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Efficacy of Cultivar Selectivity and Weed Control Treatments on Wheat Yield and Associated Weeds in Sandy Soils

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Abstract: The effect of some weed control treatments (Bifonex, Tribenuron-methyl, hand weeding and unweeded check), five wheat cultivars (Sakha 69, Sids 6, Sids 7, Sids 8 and Sids 9) and their interaction on the productivity of wheat plants and associated weeds were examined under the sandy soil conditions. The obtained data indicated that total dry weight/m² recorded at 60 days from wheat sowing significantly lower with Sids cultivars than with Sakha 69 cultivar, where Sids 8 surpassed all cultivars in this respect. Un-controlling weeds in wheat field caused a significant reduction in wheat grain yield by 41%. The excellent control of weeds was achieved by hand weeding twice followed by tribenuron-methyl herbicide treatment. Under the weed competition condition; Sids 9 cultivar produced the highest grain yield, while under weed free treatment; Sids 7 cultivar gave the maximum yield. The rank order of competitive ability of the five wheat cultivars was Sids 9> Sakha 69> Sids 8> Sids 7> Sids 6. Therefore planting Sids 7 cultivar and controlling weeds by hand or tribenuron-methyl herbicide produced the highest yield.

Key word: Tribenuron-methyl · Bifenox · Competitive ability · Wheat · Cultivars · Weeds

INTRODUCTION

Weeds limit wheat yield potential in arid region because they increase evapotranspiration and compete with wheat plants for limited soil moisture [1], water and light resulting in grain yield reduction amounted to 7% [2], 52% [3], 92% [4] and in serious cases may lead to complete crop failure [5].

Use of aggressive cultivars can be effective cultural practice for weed growth suppression [6, 7, 8]. According to Bussan *et al*. [9] the competitive ability of crop can be expressed in two ways. First is the ability of the crop to compete with weeds, reducing weed seed and biomass production. The second possibility is having crop tolerate competition from weeds, while maintaining high yields. Hucl [10] found that the less competitive genotypes suffered a 7-9% greater yield loss than that of the more competitive genotypes. On the other hand, Cardina [11] concluded that more competitive cultivars are not necessarily higher yielding. Mason *et al*., [12] reported that tallness and early heading and maturity were related to increase grain yield at the highest weed level. Greater spikes/m^2, tallness and early heading were associated with reduced weed biomass, depending on weed level. The response of wheat plants to herbicides also varied among cultivars [13, 14].

Several researchers have shown that tribenuron-methyl and bifenox herbicides can control weeds in wheat [15-18]. High wages and scarcity of labors at right time make hand weeding difficult and uneconomical day by day, especially in new reclaimed area. Some investigators found positive effect for the interaction between cultivars and weed control treatments on weeds and yield of wheat crop [13, 19]. Therefore, the objective of this study was to investigate the effect of cultivars and weed control treatments as well as their interaction on wheat yield and associated weeds under sandy soil conditions.

MATERIALS AND METHODS

Two field experiments were performed in a private farm, during 2006/2007 and 2007/2008 winter seasons in a sandy loam soil to evaluate the effect of five wheat cultivars and four weed control treatments on wheat yield and related weeds. Five wheat cultivars were Sakha 69, Sids 6, Sids 7, Sids 8 and Sids 9, while the weed control treatments were: Bifenox (Modown 4 F 48% EC) herbicide [(Methyl 5- (2,4 dichlorophenoxy)-2- nitrobenzoate], applied at the rate of 0.6 l/fed after 28 days after wheat sowing (DAS), Tribenuron-methyl (Granstar 75 DF) [Methyl 2-(((N- (4-methoxy - 6 - methyl - 1 , 3 , 5 triazin 2 - Y) methylamine) caronyl) amino) sulful) benzoate]

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herbicide, applied at the rate of 8 g/ fed at 28 DAS, hand weeding (twice at 28 and 49 DAS) and unweeded check (allowing weeds to grow with wheat plants until harvest). The experimental design was a spilt plot design with 4 replicates, 5 cultivars were located in the main plots, while the weed control treatments were occupied in sub-plots.

