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Evaluation of Sowing in Hills on Ridges as a New Technique for Enhancement of Wheat (*Triticum aestivum* L.) Productivity under Weed Control Treatments

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TWO FIELD experiments were conducted to investigate the effect of sowing wheat in hills 20 cm apart on different spaced ridges method on the productivity of wheat crop under different mechanical and chemical weed control treatments. Twenty four treatments which were the combinations of 4 sowing methods (hills in two rows on ridges 60 cm, hills in two rows on ridges 70 cm, hills in three rows on ridges 80 cm and broadcast) and 6 weed control treatments (one hand hoeing at 3 or 4 weeks after wheat sowing (WAS), two hand hoeing at 3 and 6 WAS, isoproturon, metosulam and unweeded check) were tried. The obtained results indicated that the lowest dry weights of weeds were recorded under broadcast or ridges 80 cm width sowing methods. Sowthistle (*Conchrus oleraces* L.) weed and grasses were not significantly influenced by sowing methods. Excellent weed control was achieved by two hand hoeing at 3 and 6 WAS. Application of isoproturon or metosulam herbicide gave satisfactory weed control similar to application of one hand hoeing made at 3 or 4 WAS. The heaviest biological yield was obtained under broadcast sowing methods. No significant differences in biological yield per acre were noticed between broadcast and ridges 80 cm sowing methods as well as between 60 cm and 70 cm ridges sowing methods. The maximum grain yield per acre was produced from plants sown in hills on three rows of 80 cm ridges, which significantly exceeded that of broadcast, 70 cm and 60 cm ridges sowing methods by 10, 14 and 23%, respectively. All weed control treatments caused a significant increment in grain yield over unweeded check. Controlling weeds using two hand hoeing produced the greatest grain yield over unweeded treatment by 52% and surpassed the other weed control treatments. The interaction between sowing methods and weed control treatments had significant effect on number of grains per spike and harvest index. It could be concluded that planting wheat in hills on three rows of 80 cm ridges and controlling associated weeds by hand hoeing twice produced the highest grain yield. In ridge sowing methods fertilizing was easer, controlling weeds by hand hoeing was easier and more efficient and water requirement and can support several crops in complex relays or intercropping and rotation.

Keywords: Isoproturon, Metosulam, Hand hoeing, Herbicides, Interaction .

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The entire world depends upon the wheat production as a major source of foo In Egypt, there is a big gap between wheat production and consumption. Therefor considerable interest has been devoted to increase wheat production. Among vario factors, sowing method and weed control play an important role in influencing whe production. Sowing methods of wheat may influence weed growth and hence gra yield (Aquino, 1998; Hussein *et al*., 2006 and Tanveer *et al*., 2003). Nowaday planting of wheat in hills spaced 20 cm apart within rows on both sides of ridges on raised beds, a new technique is being widely practiced by many farmers i Delta region, Egypt. Wheat planting on raised beds and furrow method coul improve water and fertilizer use efficiencies where it allow better whe emergence, and controlling weeds by hoeing was more easier and efficie (Tanveer *et al*., 2003 and Welsh *et al*., 1997). Aquino (1998) reported that tw bed planting methods were originally recommended: the use of a narrow be (50-60 cm) with one row on the bed, or the use of a wide bed (80-100cm) wit two rows on the bed. In this respect, Aquino (1998) and Tanveer *et al*. (2003 reported that weed infestation was reduced when wheat was planted on raise beds. In addition, they reported that this method improves soil fertility an structure, reduces soil erosion and water requirement and could support severa crops in complex relays or intercropping and rotation. Also, Kumar *et al*. (2002 found that the co-cultivation of wheat with sucker-planted mint (*Menth arvensis*) gave 15% more productivity over wheat alone and 70% over min alone. The relay cropping of wheat followed by transplanted mint had the highes productivity, 45% higher than that of co-cultivated wheat and mint.

Narrow planted rows shade the ground more quickly than wider spaced rows thus improve weed control (Wicks *et al*., 1995). Angiras & Sharma (1996) notice that closer row spacing (15 cm) reduced the weed dry matter and thus increased yiel and yield attributes of wheat over wider row (20cm) spacing. Sodhi & Dhaliwa (1998) mentioned that sowing wheat in narrow rows competed with wild oa (*Avena fatua* L.) more effectively than in wider rows and increased wheat grai yield by 8%. While, Stapper & Fischer (1990) noticed that plant spacing throug variation in row spacing (20 to 45cm) did not affect grain yields, but lodging wa reduced by increased row spacing. Also, Blackshow *et al*. (1999) found tha reducing wheat row spacing from 30 to 20 cm provided little benefits for wee control and/or increasing crop yield.

