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EFFICIENCY OF WEED CONTROL METHODS ON PRODUCTIVITY OF WHEAT UNDER VARIOUS MOISTURE STRESS CONDITIONS

Omar[1], A. E. A. and A. A. A. Aioub[2]

[1.] Agronomy Dept., Fac. of Agric., Zagazig Univ., Egypt

[2.] Plant Protection Dept., Fac. of Agric., Zagazig Univ., Egypt

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ABSTRACT: Two field experiments were carried out at the Experimental Farm, Fac. of Agric., Zagazig Univ., Egypt, during the two successive seasons of 2002/ 2003 and 2003/ 2004 to study the effect of three irrigation treatments (control, skipping an irrigation at heading as well as at grain filling stages) and five weed control methods (unweeded, hand weeding, use of Sinal herbicide at the rate of 40 cm^3/fad, use of Topic herbicide at the rate of 140 gm/fad and use both of them at the same rates) on yield, its attributes and grain chemical composition of wheat Giza 168 cv.

The results indicated that skipping an irrigation at heading stage significantly reduced plant height, spike length, number of spikes/m^2, number of grains /spike, 1000- grain weight, grain and biological yields/fad and grain P%. While, total weed dry weight was increased compared with skipping an irrigation at grain filling stage and control treatments. Exposing wheat plants to stress at grain filling stage caused a significant increase in crude protein % compared with control treatment (without water stress).

All weed control treatments outyielded unweeded treatment in the grain yield and its components, crude protein %, grain P% and grain K%. Application of Sinal + Topic herbicides gave the highest values of spike length, number of spikes/m^2, spike grain weight and grain yield/fad. Also this treatment was effective in minimizing total weed dry weight. While, hand weeding surpassed

the other weed control treatments in 1000 - grain weight and harvest index (HI).

No water stress treatment interacted strongly with both hand weeding and chemical weed control method by using Sinal (40 cm^3/fad) plus Topic (140 gm/fad) to increase spike grain weight or to decrease the total dry weight of the prevailed weeds in wheat fields.

Key words: Wheat, irrigation skipping, weed control, yield attributes.

INTRODUCTION

The Egyptian government seeks to increase the total wheat production to face the wide gab between consumption and local production. Wheat production could be increased through the cultivation of new high yielding released varieties and using suitable agronomic practices.

Recently, water plays a vital role in the arid and semi-arid conditions. Insufficient available water under these conditions necessitate to study the effect of missing irrigation at certain growth stages on the production potential. In this respect, Ibrahim *et al.* (1996) found that skipping an irrigation at heading stage decreased plant height and spike length. Makhloof (1996) indicated that, severe water stress treatment caused a significant reduction in yield and its attributes, while, the grain protein content showed a reverse response. Moustafa *et al.* (1996) studied the response of four spring wheat cultivars to drought stress and found that water stress at heading stage (severe stress) caused a significant reduction in number of kernels /spike and grain yields/plant, while kernel weight was not affected. Skipping an irrigation at tillering, heading and grain filling stages depressed yield and yield attributes (Kandil *et al.*, 2001; Awad *et al.*, 2002 and Kassab *et al.*, 2004). Also, Hefnawy and Wahba (2003) found that water stress at lated growth stages reduced number of spikes/m^2, 1000-grain weight, number of kernels/ spike, spike grain weight and grain, straw as well as biological yields/fad. Tawfelis and Tammam (2005) showed that, stress irrigation significantly decreased plant height, number of spikes/m^2, number of kernels/ spike, 1000-kernels weight, biological and grain yields/ha compared with normal irrigation (without stress).

Weeds compete with crop plants for nutrients, water, light and space producing a decrease in grain reduction amounted to 30.7% (Nisha *et al.*, 1999) to 61% (Hucl, 1998) compared to the weed free control (unweeded or check). Herbicides application and hand weeding are considered effective and direct methods for weed control. The directed weed control methods via herbicides or by hand weeding proved to be more effective for weed control. In this respect, Abd El-Samie (2001) indicated that application of Granstar surpassed the other weed control treatments and had favorable effect on plant height, number of spikes/m^2, spike length, number of grains/spike, grain weight/spike, 1000-grain weight, grain protein content and biological yield/fad. Hussein (2002) found that the unweeded treatment caused a significant decrement in grain nitrogen by 1.2% relative to hand weeding and herbicide treatments. Also, he added that the other weed control methods did not significantly affect grain P and K contents. Application or herbicides significantly reduced dry weight of weeds and increased wheat growth, grain yield and its components (Shafshak *et al.*, 2003 and Sorour *et al.*, 2004). Saad El-Din, Samia and Ahmed (2004) indicated that the different weed control methods surpassed unweeded check in growth, yield, yield attributes and grain P and grain protein contents.

