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Response of Wheat and Accompanied Weeds to Allelophathic Extracts of Rice Straw and Some Herbicides

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ABSTRACT

The objective of this work is to evaluate the allelopathic effects of the aqueous and methanolic extract of rice straw (*Oryza sativa L.)* on wheat (*Triticum aestivum L.)* and wheat weeds, including wild oat *(Avena fatual L.)* and canary grass *(phalaris minor).* Three concentrations (5, 10 and 20%) of each aqueous and methanolic extract as well as the recommended dose of chemical herbicide clodinafop propargyl (140 g/ fed) and diclofop-methyl (750 ml/fed) were used on the tested plants as a post-emergence treatments. Response of the treated plants were measured by using 7 parameters includes: germination %, seedling shoots and root length, dry weight, chlorophyll content, plant height, plant number and spike length and weight of treated wheat. Data of each parameter were discussed separately. Generally, treatments with higher concentrations (20% rice straw aqueous and methanolic extract) showed negative effects on wheat weeds at the same time cause increasing the wheat productivity. However, rice straw methanolic extracts showed suppressive effect on wheat seed. Comparing the efficacy of the straw extract with the tested conventional herbicides, the obtained data showed that clodinafop propargyl and diclofop-methyl were the most effective against the time tested weeds as it severely reduced the weed population and other tested parameters.

Introduction

Canary grass *(Phalaris minor*) and wild oat (*Avena fatua*) are considered the most important weeds that infect wheat fields in Egypt which cause significant economic losses as a result of damage and the increase of the cost as a result of using chemical pesticide (El-Metwally and El-Rokiek, 2007). Modern agricultural practices adopted heavy use of a large variety of herbicides to overcome weed problem. However, this intensive use of chemical herbicides leads to adverse effects against health and environment (Mehdizadeh, 2016). With rising of human health and ecological concerns about the adverse effects of indiscriminate use of farm, research on alternative

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weed management methods is underway worldwide. Exploitation of allelopathic potential of different crop/plant species for weed management under field conditions is one such approach (Cheema et al. 2008). Many researchers investigated the possibilities for using allelopathy to improve overall potentiality of weeds and crops in natural weed management.(Bhadoria, 2011; Mehdizade and Mushtaq, 2019). The role of allelopathic plants extracts such as sunflowers, sorghum, maize, barely as well as rice straw in controlling weeds in wheat fields were investigated recently by different scientists (Cheema et al. 2012; Jamil et al. 2009; Awan et al. 2012). So, the present work was carried out to evaluate the efficacy of aqueous and methanolic extracts of rice straw in comparing with some chemical herbicides against wheat weeds under different conditions.

Materials and Methods

The experimental work was carried out under laboratory, semi field and greenhouse conditions at The Agronomic Research Area, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

Preparation of tested plant extracts.

Rice Straw Aqueous Extracts (RSAE)

Rice straw collection were carried out after the harvesting season. Rice straw included only shoot and leaves, while the spikes were cut off. The dried rice straw was chopped into 3-5 cm pieces (Goran and Sakri, 2008). Dry rice straw was soaked at the rate of 200 gm samples with 2000 ml distilled water (10%) for 24 h (Afridi et al . 2013).

Rice Straw Methanolic Extracts (RSME)

The same procedures step was followed as used in RSAE, while the dry rice straw was soaked in methanol (2 L) for 48 h at room temperature (25-30^{o}C). The methanol extract was evaporated to dryness by using a rotary evaporator (50^{o}C) and the dry residue was re-dissolved in distilled water to make up three concentrations (5, 10 and 20%).