Allowing weeds to grow with wheat plants until harvest caused a significan reduction in grain yield by 18-73% (Naik *et al*., 1997), 92 % (Tiwari & Parihar 1997) and in serious cases may lead to complete crop failure (Abdul-Khalic & Imran, 2003). Hand hoeing methods are the oldest methods of managing weeds. It can be done with unskilled labor, none polluting, without residual hazards relatively save to the operator and faster and easier than hand weeding (Wicks *et al*. 1995). Prasad & Singh (1995) found that weeding by hoe at 15, 30 and 45 days after wheat sowing resulted in minimizing weed density, dry weight and nutrien depletion by weeds , as well as improving the nutrient uptake and grain yield of wheat. While, Azad & Singh (1997) showed that herbicidal treatment gave very effective control of weeds and proved significantly superior to hand hoeing twice at 4 and 6 WAS. High wages and scarcity of labors at right time make hand

weeding difficult and uneconomical day by day. Satisfactory weed control and higher grain yield could be achieved by application of metosulam (Ahmed, 2001; El-Metwally, 2002 and Metwally & Hassan, 2001) or by isoproturon herbicide treatments (Abo El-Suoud *et al.*, 2005; Saad El-Din & Ahmed, 2004 and Tanveer *et al.*, 2003).

Some researchers found positive effect for the interaction between sowing methods and weed control treatments on weeds and yield of wheat crop (Angiras & Sharma, 1996; Hussein, 2002 and Singh & Singh, 1996).

The objectives of this study were to evaluate: 1) the effect of ridges sowing method on wheat productivity, 2) the possibility of controlling weeds by hoeing at different times and 3) the effect of ridge sowing method, weed control treatments and their interactions on productivity of wheat crop and associated weeds.

Material and Methods

Two field experiments were performed in the Agriculture Experimental Station of National Research Centre at Shalakan, Kalubia Governorate, Egypt, during 2003/2004 and 2004/2005 winter seasons in a sandy loam soil to evaluate the effect of ridges sowing method and weed control treatments on the productivity of wheat and growth of associated weeds. A split - plot design with four replicates was used .The main plots included four sowing methods and the sub-plots were assigned to six weed control treatments. The main plots, ridge sowing methods, were made in constant spaced hills (20cm) on different spaced rows and ridges were as follows: 1) Ridges 60cm width with hills at two rows on the ridges (16.7 hills/m^2); 2) Ridges 70cm width with hills at two rows on the ridges (15.7 hills/m ^{2}) ; 3) Ridges 80cm width with hills at 3 rows on the ridges (18.8 hills/m^2) and 4) Broadcasting as control. The sub-plots, weed control treatments, were as follows: 1) Unweeded check; 2) Hand hoeing once at 3 weeks after sowing (WAS); 3) Hand hoeing once at 4 WAS; 4) Hand hoeing twice at 3 and 6 WAS; 6) Isoproturon (Arelon, 50% WP) herbicide [3-(4-Isoproyl phenyl)-1,1dimethyl urea], applied at the rate of 625 gram active ingredient (g.a.i) acre after 28 days from wheat sowing and 6) Metosulam (Sinal, 10% SC) herbicide [N-(2.6-dichloro-methyl phenyl)-5,7 dimethoxy (1,2,4) triazolo (1,5-a) pryimidine-2-Sulfonamide], applied at the rate of 4 g.a.i./ acre after 28 days from wheat sowing.

Sakha 93 wheat cultivar was sown on the second week of November in both seasons, using a constant seeding rate (70 kg/acre). Plot area was 14.4 m^2 (4.8 m width x 3m length), containing 8 and 6 ridges for the 60 and 80cm width, respectively. In ridges 70cm sowing method, the plot area was 14.7m^2 (4.9 m width x 3 m length) consisting 7 ridges. The normal cultural practices for growing wheat were applied as recommended. The wheat plants received 90, 23 and 24 of N, P_2O_5 and K_2O kg/acre and proceeded by maize in both seasons. After 75 days from wheat sowing, 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 t determine plant height, number of spikes/m², spike length, number and weigh of grains per spike, harvest index (percent of grain biomass to total yield) an grain index (1000 grain weight). Biological and grain yields per acre wer determined by harvesting the whole plot area. A combined analysis of data fo the two seasons was carried out according to the procedure outlined by Gomez & Gomez (1984). For comparison between means, LSD test at 5% level was used.