Therefore, this research aimed to study the effect of irrigation skipping and weed control methods on yield, yield attributes and grain chemical composition of wheat.

MATERIALS AND METHODS

Two field experiments were conducted during 2002/2003 and 2003 /2004 seasons at the Experimental Farm of the Faculty of Agriculture, Zagazig University, Egypt. The soil of the experiment was clay in texture with 8 pH, 1.42% organic matter and containing 32.5, 15 and 276 ppm available N, P and K, respectively (means of two seasons for the upper 30 cm of the soil). The experimental design was a split-plot design with three replications. The main plots included three irrigation treatments as follow: 1- Control (no skipping an irrigation). 2- Skipping an irrigation at heading

stage. 3- Skipping an irrigation at grain filling stage. Five weed control methods were located in the sub–plots as follow:

1-Unweeded (control). 2-Hand weeding twice i. e. after 35 and 55 days form sowing. 3- Sinal (triazolpyrimidine sulfonanilide) herbicide at a rate of 40 cm^3/fad (used to control broad-leaved weeds). 4- Topic (2- (4-aryloxyphenoxy) propionic acid) herbicide at a rate of 140 gm/fad (used to control narrow-leaved weeds). 5- Both Sinal +Topic herbicides at the same rates. Sinal herbicide was applied before 24 hr form 1st irrigation, while Topic herbicide was applied two weeks later by using knapsack sprayer with a volume of 200 L/ fad.

The broad –leaved weeds prevailing in the experimental fields were as follow: *Beta vulgaris,* L.; *Rumex dentatus*, L.; *Chenopodium album,* L.; *Chenopodium murale* , L.; *Medicago hispida,* L .; *Melilotus siculus,* L. ; *Sonchus oleraceus,* L. Whereas, the narrow leaved-weeds were as coming: *Phalaris minor,* L.; *Phalaris paradoxa,* L.; *Phalaris canariensis,* L.; *Avena fatua,* L.; *Lolium temulentum,* L.

The split plot area was 9 m^2 (3x 3 m). Grains of wheat cv. Giza 168 by the rate of 60 kg /fad were sown on 23 November i the two seasons. The precedin summer crop was maize in bo seasons. Calcium sup phosphate (15.5% P_2O_5) at a ra of 15.5 kg P_2O_5 /fad was applie fully pre-sowing. Nitroge fertilizer was applied by usir urea fertilizer (46% N) at a ra of 75kgN/fad in two, equal dos i.e. before the first and the secor irrigations, respectively. Th other cultural practices f growing wheat were applie Harvesting was performed in 1 May in both seasons.

At harvest, ten guarded plan were taken at random from ea experimental plot to record t following traits:

1- Plants height (cm).

2- Spike length (cm).

3- Number of grains/spike.

4- Grain weight /spike (gm).

Thereafter, bulk sampl included all wheat plants a weeds found in one square me in each sub-plot were used study:

5. Number of spikes/ m^2.

6. Total dry weight of wee (gm/m^2).

7. Thousand grain weight, gra index (gm).

8. Grain yield (ton/fad).

9. Straw yield (ton /fad).

10. Biological yield =

Grain + straw yields (ton/fad).

11. Harvest index (HI) =

$$\frac{\text{Grain yield/fad.}}{\text{Biological yield/fad.}}$$

The grain samples were analyzed by using standard procedures as mentioned by (Jackson, 1973) to determine the following measures:

12- Crude protein percentage (N% x 5.76).

13. Phosphorus percentage.

14. Potassium percentage.

Data of the two seasons and their combined analysis were statistically analyzed as mentioned by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1. Effect of Irrigation on Yield and its Attributes of Wheat

Exposing wheat plants to water stress at heading stage (skipping an irrigation at heading stage) caused significant reduction in plant height as compared with missing irrigation at grain filling stage or the control (Table 1). This was true in the 1st season and combined analysis, while at the 2nd season the differences were not significant. This was expected since that the vegetative growth ceased before the filling stage. Similar results obtained by Ibrahim *et al.* (1996) and Kassab *et al.* (2004).

Highly significant effects were found among the different irrigation treatments regarding spike length except 1st season where, the differences did no reach to the level of significance (Table 1). It clear that skipping an irrigation at heading stage had a severe effect on spike length and followed by skipping an irrigation at filling stage. These results are in agreement with those obtained by Ibrahim *et al.* (1996) and Makhloof (1996).

