وجود فروق معنويه بين النباتات فى كل من المحصول ومساهماته وجودته (نسبة البروتين والكربوهيدرات بالحبوب) نتيجة المعاملات المُطبقه. أوضحت النتائج أن رش نباتات القمح بتركيز 75% من مستخلص أوراق نبات الزربيح خلال مرحلة النمو المبكر (التشطئ) سجل زيادة تقدر بنحو 18% فى محصول الحبوب وانخفض عدد الحشائش/م^2 ووزن الحشائش الجاف/م^2 بمعدل 33% و21% على الترتيب.

الكلمات الاسترشادية: القمح، مستخلصات نباتية، الزربيح، المورينجا، اللانتانا، وقت الرش.