Results and Discussion

Weed growth

The experiment plots during the two growing seasons of wheat were infeste mainly with wild beet (*Beta vulgars* L.) sup sp. *perennis* (L.) Aellen, clove weed *(Medicago hispida* Gaertn), scorlet pimpernal *(Anagallis arvensis* L.) greater ammi *(Ammi majus* L.) and sowthistle *(Sonchus oleraceus* L.) as annua broad leaved weeds and constituted 71% of the total weeds dry weight Meanwhile, the dominant annual grasses were: canary grass (*Phalaris mino* Retz.) and ryegrass *(Lolium temulentum* Lam), which constituted 29% of th total weeds dry weight as shown in Table 1. Data also revealed that in unweede plots, wild beet weed presented more than half (53%) and 38 % of broad leave and total weeds, while canary grass weed presented more than half (60 %) an 17% of grasses and total weeds, respectively.

TABLE 1. Effect of ridge sowing methods, weed control treatments and thei interactions on dry weight of weeds (g/m²) after 75 days from whea sowing (average of two seasons).

Treatments	Dry weight (g/m²)									
	Broad leaf weeds					—	Grasses			Total
	Wild beet	Clover weed	Scarlet pimpernal	Greater ammi	Sowthistle	Total	Canary grass	Ryegrass	Total	
Ridges sowing method										
Ridges 60 cm	11.7	4.2	0.8	2.4	4.1	23.2	13.2	2.6	15.8	39.(
Ridges 70 cm	20.5	4.5	2.0	2.9	3.7	33.6	8.6	9.2	17.8	51.4
Ridges 80 cm	10.8	3.2	0.7	1.2	3.9	19.8	6.5	6.7	13.2	33.(
Broadcast	11.7	0.5	0.1	1.8	4.0	18.1	4.9	8.0	12.9	31.(
L.S.D. at 0.05	6.8	1.2	0.6	1.0	N.S	8.6	2.2	2.8	N.S	7.9
Weed control treatments										
Hand hoeing at 3 WAS	14.0	1.4	1.2	2.7	1.3	20.6	1.4	6.1	7.5	28.
Hand hoeing at 4 WAS	18.9	1.1	0.8	1.1	1.3	22.2	0.9	3.3	4.2	26
Hand hoeing at 3 and 6 WAS	2.5	0.4	0.2	1.0	0.7	4.8	0.2	3.1	3.3	8.
Isoproturon at 625 g.a.i. /acre	0.0	0.0	0.0	0.4	1.9	2.3	11.1	8.6	19.7	22
Metosulam at 4 g.a.i./ acre	0.0	0.2	0.0	1.3	1.3	2.8	14.8	4.3	19.1	21.
Unweeded check	46.9	15.5	3.2	6.0	17.1	88.7	21.4	14.5	35.9	124
L.S.D. at 0.05	8.3	1.5	0.8	1.3	3.9	11.2	5.4	3.4	10.5	11.
LSD for interaction	16.5	N.S	N.S	N.S	N.S	22.3	N.S	6.7	N.S	N.