Irrigation skipping at heading stage caused a significant adverse effect on number of spikes/m^2 (Table 1). This can be explained on the light of the fact that number of spikes is decided during the water stress treatment at heading stage. These results are in accordance with those obtained by Makhloof (1996),

Table 1: Plant height (cm), spike length (cm) and number of spikes/m^2 of wheat as influenced by irrigation treatments and weed control methods

Treatments	Plant height (cm)			Spike length (cm)			No of spikes/m^2		
	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.
Irrigation skipping (I):									
- Control (without irrigation skipping)	97.73a	93.22	95.47a	10.78	10.22a	10.50a	365.91	306.13a	336.02a
- Irrigation skipping at heading stage	95.25b	89.73	92.49b	10.30	9.57b	9.93c	348.60	276. 07c	312.33b
- Irrigation skipping at filling stage	97.25a	92.33	94.79a	10.76	9.76b	10.26b	366.27	292.67b	329.47a
F-test	**	N.S.	**	N.S.	**	**	N.S.	**	**
Weed control methods (W):									
- Unweeded (control)	98.72a	92.86	95.79a	9.60c	9.10c	9.35d	300.33d	230.22e	265.28d
- Hand weeding	95.82b	90.89	93.35d	10.94ab	10.21b	10.57b	384.70 d	317.56b	351.13b
- Sinal * (broad leaves)	97.23ab	92.16	94.70b	10.75ab	9.33c	10.04c	362.89 c	277.33d	320.11c
- Topic **(narrow leaves)	96.40b	91.83	94.11c	10.64b	10.07b	10.36b	349.59 c	296.00c	322.80c
- Sinal + Topic	95.56b	91.05	93.30d	11.15a	10.53a	10.84a	403.78a	337.00a	370.39 a
F- test	**	N.S.	**	**	**	**	**	**	**
Interaction:									
I X W	N.S.	N.S.	N.S.	N.S.	**	N.S.	N.S.	N.S.	N.S.

* Sinal : used to control broad - leaved weeds

** Topic: used to control narrow - leaved weeds

Hefnawy and Wahba (2003) and Tawfelis and Tammam (2005).

Number of grains/spike was affected significantly by irrigation treatments (Table 2). Irrigation skipping at heading and filling stage caused a significant reduction in number of grains /spike, reached to 9.09 % and 2.49% compared with control treatment, respectively. This results may be attributed to the effect of water stress at heading stage which reduced number of grains/spike through decreasing the pollination and fertilization processes. In addition, water stress during grain filling stage produced some undeveloped grains in what spikes. These results are in agreement with those given by Abo-Shetaia and Abd El-Gawad (1995), Makhloof (1996), Awad *et al.* (2002) and Hefnawy and Whaba (2003).

Highly significant effect of irrigation skipping was seen on spike grain weight (Table 2). Skipping an irrigation at heading or filling stage caused a significant reduction in spike grain weight compared with control treatment but without significant differences. In this regard, Abd-El-Gawed *et al.* (1993) attributed that reduction in the sink capacity of wheat plants by skipping an irrigation to the lack of metabolites translocated to spike primordia. Water stress caused a significant reduetion in spike grain weight (Makhloof, 1996 and Hefnawy and Wahba, 2003). On the other hand, Moustafa *et al.*, (1996) indicated that, kernel weight was not affected by water stress.

The effect of irrigation treatments was significant on 1000-grain weight (Table 2). Skipping an irrigation at filling stage significantly reduced 1000-grain weight followed by skipping an irrigation at heading stage compared with control treatment. The reduction in 1000-grain weight reached to 3.76% and 6.21% with skipping an irrigation at heading and filling stage, respectively compared with control. These results may be attributed to that water stress at filling stage reduced the amount of available assimilates and their translocation to the grains (sink). Similar results were obtained by Makhloof (1996), Awad *et al.* (2002) and Kassab and EL-Zeiny (2005).

The grain yield /fad was significantly affected by irrigation treatments (Table 3). Skipping an irrigation during heading or filling stages caused a significant reduction in grain yield compared with control

Table 2:Number of grains/spike, spike grain weight (gm) and 1000-grain weight (gm) of wheat as influenced by irrigation treatments and weed control methods