Herbicides used

Diclofop-methyl and Clodinfop propargyl belonging to aryloxyphenoxy- propenic group were tested. These herbicides are widely used in Egypt for controlling target key weeds attacking wheat plants and other crops**.**

Experimental design and recording data of herbicidal activity

Three concentrations (5, 10 and 20 %) were equipped from rice straw extracts with using distilled water. The prepared concentrations as well as the recommended dose of diclofop- methyl (750 ml/fed) and clodinafop- propargyl (140 gm/fed) were used to investigate the herbicidal activity on wheat (*Triticum aestivum L.)*and wheat weeds, namely wild oat *(Avena fatua* L.*)* and canary grass (*phalaris minor*). Experiments were arranged in a randomized complete block design (RCBD) with four replicates.

Under laboratory conditions

Five seeds were sited on filter paper in each Petri dish of 3 ml extract of various concentrations and tested herbicides. Distilled water in control was applied. Both treated and control Petri dishes were kept continuously moisted by applying distilled water whenever needed. Germination was recorded daily for 10 days. Shoot and root length (cm) data of seedling were recorded with a measuring tape on 8 DAS (Days After Sowing). Seedling dry weight (mg) was recorded on 10 DAS using an electric balance after drying in an oven 70^0C for 48 h (Ashraf and Akhlaq, 2007).

Under greenhouse conditions

Fifteen seeds were placed in each pot and irrigation was continued until plant establishment. The same treatments as used in germination bioassay were applied after calibration of mini sprayer (Hand Atomizer) as spray to seedling in pots. Control treatment having water in pot was included for comparison. The experiment was comprised the different rice straw extracts treatments as : 1st spray at 30 DAS; 2nd spray at 45 DAS ; 3rd spray at 60 DAS and 4th spray at 75 DAS for each concentration, respectively. In addition to, herbicides treatments as: Clodinfop- propargyl was sprayed after 30 days from the first irrigation while diclofop- methyl was sprayed at 3 to 4 leaf stage. Plant dry weight was recorded on 95 DAS using balance after drying in an oven at 70^oC for 48 h. Chlorophyll content was measured by using a Minolta Chlorophyll Meter SPAD 502 plus, (Pujisiswanto et al. 2013). Data of chlorophyll at seedling were measured after 8 days of each treatment **(**38 (A_1), 53 (A_2), 68 (A_3) and 83 (A_4) DAS**).** Plant height was measured after 80 days (T_2) treatments. Spike length and weight of treated and untreated plants were assessed by using measuring tape and electronic balance, respectively after 85 days of spraying.

Under semi field conditions

Seeds of wheat and wheat weeds were mixed and placed into plots. The same as used in green house were applied after calibration of mini sprayer (Hand Atomizer) as spray to seedling in plot, as well as procedure for recording data for plant height, dry weight, chlorophyll content, dry weight

of spike, spike length and grain weight. Plants number was randomly counted at 90 DAS by using a woody frame (90 cm x 44 cm).

Statistical analysis

The obtained results were statistically analyzed by using Costat analysis of variance technique and least significant difference (LSD) test at the 5 % probability level was applied to compare the treatments mean.

Results and Discussion

Germination Percentage

Data of reduction effect on germination of wheat, wild oat and canary grass were summarized in Table (1). The obtained data indicated different range of germination % on wheat with the three tested concentration of aqueous and methanolic extracts of rice straw. The maximum germination percentage (72%) of wheat was observed by 20% aqueous extract of rice straw compared to the control and the tested herbicides. In case of wild oat and canary grass, all tested extracts at 10 and 20% significantly suppressed germination by 100 % compared to the control and tested herbicides. However, 5% aqueous and methanolic extract of rice straw showed the minimum inhibition in germination by 31.8 and 21.3 % with canary grass, respectively. These data was in a harmony with Afridi et al. (2013) who found that, rice straw extract significantly decreased the germination and growth of test plants. Also, (Moosavi et al. 2011) indicated that allelopathic effect of different concentrations was not significant for germination percentage, but germination rate and mean germination time decreased significantly by increasing the concentration of allelopathic extracts.

Table 1. Effect of prepared extracts and conventional herbicides on germination percentage of wheat and associated weeds.