WAS: Weeks after sowing

Effect of ridges sowing method on weeds

Results in Table 1 showed that dry weight of most weed species, broad leaved weeds and total weeds were significantly affected by the sowing methods of wheat crop. While, sowthistle weed and grasses were not significantly affected by sowing methods. The lowest dry weights of wild beet greater ammi and sowthistle weeds were noticed under sowing wheat in hills on the three rows of ridges 80 cm width, while the minimum dry biomass of clover weed, greater ammi, broad leaved weed and total weeds were recorded under broadcast sowing method. On the other hand, ridges 70cm width sowing method exhibited the largest dry weight of weeds. Sowing wheat broadcasting or in three rows on 80cm ridge width methods caused a significant reduction in the total dry matter accumulation by weeds by 40 and 36 %, compare to sowing wheat on two rows of 70 cm ridges width , respectively. The reduction in dry weight of most weeds in broadcast sowing method as well as in ridges 80 cm width might be due to the uniform of crop canopy cover, which might have reduced light penetration to the weed plants and hence its shading effect (Angiras & Sharma, 1996). Concerning to the effect of different ridges widths and the distance between rows in ridges (where the distance between rows were 30, 35 and 26.7 for ridges 60, 70, and 80cm, respectively) on weed growth, data in Tables 1 and 2 indicated that decreasing distance between rows from 35 to 30 and to 26.7cm exhibited a decrement in total dry weight of weeds amounted by 24 and 36%, respectively. These results are in parallel with those obtained by Angiras & Sharma (1996), Singh & Singh (1996) and Hussein *et al.* (2006). Thakur *et al.* (1998) reported that the reduction in weed count and weed dry biomass in close spaced rows may be attributed to the competition stress created by the canopy of more number of crop plants in an unit area and hence a suppressive effect on associated weeds. Results presented in Tables 1 and 2 also showed that there was no significant differences were noticed between broadcasting and close spaced rows on 80cm ridges width regarding the dry weight of weeds. Reducing the space between rows had minor effect on total grasses, but more adverse effects on total dry weight of weeds. Similar results were noticed reported by Sodhi & Dhaliwal (1998). It could be concluded from the previous results in Tables 1 and 2 that broadcasting as well as three rows on ridges 80cm width sowing methods had smothering effect on growth of wheat weeds.

Effect of weed control treatments on weeds

The results in Tables 1 and 2 indicated that all weed control treatments caused a significant depression on weed growth compare to unweeded check. Reduction in weed dry matter due to different weed control methods has also been reported by Ahmed (2001), Abdul-Khaliq & Imran (2003), Khan *et al.* (2003), Abo El-Suoud *et al.* (2005) and Barros *et al.* (2005). Excellent weed control was achieved by two hand hoeings at 3 and 6 WAS, it caused a significant reduction in dry weight of total broad leaved weeds, grasses, and total weeds by 95, 91 and 94%, respectively, compare to unweeded check and surpassed significantly isoproturon and metosulam treatments by 63 and 63% , respectively. These results may be attributed to that hand hoeing gave more reduction in grass weeds (Table 1) than the two herbicides treatments. Similar direction was reported by Ahmed (2001), Metwally & Hassan (2001), Khan *et al.* (2003) and Dastgheib (2004). On the other hand, Azad *et al.* (1997), Saad El-Din & Ahmed (2004) and Abo El-Suoud *et al.* (2005) reported that two hand weeding at 4 and 6 WAS was less effective than isoproturon herbicide application or metosulam (El-Metwally, 2002) treatments.

TABLE 2. Effect of the interaction between ridge sowing methods and weed control treatments on dry weight of wild beet, broad leaf and ryegrass weeds (g/m²) after 75 days from wheat sowing (average of two seasons).

Treatments	Ridges width (cm)			Broadcast	Ridges width (cm)			Broadcast	Ridges width (cm)			Broadcast
	60	70	80		60	70	80		60	70	80	
	Wild beet				Broad leaf weeds				Ryegrass			
Hand hoeing at 3 WAS	16.2	16.7	9.4	13.6	31.8	24.3	19.3	7.8	7.9	12.0	1.6	3.0
Hand hoeing at 4 WAS	19.8	22.4	20.0	13.2	19.2	33.3	15.8	20.7	6.8	6.2	0.0	0.0
Hand hoeing at 3 and 6 WAS	0.2	5.8	3.0	1.1	1.2	5.0	3.6	9.4	2.6	3.4	5.3	0.9
Isoproturon 625 g.a.i./acre	0.0	0.0	0.0	0.0	3.1	2.4	1.8	3.1	5.9	4.5	5.2	1.4
Metosulam 4 g.a.i./acre	0.0	0.	0.0	0.0	5.2	2.9	1.9	5.2	8.4	11.3	14.0	0.6
Unweeded check	34.2	78.3	32.5	42.5	84.7	132.0	76.1	62.1	7.9	29.9	14.3	5.8
LSD at 0.05	16.5				22.3				6.7			