Treatments	No of grains/spike			Spike grain wt. (gm)			1000-gain wt. (gm)		
	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.
Irrigation skipping (I):									
- Control (without irrigation skipping)	50.76a	49.81a	50.29a	2.292a	2.233a	2.262a	43.828a	42.608a	43.218a
- Irrigation skipping at heading stage	46.02c	46.18 c	46.10c	2.035b	1.911b	1.973b	42.251b	41.055b	41.653b
- Irrigation skipping at filling stage	49.03b	49.11b	49.07b	2.073b	2.056b	2.065b	41.205c	40.175b	40.690c
F-test	**	**	**	**	**	**	**	**	**
Weed control methods (W):									
- Unweeded (control)	44.16c	44.67c	44.41c	1.881c	1.840d	1.861d	41.114 d	40.698bc	40.906d
- Hand weeding	49.69ab	49.81ab	49.75ab	2.201ab	2.147b	2.174b	43.929a	42.071a	43.00a
- Sina l * (broad leaves)	49.04b	48.32b	48.68b	2.114b	2.029c	2.071c	42.327 bc	40.424 c	41.376cd
- Topic **(narrow leaves)	49.12ab	48.69b	48.91b	2.182b	2.071bc	2.126bc	41.939c	41.338ab	41.638c
- Sinal + Topic	51.01a	50.36a	50.68a	2.290a	2.246a	2.268a	42.830b	41.864a	42.347b
F- test	**	**	**	**	**	**	**	**	**
Interaction:									
I X W	N.S.	N.S.	N.S.	N.S.	*	**	N.S.	*	N.S.

* Sinal : used to control broad - leaved weeds

** Topic: used to control narrow - leaved weeds

treatment. This reduction reached to 20.63% and 11.99 % with skipping an irrigation at heading and filling stage, respectively compared with control. The severe reduction occurred in the grain yield due to stress of water during heading stage could be attributed to the effect of this stress on number of spikes/m^2, number of grains/spike and grain index (the reduction in the former traits, being 7, 8.3 and 3.6%, respectively). While, the reduction in the former characters was 1.9, 2.4 and 5.8%, respectively with missing the watering during grain filling stages. This means that the three yield components were more severely affected when stress was caused during heading stage than when stress was done during grain filling stage. It could be said that heading stage is more sensitive to water stress than grain filling stage. These results are similar to those reported by Abo-Shetaia and Abd El-Gawad (1995), Makhloof (1996), Kandil *et al.* (2001), Hefnawy and Wahba (2003), Kassab *et al.* (2004) and Kassab and El-Zeiny (2005).

Also, straw yield /fad was affected significantly by irrigation treatments (Table 3). This results were true in the 2nd season and combined analysis. While, the differences did not reach to the level of significance at 1st season. Water stress at heading or filling stage caused a significant reduction in straw yield/fad, but with insignificant differences between skipping an irrigation at heading and filling stage. In this regard, Awad *et al.* (2002) indicated that irrigation skipping at heading and filling stage had the same effect on straw yield.

Irrigation skipping treatments significantly affected the biological yield/fad (Table 3). Skipping an irrigation at heading and filling stages decreased biological yield by 13.24% and 7.52%, respectively as compared to control treatment. These results are in harmony with those reported by Kheiralla *et al.* (1989), Makhloof (1996), Hefnawy and Whaba (2003), Kassab *et al.* (2004) and Kassab and El-Zeiny (2005).

There was no significant effect of irrigation treatments on harvest index in both seasons. On the other hand, the combined analysis indicates a significant affect (Table 4). Skipping an irrigation at heading stage caused a significant reduction in HI

Table 3: Grain yield (ton/fad), straw yield (ton/fad) and biological yield (ton/fad) of wheat as influenced by irrigation treatments and weed control methods

Treatments	Grain yield (ton/fad.)			Straw yield (ton/fad.)			Biological yield (ton/fad.)		
	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.
Irrigation skipping (I):									
- Control (without irrigation skipping)	2.592a	2.415a	2.503a	5.219	4.548a	4.884a	7.811a	6.963a	7.387a
- Irrigation skipping at heading stage	2.251b	1.899c	2.075c	4.846	4.050b	4.448b	7.097b	5.950c	6.523c
- Irrigation skipping at filling stage	2.407ab	2.063b	2.235b	4.953	4.315ab	4.634b	7.361 ab	6.379b	6.870b
F-test	*	**	**	N.S.	**	**	*	**	**
Weed control methods (W):									
- Unweeded (control)	1.923c	1.661e	1.792e	3.945c	3.641c	3.793d	5.868d	5.302d	5.585d
- Hand weeding	2.563ab	2.442 b	2.502b	5.058b	4.432b	4.745bc	7.621bc	6.874b	7.247b
- Sina l * (broad leaves)	2.442b	1.903d	2.173d	4.917b	4.268b	4.593c	7.359c	6.172c	6.766c
- Topic **(narrow leaves)	2.453b	2.078c	2.266c	5.737a	4.232b	4.984ab	8.190a	6.310c	7.250b
- Sinal + Topic	2.703a	2.546a	2.624a	5.373ab	4.950a	5.161a	8.075ab	7.495a	7.785a
F- test	**	**	**	**	**	**	**	**	**
Interaction:									
I X W	N.S.	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

* Sinal : used to control broad - leaved weeds

** Topic: used to control narrow - leaved weeds

compared with control treatment. This may be explained by the magnitudes of reduction in grain yield caused by missing irrigation at heading and at grain filling stage. These results are in harmony with those obtained by Awad *et al* (2002). On the other hand, Makhloof (1996) and Hefnawy and Wahba (2003) indicated that severe water stress happened during the critical growth stages caused significant increase in HI.