Treatments		Germination percentage		
	Concentration	Wheat	Wild Oat	Canary Grass
Control		75 ± 1.4	65.6 ± 1.7	68 ± 1.1
Diclofop- methyl	750 ml/fed	60.7 ± 2.9	30 ±1.6	23.3 ± 2.5
Clodinafop- propargyl	140 gm/fed	59 ± 2.6	38.8 ± 2.5	31.8 ± 2.1
RSAE	5%	40 ± 1.3	5.25 ± 0.2	40 ± 0.9
	10%	64 ± 2.4	0 ± 0	0 ± 0
	20%	72 ± 1.7	0 ± 0	0 ± 0
LSD		NS	10.3	23.27
RSME	5%	21.3 ± 2.5	0 ± 0	21.3 ± 1
	10%	15.8 ± 1	0 ± 0	0 ± 0
	20%	16.3 ± 2.5	0 ± 0	0 ± 0
LSD		33.63	4.69	28.26

Seedling shoots and root length under laboratory conditions

Wheat, data in Figure (1) showed that, all tested aqueous extracts had no negative effect on seedling shoot and root length. However, the tested methanolic extracts and the tested conventional herbicides revealed deficiency of selectivity on wheat as they significantly decreased seedling shoot and root length. Regarding wild oat and canary grass**,** all tested treatments completely suppressed seedling shoot and root length of wild oat and canary grass compared with the control (2.38 ±0.8 and 1.75 ±1.3) and (6.04 ±0.3 and 2.7 ±0.5), respectively. (Tables 2). Highly concentration of rice straw extract showed inhibitory effect on the shoot length of some of the tested plants**.**

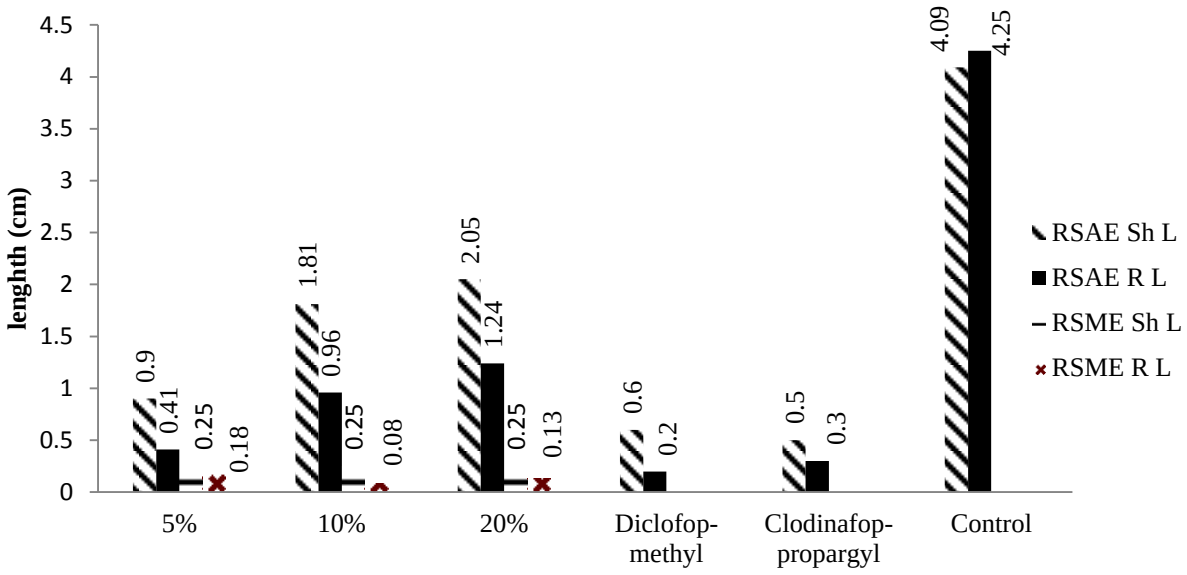

Figure 1. Effect of prepared extracts and conventional herbicides on shoot (ShL) and root length (RL) of wheat seedling.