Wheat cultivars seeds were sown on the third week of November in both seasons, using a constant seeding rate (80 kg/fed). Plot area was 12 m². The normal cultural practices for growing wheat were applied as recommended. The crop received 90, 22.5 and 24 of N, P_2O_5 and K_2O kg /fed and preceded by maize (*Zea mays* L) in both seasons. After 75 DAS, weeds were counted from one square meter randomly taken from each plot. Weeds were identified and their dry weights were recorded. At harvest, a plant sample of one square meter from each plot was taken to determine number of tillers/m², number of grains per spike and grain index (1000 grains weight). Biological and grain yields per feddan were determined by harvesting the whole plot area. (Feddan (fed.) = 4200 m^2).

Combined analysis of data for the two growing seasons was carried out according to Snedecor and Cochran, [20]. For comparison between means, L.S.D. test at 5% level was used.

RESULTS AND DISCUSSION

Effect of Treatments on Weeds: The dominant weeds in the unweeded plot at 60 days after wheat sowing (Table 1) were prickly dock (*Emex spinosa*(L.) Campd), black mustard (*Brassica nigra* L (Koch)), scorlet pimpernel (*Anagallis arvensis* L.) and lambsquarters *(Chenopodium album* L.) as broad leaf weeds and wild oats (*Avena fatua* L.) as grass. Sids 8 *cv* plants suppressed weed growth by more than 80%, compared to Sakha 69 *cv*., while Sids 7 *cv*. suffered from the weeds than others Sids cultivars (Table 1). Previous studies have shown that some wheat cultivars are more competitive than others [8, 21, 22]. The difference in the ability of cultivars to suppress weed growth than other might be due to the differential rooting patterns, allelochemicals production, higher leaf area index and more light interception, tillering capacity and vegetative growth habit [6, 23].

Concerning the effect of weed control treatments on weeds, data in Table 1 indicated that application of tribenuron - methyl herbicide resulted in marked reduction in the dry weight of weeds when compared with hand weeding, bifenox and unweeded treatments. The lowest weed control efficiency of hand weeding than tribenuron –methyl herbicide was due to the fact that hand weeding removes inter- row weeds only, while the weeds within the crop rows and immediate vicinity of the wheat plants are not removed.

Results in Table 1 revealed that the interaction between treatments had insignificant effect on weeds in most cases, except on the total dry weight of weeds as shown in Table 3. The lowest number and dry weight of weeds were achieved by sowing Side 8 cv. and using tribenuron - methyl herbicide (Table 3). Similar results on the significant interaction between the competitive ability of wheat cultivar and controlling weeds by tribenuron- methyl were reported with Christensen [22]. From the data in Table 3 broadcasting Sids 8 cultivar and controlling weeds by tribenuron-methyl herbicide reduced the total number and dry weight of weeds to the lowest level compared to the other interaction treatments.

Table 1: Effect of wheat cultivars, weed control treatments and their interaction on dry weight of weed species (g/m²) after 60 days from wheat sowing (Combined analysis of two seasons)

Treatments	*Emex spinosa*	*Brassica nigra*	*Anagallis arvensis*	*Chenopodium album*	*Avena fatua*	Total
Cultivars						
Sakha 69	17.0	9.3	1.2	2.9	2.6	33.0
Sids 6	6.7	0.9	0.8	0.3	0.6	9.3
Sids 7	7.7	0.9	0.5	0.7	0.5	10.3
Sids 8	3.5	1.7	0.4	0.3	0.4	6.3
Sids 9	9.7	1.1	0.5	1.2	0.8	13.3
L S.D at 5%	2.7	1.8	N.S.	1.0	1.1	3.3
Weed Control Treatments						
Un -weeded check	21.5	8.3	1.6	2.1	1.8	35.3
Hand weeding	4.2	1.7	0.0	0.3	0.0	6.2
Tribenuron -methyl	1.1	0.3	0.0	0.3	1.0	2.7
Bifenox	9.5	1.4	0.0	0.8	1.0	12.7
LSD at 5%	2.4	1.6	N.S.	0.9	1.0	2.9
LSD at 5% for interaction	N.S.	N.S.	N.S.	N.S.	N.S.	18.0

Table 2: Effect of wheat cultivars, weed control treatments and their interaction on wheat yield and its attributes (Combined analysis of two seasons)