Irrigation treatments had a significant effect on the total weed dry weight (Table 4). Water stress at both stages caused encouragement of weed growth. The magnitude in weed weight increase was higher when stress was done at earlier heading stage than the later (grain filling). This result may be attributed to the ability of weeds to grow and compete greatly under stress conditions rather than wheat plants.

II. Effect of Weed Control Methods on Yield and its Attributes

Weed control treatments had a significant effects on plant height (Table 1). This was true in 1st season and combined analysis. Wheat plants of unweeded treatment were significantly taller compared with other weed control methods. These results may be due to the increased ability of weed plants to compete severely under unweeded check conditions compared with wheat plants. Treating wheat crop by two herbicides (Topic for narrow leaves and Sinal for broad leaves) caused the shortest plants. Similar results were obtained by Ghanem and El-Khawaga (1991).

Also, weed control treatment had a significant effect on spike length (Table 1). The tallest spikes were obtained by application of Sinal + Topic herbicides followed by either hand weeding or Topic herbicide or by Sinal herbicide and then followed by unweeded treatment. These results may be attributed to the efficiency of Sinal + Topic in minimizing competition of weeds to wheat plants. These results are in harmony with those obtained by Ghanem and El-Khawaga (1991), Abd El-Samie (2001) and Shafshak *et al.*, (2003).

Number of spikes/m^2 was significantly affected by weed control treatments (Table 1). All weed control treatments surpassed the unweeded treatment in number of spikes/m^2. Application of Sinal + Topic herbicides gave the highest

Table 4: Harvest index (HI) and total weed dry weight (gm/m^2) of wheat as influenced by irrigation treatments and weed control methods

Treatments	Harvest index			Total weed dry wt. (g/m^2)		
	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.
Irrigation skipping (I):						
- Control (without irrigation skipping)	0.333	0.347	0.340a	47.819b	47.258c	47.538c
- Irrigation skipping at heading stage	0.318	0.317	0.318b	61.029a	65.839a	63.434a
- Irrigation skipping at filling stage	0.329	0.322	0.325ab	50.635b	56.803b	53.719b
F-test	N.S.	N.S.	*	**.	**	**
Weed control methods (W):						
- Unweeded (control)	0.327ab	0.312d	0.320c	128.067a	141.704a	134.885a
- Hand weeding	0.338a	0.355a	0.347a	16.488d	16.941d	16.714 d
- Sina l * (broad leaves)	0.333a	0.307d	0.320c	40.643c	49.031c	44.837c
- Topic **(narrow leaves)	0.300b	0.329c	0.314c	70.094b	64.863b	67.479b
- Sinal + Topic	0.335a	0.340b	0.338b	10.513e	10.628e	10.571e
F- test	*	**	**	**	**	**
Interaction:						
I X W	N.S.	**	N.S.	**	**	**

* Sinal : used to control broad - leaved weeds

** Topic: used to control narrow - leaved weeds

values of spikes/m^2 followed by, hand weeding then by Sinal or Topic herbicide. These results could be attributed to the effective reduction in weed competition by using Sinal + Topic herbicides on both broad leaves and grassy weeds. Hand weeding was effective but less than Sinal + Topic herbicides. These results are in harmony with those reported by Metwally *et al.* (1999), Abd El-Samie (2001), Shafshak *et al.* (2003) and Soruour *et al.* (2004).

In addition, weed control treatments had a significant effect on number of grains/spike (Table 2). Application of Sinal + Topic herbicides gave the best effect on number of grains/spike, but without significant differences among weeding treatment and either Sinal or Topic herbicides. On the other hand, the unweeded treatment gave the lowest value of grains/spike. Similar results were obtained by Abd El –Samie (2001), Hussein (2002) and Sorour *et al.* (2004).

All weed control methods surpassed the unweeded treatment in spike grain weight (Table 2). Application of Sinal + Topic herbicides gave the heaviest spike. No significant difference was seen between hand weeding and Topic herbicide. These results are in harmony with those reported by Ghanem and EL-Khawaga (1991), Abd El-Samie (2001), Hussein (2002) and Shafshak *et al.* (2003).