These results are in agreement with those of Afridi et al. (2013) and Naderi and Bijanzadeh (2012) concluded that rice straw extract inhibited the root length of some tested plants i.e*., G. hirsutum* and *R. dentatus*.

Dry Weight

In laboratory

Wheat, maximum dry weight was obtained with 10 and 20% aqueous extract of rice straw (+12.5 and +16.6 %) and was followed by herbicides (4.16 and 16.6%) for diclofop- methyl and clodinafop- propargyl, respectively. For wild oat**,** the highest reductions (100%) were observed for

all concentrations of the methanolic extracts, 10 and 20% aqueous extracts. while the maximum inhibition in the dry weight of canary grass (100%) was obtained for concentrations of 10 and 20% rice straw extracts compared to the tested herbicides. (Table 3).

Table 2. Effect of prepared extracts and conventional herbicides on shoot (ShL) and root length (RL) of wild oat and canary grass seedling

Treatments	wild oat				canary grass			
	RSAE		RSME		RSAE		RSME	
	Sh L	R L	Sh L	R L	Sh L	R L	Sh L	R L
5%	0.25 ± 0.1	0.75 ± 0.4	-	-	0.06 ± 0.02	-	0.19 ± 0.1	0.06 ± 0.01
10%	-	-	-	-	-	-	-	-
20%	-	-	-	-	-	-	-	-
Diclofop- methyl	0.6 ± 0.6	0.2 ± 0.2			0.2 ± 0.2	0.1 ± 0.08		
Clodinafop- propargyl	0.8 ± 0.7	0.2 ± 0.2			0.3 ± 0.2	0.1 ± 0.07		
Control	2.38 ± 1.8	1.75 ± 1.3			6.04 ± 1.3	2.7 ± 1.5		
LSD	NS	NS	1.94	1.27	0.46	0.52	0.46	0.54

In greenhouse

Wheat, all treatments including tested extracts had no significant different effect on dry weight of wheat compared to the control. These results indicated the appropriate s/electivity of the tested extracts and herbicides on wheat plant. Wild oat, the highly reductions of dry weight were observed with diclofop- methyl then clodinafop- propargyl by 43 and 27.2 %, respectively. Lower % reductions were recorded by tested extracts. Canary grass, results showed that, maximum reduction in 20% aqueous extract of rice straw by 49.3 % and were followed by 39.8 and 37% with clodinafop-propargyl and 20 % aqueous extract of rice straw. (Figure 2).

Table 3. Effect of prepared extracts and conventional herbicides on dry weight (mg) of wheat and wheat weed under laboratory condition

Treatments	wheat				Wild oat				Canary grass			
	RSAE	% reduction	RSME	% reduction	RSAE	% reduction	RSME	% reduction	RSAE	% reduction	RSME	% reduction
5%	0.17	29.1	0.108	58.5	0.02	67.7	0	100	0.002	97.4	0.02	74.4
10%	0.27	12.5	0.093	61.7	0	100	0	100	0	100	0	100
20%	0.285	16.6	0.11	54.3	0	100	0	100	0	100	0	100
Diclofop-methyl	0.23	4.16			0.06	3.2			0.029	62.7		
Clodinafop-propargyl	0.2	16.6			0.079	27.41			0.036	53.7		
Control	0.24				0.062				0.078			
$LSD_{0.05}$	NS		NS		NS		NS		0.019		0.022	