WAS: Weeks after sowing

Isoproturon application gave complete control to wild beet, clover weed, and scorlet pimpernel weeds, while metosulam herbicide spraying gave complete control to wild beet and scorlet pimpernal weeds (Table 1). The two herbicides surpassed the hoeing weed control treatments in controlling the broad leaf weeds with insignificant difference with hoeing twice treatment. The high effectiveness of the two herbicides against broad-leaved weeds may be attributed to the high susceptibility of the present weeds to the herbicidal activity of the two herbicides. These results are in agreement with those reported by El-Metwally (2002), Saad El-Din & Ahmed (2004) and Abo El-Suoud *et al.* (2005). The poor performance of the one hoeing weed control compared to these herbicides could probably attributed to new flushes of weeds appeared in these plots after hoeing and to the dense wheat population, only some inter-hills weeds were eliminated during hoe weeding , thus leaving some of the inter – row weeds to escape control (Dadari & Mani, 2005). Therefore , the addition of one hand hoeing at 6 WAS significantly increased the reduction of total dry weight of weeds by 71 and 62 % compare to one hand weeding at 3 or 4 WAS, respectively (Table 1). Significant reduction was recorded in narrow leaf weeds and total weeds due to the two hand hoeing treatment compare to the other weed control treatments. Application of isoproturon and metosulam herbicides caused a significant reduction in dry weight of broad leaf weeds by 97 and 97% and in total weeds by 82 and 82 %, respectively, compare to unweeded check (Table 1). No significant differences between the two herbicides on weeds as well as between the 3 hoeing treatments on grassy weeds, which in parallel with Naik *et al.* (1997). Dry biomass of grasses was significantly decreased by 79, 88 and 91% due to one hand hoeing at 3 or 4 and two hand hoeing at 3 and 6 WAS, respectively compared to the untreated check.

Effect of the interaction between ridge sowing methods and weed control treatments on weeds

As shown in Tables 1 and 2, the effectd of the interaction between sowing methods and weed control treatments on dry weight of weed species, broad and narrow leaf weeds and their total was not significant and consequently the data were excluded. These results mean that ridges sowing methods and weed control treatments acted independently. Also, the same data indicated that dry weight of wild beet weed, total broad leaved weeds and ryegrass were significantly affected by the interaction between sowing methods and weed control treatments.

Wheat yield and its attributes

Effect of sowing method on wheat yield and its attributes

The results in Table 3 revealed clearly that most yield parameters were significantly influenced by ridges sowing methods, except plant height and spike length. Sowing wheat in 80cm ridges width recorded the highest number of spikes/m^2 and spike grain weight and consequently produced the highest grain yield/m^2. There was significant difference in harvest index between ridges method and broadcast, the traditional method, which indicated better efficiency in water use in terms of grain production. Similar results were reported by Tanveer *et al.* (2003).

TABLE 3. Effect of ridge sowing methods, weed control treatments and their interactions on wheat yield and its attributes (average of two seasons).

Treatments	Plant height (cm)	Spike characters			No. of spikes/m²	Grain yield (g/m²)	Grain index (g)	Bio. Yield (t/acre)	Harvest index (%)	Grain yield (t/acre)
		Length (cm)	No. of grains	Grain weight (g)						
Ridges sowing method										
Ridges 60 cm x 2 rows	103.7	9.7	42.2	1.98	411.6	815.0	46.91	8.44	37.8	3.192
Ridges 70 cm x 2 rows	104.4	10.1	49.7	2.14	510.5	1092.5	43.06	8.36	41.1	3.435
Ridges 80 cm x 3 rows	103.2	10.4	50.5	2.24	627.2	1404.9	44.36	9.65	40.7	3.929
Broadcast	107.8	10.4	47.5	2.16	567.5	1225.8	45.47	10.29	34.3	3.558
L.S.D at 0.05	N.S.	N.S.	3.7	0.18	46.2	168.5	1.37	0.24	2.5	0.184
Weed control treatments										
Hand hoeing at 3 WAS	105.5	10.1	47.1	2.12	540.8	1146.5	45.01	9.12	38.3	3.494
Hand hoeing at 4 WAS	104.5	10.3	48.4	2.20	544.5	1197.9	45.46	9.34	38.2	3.568
Hand hoeing at 3 and 5 WAS	110.4	10.3	51.6	2.30	565.0	1299.5	44.57	10.23	39.9	4.081
Isoproturon (625 g.a.i/acre)	105.3	10.0	49.1	2.18	534.8	1165.9	44.40	9.38	38.5	3.610
Metosulam (4 g.a.i./acre)	105.5	10.2	47.8	2.22	524.5	1164.4	46.44	9.93	37.6	3.734
Unweeded check	97.6	9.7	40.7	1.76	464.8	818.1	43.24	7.01	38.4	2.692
LSD at 0.05	5.1	N.S	4.5	0.22	56.3	205.9	2.29	0.29	N.S.	0.151
LSD for interaction	N.S.	N.S.	8.9	N.S.	N.S.	N.S.	N.S.	N.S.	4.9	N.S.