Weed control treatments had a significant effect on 1000-grain weight (Table 2). Hand weeding caused the heaviest grains followed by Sinal +Topic herbicides then by Topic or Sinal herbicide and then by unweeded treatment. These results are in harmony with those obtained by Abd El-Samie (2001) and Hussein (2002).

Significant effect of weed control treatments on grain yield/fad was observed (Table 3). The highest grain yield was obtained by application of Sinal+ Topic herbicides which surpassed all the other weed control methods, followed by hand weeding, followed by Topic herbicide (grassy weed control), followed by Sinal herbicide (broad weed control) and then followed by unweeded treatment which gave the lowest grain yield. Application of Sinal + Topic herbicides surpassed the other treatments by 46.43%, 4.88%, 20.75% and 15.80%

compared with the unweeded treatment, hand weeding, Sinal herbicide and Topic herbicide, respectively. The superiority of Sinal + Topic may by attributed to the increase in yield attributes i.e. number of spikes/m^2 (Table 1), number of grains/spike and spike grain weight (Table 2). Also, the reduction of weed competition due to the reduction of broad and grassy weed dry weights which associated with wheat plants when treated, with both herbicides (Sinal + Topic). On the other hand, the lowest grain yield which obtained by the unweeded treatment could be attributed to the reduction in wheat growth and wheat attributes due to the severe competition between wheat plants and weeds for different growth factors above and below soil. These results are in agreement with those reported by Abd El-Hamid (1998), Sheble (1998), Metwally *et al.* (1999), Abd El-Samie (2001), Hussein (2002), Shafshak *et al.* (2003) and Saad El-Din, Samia and Ahmed (2004).

Weed control treatments had a significant effect on straw yield (Table 3). All weed control methods produced higher straw yield than the unweeded treatment. Application of Sinal + Topic herbicides gave the best results of straw yield but, with insignificant differences with application of Topic herbicide. The superiority of Sinal + Topic may be attributed to the effectiveness of both herbicides in reducing both types of weeds. These results are in harmony with those obtained by Ghanem and El-Khawaga (1991) Shafshak *et al.* (2003) and Saad El-Din, Samia and Ahmed (2004).

Also, significant effects of weed control treatments on biological yield/fad were given (Table 3). Application of Sinal + Topic herbicides significantly outyielded all other weed control treatments and followed by either hand weeding or Topic and then by Sinal herbicide and then by unweeded treatment. The superiority of Sinal + Topic herbicides could be attributed to the efficiency of both herbicides in decreasing grassy and broad-leaved weeds compared with hand weeding or Topic and Sinal herbicide alone. These results are in a good harmony with those reported by Ghanem and El-Khawaga (1991), Abd El-Samie (2001) and Hussein (2002).

The harvest index (HI) was influenced significantly by weed

control methods (Table 4). Hand weeding gave the highest value of HI followed by Sinal + Topic herbicides and followed by the other treatments. These results are in harmony with those obtained by Ahmed (2001). On the other hand, Ghanem and El-Khawaga (1991) indicated that HI was not affected by weed control methods.

The absence of weeds in the wheat field is the aim of various weed control methods. All weed control treatments significantly reduced total dry weight of weeds as compared with the unweeded treatment (Table 4). Application of Sinal + Topic herbicides gave the best results, followed by hand weeding, then by Topic herbicide and then by Sinal herbicide. Using both Sinal and Topic reduced the presence of weeds by 92% compared with 87.5% for hand weeding. The use of broad leaves herbicide Sinal reduced the weight of weeds by 66.7% compared with the use of Topic (narrow leaves) which reduced the presence of weeds only by 50%. These results are in harmony with those obtained by Abd El-Samie (2001), Ahmed (2001), Hussein (2002) and Sorour *et al.*(2004).

III. Effect of Irrigation Treatments on Crude Protein, Phosphorus and Potassium Contents

The protein content of wheat grains was affected by missing irrigation at two growth stages (Table 5). Subjecting wheat plants to water stress at grain filling stage produced lighter grains with more protein % as compared with the unstressed plants which had the heaviest grains (Table 2). Missing an irrigation during heading stage did not differ with the other two irrigation treatments. This could be explained on the light of the fact of dilution effect where the heavier grains had the same amount of protein stored in the lighter grains. These results are in harmony with those reported by Abd El-Gawed *et al.* (1994), Makhloof (1996) and Awad *et al.* (2002).