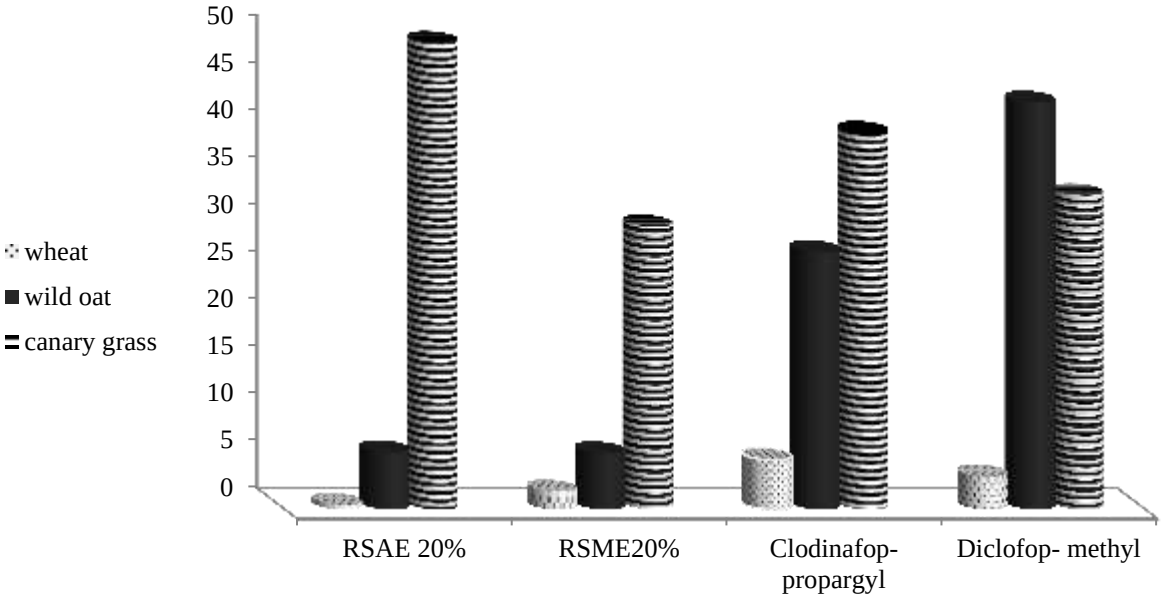

Figure 2. Effect of prepared extracts and conventional herbicides on % reduction of wheat and wheat weeds dry weight under greenhouse conditions.

In semi field conditions

Wheat**,** the obtained result reveled that all tested extracts and herbicides have no negative effect on dry weight of wheat leaves compared to the untreated plants (control). The highest treatments were observed with 20% tested extracts and herbicides. Wild oat, reduction in wild oat dry weight

was observed with all treatments. The maximum reduction was recorded with diclofop-methyl treatment (30.97%). Other extracts caused variable percentage of reduction based on the tested concentrations. Canary grass**,** dry weight was reduced in all treatments. Diclofop-methyl showed maximum reduction (53.85%) and was followed by clodinafop- propargyl (37.12%) and 20% RSAE (30.1%). (Table, 4). Reduction of dry weed biomasses as affected by chemical herbicides was confirmed by Hamada et al*.* (2013) and Shehzad et al. (2012).

Table 4. Effect of prepared extracts and conventional herbicides on % dry weight reduction of wheat and wheat weeds under semi field conditions.

Treatments	Wheat		wild oat		canary grass	
	RSAE	RSME	RSAE	RSME	RSAE	RSME
5%	18.8	9.4	10.2	12.39	21.07	6.35
10%	11.54	3.85	20.4	19.47	27.09	12.37
20%	5.56	0.85	28.3	22.12	30.1	15.38
Clodinafop-propargyl	36.32		22.12		37.12	
Diclofop- methyl	12.39		30.97		53.85	
$LSD_{0.05}$	9.55	9.27	4.12	3.31	7.16	4.71

Meanwhile allelopathic effects caused a significant decrease weed biomass (67 and 62%) and height (57 and 56%) of barnyard grass in greenhouse experiment (Naderi and Bijanzadeh, 2012).