Treatments	Number of tillers/m²	Number of grains/ spike	Grain index (g)	Grain yield (t/fed.)	Bio. yield (t/fed.)	Grain (%) N	Grain (%) P	Grain (%) K
Cultivars								
Sakha 69	309.00	36.10	35.50	1.71	3.50	1.42	0.188	0.355
Sids 6	318.00	32.20	40.90	1.55	4.40	1.51	0.192	0.543
Sids 7	286.00	31.70	40.00	1.73	4.50	1.51	0.196	0.546
Sids 8	293.00	32.20	39.20	1.74	4.10	1.52	0.196	0.546
Sids 9	332.00	34.00	42.50	11.60	3.80	1.52	0.193	0.544
LSD at 5%	18.00	N.S.	1.40	N.S.	0.40	0.05	0.006	N.S.
Weed control treatments								
Unweeded check	256.00	22.70	38.90	1.23	2.90	1.47	0.192	0.542
Hand weeding	360.00	37.70	41.00	2.10	4.90	1.51	0.193	0.543
Ttribenuron-methyl	305.00	37.50	39.90	1.86	4.30	1.51	0.193	0.543
Bifenox	309.00	35.00	38.70	1.56	4.10	1.51	0.193	0.543
LSD at 5%	16.00	3.50	1.20	0.20	0.30	0.04	N.S.	N.S.
LSD at 5% for interaction	36.00	7.70	N.S.	0.44	0.80	N.S.	N.S.	N.S.

Table 3: Effect of the interaction between wheat cultivars and weed control treatments on weeds dry weight and wheat yield (Combined analysis of two seasons)

Treatments	Sakha 69	Sids 6	Sids 7	Sids8	Sids9	Sakha 69	Sids 6	Sids 7	Sids8	Sids9
	Dry weight of weeds (g/m²)					Number of tillers /m²				
Unweeded	89.2	20.9	21.2	20.2	30.3	260	269	242	241	234
H.W.	5.4	5.8	7.0	3.1	9.7	349	340	375	305	248
T.M.	1.4	4.4	7.0	0.0	0.9	324	363	279	291	320
Bifenox	32.3	6.2	5.9	7.0	12.3	305	315	247	333	347
LSD at 5%	12.7					36				
	Number of grains /spike					Grain index (g)				
Unweeded	21.6	24.2	17.0	24.8	26.8	35.0	39.7	39.2	38.9	41.9
H.W.	34.3	35.1	39.3	42.7	37.1	36.9	41.7	40.9	41.5	44.3
T.M.	47.3	34.5	5.0	32.8	38.0	35.9	40.8	40.4	39.4	43.2
Bifenox	42.0	35.0	35.5	28.4	34.1	34.5	41.3	39.9	37.2	40.5
LSD at 5%	7.7					N.S.				
	Grain yield (t/fed.)					Biological yield (t/fed.)				
Unweeded	1.11	0.80	1.01	1.37	1.47	1.8	3.8	3.6	2.8	2.8
H.W	1.62	2.19	2.34	2.15	1.95	4.2	4.9	5.9	4.8	4.7
T. M.	2.13	1.70	1.89	2.18	2.15	4.3	4.7	4.7	4.4	3.6
Bifenox	1.65	1.52	1.7	1.53	1.53	3.6	4.2	3.9	4.3	4.2
LSD at 5%	0.44					0.8				

H.W: hand weeding T.M.: tribenuron -methyl

Effect of Treatments on Wheat Yield and its Attributes: Data in Table 2 indicated that Sids 7 and Sids 6 cultivars surpassed the other three cultivars in biological yield, while Sids 9 was superior in grain index. The differences between cultivars in grain and biological yields might be due to the genetical differences among cultivars and different genotypes concerning dry matter partitioning where wheat cultivars might differ in carbon equivalent, yield energy per plant and per fedden [24]. However, Sids *cv.* 8 was more competitive, no significant differences among the 5 cultivars in grain yield per feddan were found (Table 2). Challaiah *et al*. [21] concluded that cultivar Turkey was the most competitive cultivar on the basis of decreasing *B. tectorum* growth, but it had poor grain yield.