Grain P content was significantly affected by irrigation treatments (Table 5). Exposing wheat plants to moisture stress at on earlier stage of growth (heading) caused P% to come down. It seems evident that absorption of P continued during heading stage and when

Table 5: Crude protein%, grain P% and grain K% of wheat as influenced by irrigation treatments and weed control methods

Treatments	Crude protein %			Grain P%			Grain K %		
	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.	2002/2003	2003/2004	Comb.
Irrigation skipping (I):									
- Control (without irrigation skipping)	11.24	12.64	11.94 b	0.399	0.483 a	0.441 a	2.741	2.424	2.583
- Irrigation skipping at heading stage	11.96	12.85	12.41 ab	0.362	0. 349 b	0.356 b	2.524	2.502	2.513
- Irrigation skipping at filling stage	12.11	13.11	12.61 a	0.378	0.455 a	0.417 a	2.599	2.603	2.601
F-test	N.S	N.S	*	N.S	*	**	N.S	N.S	N.S
Weed control methods (W):									
- Unweeded (control)	10.94 b	12.00 b	11.47 c	0.353	0.385 b	0.369 b	2.432	2.157 c	2.294 c
- Hand weeding	12.51 a	12.84 a	12.68 a	0.372	0.462 a	0.417 a	2.665	2.640 a	2.652 ab
- Sina l * (broad leaves)	12.00 a	13.16 a	12.58 a	0.388	0.430 a	0.409 a	2.572	2.605 ab	2.588 ab
- Topic **(narrow leaves)	11.19 b	12.85 a	12.02 b	0.377	0.443 a	0.410 a	2.713	2.410 b	2.562 b
- Sinal + Topic	12.22 a	13.50 a	12.86 a	0.408	0.425 a	0.417 a	2.725	2.737 a	2.731 a
F- test	**	**	**	N.S	*	*	N.S	**	**
Interaction:									
I X W	*	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

* Sinal : used to control broad - leaved weeds

** Topic: used to control narrow - leaved weeds

water stress was delayed to grain filling stage no effect on P content was seen, since these late stressed plants ceased P absorption. Hefni *et al.* (1983) indicated that irrigation treatments did not significantly affect grain P%.

Respecting K content, there was no effect of irrigation treatments on K content of the grains. This is rather expected since only small amount of K is stored in the grains (Table 5). Similar results were obtained by Hefni *et al.* (1983).

IV. Effect of Weed Control Methods on Crude Protein, Phosphorus and Potassium Contents

Weed control treatments had a significant effect on crude protein% (Table 5). Application of Sinal + Topic herbicides, hand weeding and Sinal herbicide gave the highest values of crude protein % followed by Topic herbicide. While the lowest value of crude protein % was recorded by the unweeded treatment. Similar results were obtained by Abd El-Samie (2001) and Saad El-Din, Samia and Ahmed (2004). In this respect, Friesen *et al.* (1960) mentioned that weeds compete very effectively with the crop for available nitrogen to the point that reduction in yield resulting from weed competition are generally accompanied by reduction in protein content as well.

Weed control treatments had a significance effect on grain P % (Table 5). All weed control methods could absorb more P than the unweeded control. These results are in agreement with those reported by Ahmed (2001), El-Metwally (2002). On the contrary, Hussein (2002) reported that grain P. % was not significantly influenced by control treatment.

Also, weed control treatments had significant effect on gain K% (Table 5). Application of Sinal + Topic herbicides gave the highest value of grain K %, but without significant differences with either hand weeding or Sinal herbicide. While the unweeded treatment gave the lowest value of grain K%. Similar results were obtained by Ahmed (2001) and El-Metwally (2002).

V. Interaction Effect

Spike grain weight was significantly affected by the interaction between the different irrigation treatments and weed

Table 6: Spike grain weight (gm) as influenced by the interaction between irrigation treatments and weed control methods (combined data)

Irrigation treatments	Weed control methods				
	Unweeded	Hand weeding	Sinal	Topic	Sinal + Topic
Control (without irrigation skipping	C 2.042 a	A 2.391 a	B 2.246 a	B 2.226 a	A 2.406 a
Irrigation skipping at heading stage	D 1.643 b	BC 2.047 b	C 1.939 c	AB 2.062 b	A 2.173 b
Irrigation skipping at filling stage	C 1.898 a	B 2.084 b	B 2.028 b	B 2.090 b	A 2.225 b

Table 7: Total weed dry weight (gm/m^2) as influenced by the interaction between irrigation treatments and weed control methods (combined data)

Irrigation treatments	Weed control methods				
	Unweeded	Hand weeding	Sinal	Topic	Sinal + Topic
Control (without irrigation skipping	A 118.422 c	D 11.715 b	C 38.767 c	B 59.598 c	D 9.190 a
Irrigation skipping at heading stage	A 159.473 a	D 21.148 a	C 50.083 a	B 73.647 a	E 12.820 a
Irrigation skipping at filling stage	A 126.762 b	D 17.280 a	C 45.662 b	B 69.192 b	E 9.702 a

control methods as found in (Table 6). It is clear that the heaviest weights of spike grains was recorded by treating the no water stress plants (control) with the Sinal plus Topic herbicides. On the other hand, the lowest mean value of spike grain weight was given when the wheat plants exposed to water stress during heading stage were unweeded. Other spike grain weight values due to the different treatments laid in between.