Chlorophyll content

In Greenhouse conditions

Wheat, the obtained result reveled that all tested extracts and herbicides have no negative effect on chlorophyll contents of wheat leaves compared to the untreated plants (control). Wild oat**,** the tested herbicides showed the highest reduction of chlorophyll content reached 28.2 and 30.7 for diclofop-methyl and clodinafop-propargyl, respectively. 20% RSME decreased chlorophyll content to reach 31.4; followed by 20% RSAE to reach 30%. Chlorophyll content of canary grass was suppressed in all the treatments. clodinafop- propargyl and diclofop-methyl revealed the maximum suppression reach 24.5 and 26, respectively, and was followed by all concentrations of rice straw extracts (Table 5).

Table 5. Effect of rice straw extracts and conventional herbicides on chlorophyll content of wheat, wild oat and canary grass under greenhouse conditions after four applications

Treatments	Chlorophyll content(SPAD units) after different applications					
	Wheat		wild oat		canary grass	
	Aqueous	Methanolic	Aqueous	Methanolic	Aqueous	Methanolic
Concentration						
5%	38.8	39.2	33	32.9	28.2	28.4
	± 0.9	± 1.2	± 2.8	± 3.2	± 1.4	±0.6
10%	39.5	40.2	31.7	31.8	28.5	28.2
	± 0.4	± 0.5	± 1.3	± 2.9	± 1.8	±1.5
20%	40.4	42	30	31.4	26.1	27.7
	± 0.4	± 0.7	± 0.8	± 2.8	± 1.9	±1.1
Clodinafop-propargyl	41 ± 1.0		28.2 ± 0.9		26 ± 1.1	
Diclofop- methyl	41.1 ± 0.9		30.7 ± 2.5		24.5 ± 0.9	
Control	42.2 ± 1.0		32.9 ± 1.3		29.3 ± 2.8	
$LSD_{0.05}$	1.9	2.37	3.72	3.11	2.87	2.81

In Semi field

Chlorophyll contents of wheat leaves after successive application of the tested extract are tabulated in Table (6). This finding proved high selectivity of the treatments on wheat plants. Wild oat**,** the chlorophyll content was reduced to reach 24.5 as a result of treatment with diclofop–methyl and was followed by clodinafop-propargyl and 20% of tested extracts. Chlorophyll content of canary grass was significantly decreased by all treatments as compared to control. Maximum suppression was obtained with clodinafop-propargyl and diclofop-methyl reach 18.9 and 18.5 respectively, and was followed with all tested extracts.

The inhibitory effect of the chemicals exuded from rice straw on decomposition and those phytotoxic chemicals would interfere the synthesis of porphyrin, a precursor of chlorophyll biosynthesis (Rice, 1984; Yang et al. 2004; Huang et al. 2011).

Table 6. Effect of rice straw extracts and conventional herbicides on chlorophyll content of wheat, wild oat and canary grass under semi field conditions after three applications.

Treatments	Chlorophyll content(SPAD units) after different applications					
	Wheat		wild oat		canary grass	
	Aqueous	Methanolic	Aqueous	Methanolic	Aqueous	Methanolic
Concentration						
5%	43.7	44.1	33.1	34.8	23	24.1
	± 0.8	± 0.8	± 0.8	± 0.4	± 1.8	± 0.3
10%	44.8	45.4	31.1	33.6	22.8	23
	± 1.0	± 0.6	± 0.9	± 0.8	± 0.8	± 0.2
20%	47.1	48.2	29.6	30.3	20.9	21.2
	± 0.3	± 1.9	± 0.2	± 0.1	± 0.6	± 1.3
Clodinafop-propargyl	47.2 ± 0.9		26.6 ± 1.8		18.9 ± 1.3	
Diclofop- methyl	46 ± 1.2		24.5 ± 1.0		18.5 ± 13.1	
Control	46 ± 0.4		37.6 ± 1.3		30.2 ± 0.4	
$LSD_{0.05}$C*A	2.11	2.37	NS	NS	2.1	1.89

Plant height

In Green house

All tested extracts had no negative effect on plant height of wheat compared to the untreated plants. This finding proved high selectivity of the treatments on wheat plants. Therefore, the tested extracts and herbicides can be applied safely on wheat plants. Wild oat, maximum reduction was observed with clodinafop-propargyl by 19.9 cm and was followed by 24.5 cm reduction with diclofop-methyl and also followed 20% tested extracts compared with control. Canary grass, maximum suppression was observed by clodinafop-propargyl by 29.8 cm and was followed by 20% tested extracts (Table 7).