Regarding the effect of weed control treatments, results in Table 2 indicated that allowing weeds to grow with wheat plants in unweeded plots caused a significant decrement in number of tillers/m², number of grains per spike and consequently led to a high reduction in grain yield amounted by 41%, compared to hand weeding treatment. Abouziena *et al.* [25] reported that controlling wheat weeds using two hand hoeing produced the greatest grain yield over unweeded treatment by 52% and surpassed the herbicides treatment. The harmful effect of weeds may be attributed to allelopathy of weeds on wheat plants [26], number of spike bearing tillers, grains per spike, net assimilation rate [27] and removal macro- and micro-nutrients from soil [28, 29] who reported that weeds left for 9 weeks associated maize plants removed 47, 8 and 29 kg of N, P, K and 58, 630 and 77 g of Zn, Fe and Mn elements per feddan, respectively. Similar results were found by Shah *et al*. [2], El- Metwally [30], Barros *et al.* [31] and Hussein *et al*. [32]. Weiner *et al.* [33] reported that there was a linear relationship between above-ground weed biomass and crop yield, so weed suppression translocated directly into yield. Results in Table 2 showed that in the absence of hand weeding, application of tribenuron – methyl herbicide led to a significant increament in grain and biological yields by 51 and 48% over the un-weeded check and equal 89 and 88% from the hand weeding treatment, respectively. Similar results were recorded with Hussein and Radwan [15], Abo El- Suoud *et al.* [17], Brzozowska *et al*. [18] and Milberg and Hallgreen [34]. Bifenox herbicide treatment recorded the lowest increases of wheat yield over un-weeded control in comparison to hand weeding and tribenuron-methyl trteatments (Table 2). The present data confirm the finding of Iqbal and Wright [27] and Radwan and Hussein [35].

Concerning the effect of interaction on yield, data in Table 3 showed that there were considerable differences in the grain yield reduction of the 5 cultivars under weed- infested conditions (unweeded plots). Based on the decrease percent (%) in grain yield/fed., compared to weed-free (hand weeding) condition, the competitive ability of cultivars [(Yield in unweeded plots /Yield in hand weeded plots) X 100] was different and it could be arranged in descending order as follows: Sids 9 (75%)> Sakha 69 (69%)> Sids 8 (64%)> Sids 7 (40%)> Sids 6 (39%). In general, the old cultivar (Sakha 69) was more suppressive than Sids cultivars, except Sids 9 which surpassed all cultivars in this respect. Differences in competitive ability appear to be related to various attributes including rate of establishment, vegetative growth nature, tillering capacity and plant height [8, 36]. However, Christensen [22] showed that there was no clear correlation between grain yield and competitiveness, suggesting that both characters could be improved by breeding. Concerning the competition and yielding ability of wheat cultivars in the presence of weeds; Sids 7 cultivar with hand weeding treatment produced the maximum grain and biological yields per feddan (Table 3). Data also indicate that the response of cultivars to herbicides was different, where Sids 9 *cv*. produced more number of tillers than Sids 7 *cv.* under bifenox herbicide treatment but the reverse was true with biological yield. Similar results were reported by Cosser *et al.* [37]. The differential rates of metabolism are the main reasons for differences in sensitivity to herbicides between wheat cultivars [38].

Effect of Treatments on Wheat Grain N, P and K Content: Results in Table 2 illustrated that un-controlling weeds caused a significant reduction in grain nitrogen by 2.7%, relative to hand weeding treatment or herbicide treatments. Similar finding was reported by Iqbal and Wright [27] and Radwan and Hussein [35]. In this concern, Friesen *et al*. [39] mentioned that weeds compete very effectively with the crop for available nitrogen to the point that the reduction in yields from weed competition are generally accompanied by reduction in protein content as well. On the other hand, weeds in unweeded control plots did not significantly affect grain P and K contents (Table 2).

Generally, Sids cultivars had higher N and P content than Sakha 69 cultivar (Table 2). This could be attributed to possible differences among wheat cultivars in N and P uptake and as well dry matter partitioning. The interaction between weed control treatments and wheat cultivars had insignificant effects on the content of N, P and K of wheat grains (Table 2).

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