Also, the total dry weight of weeds was markedly affected by the interaction between the different treatments under study (Table 7) indicating that the greatest mean record of such trait was given when the unweeded wheat plants were exposed to the water stress during heading stage. At the meantime, treating wheat plants by both Sinal+ Topic herbicides produced significantly the lowest value of such character when the normal watering treatment was in the picture, the other mean values of total dry weigh of weeds due to the various studied treatments laid in between (Table 7).

Finally, from the results of this work, it could be seen that wheat irrigation (without stress) and applying the chemical weed control method by using Sinal (40 cm^3/fad) plus Topic herbicide (140 gm/fad) proved to be more effective procedures to increases the productivity of Giza 168 wheat cultivar under the conditions of the experimental Farm, Fac. of Agric. Zagazig Univ., Egypt.

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كفاءة طرق مقاومة الحشائش على إنتاجية القمح تحت ظروف إجهاد رطوبى مختلفة

عبد الرحمن السيد أحمد عمر[١] - على أحمد على أيوب[٢]

[١] قسم المحاصيل - كلية الزراعة - جامعة الزقازيق - مصر.

[٢] قسم وقاية النبات - كلية الزراعة - جامعة الزقازيق - مصر.

أقيمت تجربتان حقليتان بمزرعة كلية الزراعة ـ جامعة الزقازيق ـ جمهورية مصر العربية خلال الموسمين الزراعيين ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤ لدراسة تأثير ثلاث معاملات للرى (الكنترول، إسقاط رية في مرحلة الطرد، إسقاط ريه في مرحلة إمتلاء الحبوب) وخمسة معاملات لمكافحة الحشائش (بدون مقاومة، مقاومة يدوية مرتين، مبيد سينال بمعدل ٤٠سم^{٣}/فدان، مبيد توبك بمعدل ١٤٠جم/فدان ومبيدى سينال وتوبك بنفس المعدل لكل منهما) على المحصول ومساهماته والتركيب الكيميائى لحبوب القمح (صنف جيزة ١٦٨).

أظهرت النتائج أن إسقاط ريه في مرحلة الطرد أدى إلي نقص معنوى في إرتفاع النبات، طول السنبلة، عدد السنابل/م^{٢}، عدد الحبوب/سنبلة ، وزن الألف حبة (دليل الحبة) ، محصول الحبوب والمحصول البيولوجي/فدان ونسبة الفوسفور في الحبوب، بينما ازداد الوزن الجاف الكلى للحشائش معنوياً بالمقارنة بإسقاط ريه في مرحلة إمتلاء الحبوب والكنترول. أدى تعريض نباتات القمح للإجهاد المائى في مرحلة إمتلاء الحبوب إلي زيادة معنوية في نسبة البروتين الخام بالحبوب بالمقارنة بالكنترول (بدون إجهاد مائى).

تفوقت جميع معاملات مقاومة الحشائش على معاملة الكنترول (بدون مقاومة) في جميع صفات القمح المدروسة، المحصول ومكوناته، نسبة البروتين الخام بالحبوب، نسبة الفوسفور والبوتاسيوم بالحبوب. أدت مقاومة الحشائش بإستعمال مبيدى سينال وتوبك إلي إعطاء أعلى قيم لصفات طول السنبلة، عدد السنابل/م^{٢}، وزن الحبوب/سنبلة، محصول الحبوب/فدان. وكذلك كانت تلك المعاملة أكثر كفاءة في تقليل الوزن الجاف الكلى للحشائش بينما تفوقت طريقة المقاومة اليدوية للحشائش في صفات وزن ١٠٠٠حبة ودليل الحصاد بالمقارنة بجميع طرق المقاومة الأخرى.

أظهرت نتائج التفاعل بين معاملات الرى وطرق مقاومة الحشائش أن إستعمال مبيدى سينال (٤٠ سم^{٣}/ فدان) + توبك (١٤٠ جم/ فدان) أو المقاومة اليدوية كانت أكثر فعالية فى زيادة وزن حبوب السنبلة وتقليل الوزن الجاف الكلى للحشائش المتواجدة بالقمح تحت ظروف معاملة عدم الإجهاد المائي.