Clodinafop-propargyl showed the maximum reduction of wild oat and canary grass. On the contrary, with the wheat plant in wheat field (Khatam et al. 2013). Maximum value plant heights (cm) at maturity were recorded in Topik 15%WP in wheat field (Bibi et al. 2008). Also, this reduced plant height under the treatments of concentrated sorghum aqueous extracts may be attributed to

the selective behavior of allelochemicals present in these extracts showed inhibitory effect on plant height in wheat plants as reported by Batish et al. (2006).

Table 7. Effect of prepared extracts and conventional herbicides on plant height of wheat and associated weeds.

Treatments	Plant height (cm)* under different treatment			
	Concentrations	Wheat	Wild Oat	Canary Grass
Control		41.4	41.5	38.6
0Diclofop- methyl	750 ml/fed	43.6	24.5	33.3
Clodinafop- propargyl	140 gm/fed	45.9	19.9	29.8
	5%	39.3	41.1	38.8
RSAE	10%	38.9	40.6	38.4
	20%	36.6	40.4	37.3
LSD		NS	2.21	NS
	5%	40.4	41.7	40.3
RSME	10%	44.1	38.6	36.6
	20%	47.1	37	35.6
LSD		4.03	3.09	NS

In Semi field

Plant height of wild oat was not significantly different with all treatments, but maximum suppression was observed with diclofop-methyl and clodinafop-propargyl to reach 28.9 and 29.6 cm, respectively. Canary grass, clodinafop-propargyl and 20% aqueous extracts of rice straw treatments appeared more suppressive in reducing plant height of field to reach 26.6 and 26.5 cm, respectively, and were followed by 28.8 cm with diclofop-methyl compared with the control (Table 8).

Plant Number (under Semi Field Conditions)

Data in Table (9) showed that wild oat**,** the maximum reduction in plant number (81.1%) was obtained with diclofop-methyl and was followed by clodinafop-propargyl (77%), and also followed all tested extracts. Canary grass, Diclofop–methyl and clodinafop-propargyl appeared more suppressive in reducing of plants number by 88.5-78.7%, respectively, compared to the control and all other tested extracts, except in plots treated with 10 and 20% methanolic extract of rice straw by 67.2 and 83.6 %, respectively.

Table 8. Effect of prepared extracts and conventional herbicides on plant height of wheat and associated weeds.

Treatments		plant height (cm)		
	Concentration	Wheat	Wild oat	Canary Grass
Control		57.6 ±3.7	33.2 ±3.2	34.1 ±1.6
Diclofop- methyl	750 ml/fed	58.7 ±0.6	28.9 ±1.1	28.8 ±1.1
Clodinafop- propargyl	140 gm/fed	57 ±2.8	29.6 ±0.8	26.6 ±0.8
RSAE	5%	51.2 ±1.4	33.3 ±0.9	33.3 ±1.0
	10%	57.1 ±0.6	32.2 ±3.1	28.8 ±1.7
	20%	56.6 ±0.7	31.5 ±2.2	26.5 ±2.1
LSD		NS	NS	6.09
RSME	5%	49.2 ± 0.8	32.6 ±3.5	31 ±2.8
	10%	53.6 ± 0.6	31.8 ±3.1	30.7 ±0.8
	20%	55.1 ± 4.7	31.8 ±1.2	29.2±1.1
LSD		NS	NS	6.41

The obtained data are similar with Cheema et al. (2001) and Cheema and khaliq (2000) who found that sorgaab reduced the weed population by killing the existing weed. The inhibitory effects of rice straw water extract on the weed density by 56-76 % (Chung et al. 2001).Also, Hassan et al. (2005) found that diclofop-ethyl were recorded reduction of weed density of *Phalaris minor* and *Avena fatua* compared with control.

Spike length and spike weight of treated wheat

In Green house

20% methanolic extracts of rice straw was recorded the maximum spike weight (7.1 mg) compared to the control (Table .10)

In Semi field conditions

maximum spike length, grain weight were recorded in plots treated with 20% RSAE to reach 7.1 cm and 20.6 mg, respectively. In this respect, 20% RSME showed the maximum grain weight (12.8 mg) of wheat (Table 10).

Table 9. Effect of prepared extracts and conventional herbicides on plant number of Wild oat and canary grass under semi field conditions

Treatments	wild oat				canary grass			
	RSAE	% reduction	RSME	% reduction	RSAE	% reduction	RSME	% reduction
5%	11.5 ±2.12	68.9	8 ± 2.83	78.4	37 ±1.41	21.31	21.5 ± 3.84	29.5
10%	12.5 ± 1.84	66.2	15 ± 4.02	59.5	32.5 ± 2.12	6.15	10 ± 1.41	67.2
20%	18.5 ±0.76	50	8.5 ± 0.71	77	25 ± 4.21	18	5 ± 2.41	83.6
Clodinafop-propargyl	8.5 ± 0.71	77			6.5 ± 2.13	78.7		
Diclofop- methyl	7 ± 1.21	81.1			3.5 ± 0.74	88.5		
Control	37 ± 4.23				30.5 ± 2.12			
$LSD_{0.05}$	8.89		11.1		11.2		10.6	

Table 10. Effect of prepared extracts and conventional herbicides on spike length (SL) ,spike weight (SW)and grain weight (GW) of wheat

Treatments	**under greenhouse**				**under semi field**					
	RSAE		RSME		RSAE			RSME		
	SL	SW	SL	SW	SL	SW	GW	SL	SW	GW
5%	7.1 ± 0.3	5.2 ± 0.2	8.4 ± 0.9	5.8 ± 0.6	7 ± 0.3	22.7 ± 1.3	12.8 ± 0.2	5.5 ± 0.2	18.9 ± 0.2	11.8 ± 0.2
10%	7.5 ± 0.3	5.8 ± 0.8	8.2 ± 1.1	6.8 ± 0.1	6.7 ± 1.8	20.6 ± 1.1	11.1 ± 0.3	6.4 ± 0.1	20.3 ± 0.5	12 ± 0.2
20%	8.6 ± 0.3	6.6 ± 0.4	9.5 ± 0.5	7.1 ± 0.6	7.1 ± 0.2	19.4 ± 0.8	12.6 ± 0.8	6.9 ± 0.4	20.8 ± 0.5	12.8 ± 1.3
Clodinafop-propargyl	8.2 ± 0.4	6.5 ± 0.3			6.6 ± 0.1	23.1 ± 0.8	12.9 ± 0.4			
Diclofop-methyl	8.2 ± 0.3	6.7 ± 0.5			6.9 ± 0.8	23.5 ± 1.5	13. 5 ± 0.6			
Control	8.3 ± 0.5	5 ± 0.5			6.1 ± 0.4	22.9 ± 1.7	13.6 ± 0.4			
$LSD_{0.05}$	0.88	1.07	1.17	1.43	NS	NS	2.05	NS	NS	NS

Conclusion

The maximum germination percentage of wheat and suppression of weed were observed by 20% aqueous extract of rice straw. All treatments had significant different effect on dry weight compared to the control without 5% extracts. Chlorophyll content of weeds was suppressed in all the treatments. Clodinafop-propargyl and diclofop-methyl were the most effective against the time tested weeds as it severely reduced the weed population and other tested parameters. Generally, clodinafop-propargyl and diclofop-methyl were the most effective against the tested weeds as it severely reduced the weed population and other tested parameters.

Conflicts of Interest

No conflict of interests has been declared.

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