WAS: Weeks after sowing

Increasing the distance between rows hills within rows from 30 to 35cm led to a significant increase in harvest index by 8.7%. However, the number of spikes per square meter was increased by decreasing the distance between hills-rows, whereas the highest number was recorded on ridges 80cm width. This conclusion is in agreement with Angiras & Sharma (1996), Thakur *et al.* (1998) and Tanveer *et al.* (2003). Data presented in Table 3 also demonstrated that wheat broadcasting recorded the heaviest biological yield and significantly exceeded that of ridges sowing methods, which supported by Tanveer *et al.* (2003).

Concerning to the grain yield per acre, data in Table 3 indicated that the highest grain yield/acre was produced from ridges 80cm sowing method, which surpassed the broadcast sowing by 10 %. These results may be attributed to the uniform distribution and the better physiological performance of the crop in ridges 80cm method and consequently produced more spikes/m^2, number and weight of grains per spike. Similar direction was mentioned by Aquino (1998) and Hussein *et al.* (2006). Also, the same data showed that planting wheat in ridges 80cm width with 3 rows-hills gave significantly more grain yield/acre than that of 60 or 70cm ridges sowing methods amounted by 23 and 14 %, respectively. Angiras & Sharma (1996) mentioned that closer row spacing reduced the weed dry matter and thus increased the LAI, CGR, yield and yield attributes of wheat over wider row spacing. It can be concluded from these results that sowing wheat in hills on 80cm ridges width caused a significant increment in grain yield over broadcast sowing method. Indeed, Aquino (1998), Kumar *et al.* (2002), Tanveer *et al.* (2003) and Rasmussen (2004) reported that ridge sowing methods have provided several advantages such as, fertilization was easier, controlling weeds by hand hoeing or mechanically was more easier and efficient, reducing soil erosion and water requirement, which could support several crops in complex relays or intercropping and rotation particularly when permanent ridges are used and residual is kept on the soil.

Effect of weed control treatments on wheat yield and its attributes

Presence of weeds significantly decreased plant height, number of spikes/m^2, number of grains/spike, grain index and consequently reduced grain yield per acre by 52 %, compare to two hand hoeing treatment. The decrement in grain yield due to weeds may be attributed to the allelopathic effects of weeds on wheat plants (Oudhia, 2000), removal of macro- and micro-nutrients from soil (Hussein, 1996) 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 acre , respectively. Similar results were reported by Khan *et al.* (2003), Turk & Tawaha (2003), Milberg & Hallgreen (2004), Dadari & Mani (2005) and Hussein *et al.* (2006).

There is a significant increase in number and weight of grains per spike and number of spikes/m^2 as a result of weed removal mechanically or chemically. This increment was attributed to the availability of resources to the wheat plant (Khan *et al.*, 2003). In this concern, Azad (1997) found that 50 kg N/ha could be saved when isoproturon was used. Controlling weeds using isoproturon or metosulam treatment produced higher yield than that of unweeded check or once hand hoeing applied at 3 or 4 WAS, but was significantly inferior to the two

hand hoeing at 3 and 6 WAS in biological and grain yield. These results are in agreement with El-Metwally (2002), Abdul-Khaliq & Imran (2003), and Abo El-Suoud *et al.* (2005). Verma & Srivastiava (1989) reported that hand hoeing at 15 and 30 days after sowing provided more grain yield and net returns than the herbicide treatment. However, Azad (1997), Ahmed (2001) and Saad El-Din & Ahmed (2004) reported that isoproturon or metosulam herbicide gave more grain yield than the two hand weedings. There is no significant differences in wheat yield and its attributes were noticed between one hand hoeing at 3 or 4 WAS and between the two herbicides. However, one hand hoeing at 3 or 4 WAS and isoproturon or metosulam exhibited significant increases in grain yield/acre more than unweeded control amounted by 30, 33, 34, and 39 %, respectively. The increases in grain yield in the four treatments were probably due to the efficient weed control and thus the crop was efficiently flourished and utilized all the available resources (Khan *et al.*, 2003).

Elimination of weeds using two hand hoeing at 3 and 6 WAS produced the maximum biological and grain yields/acre and significantly surpassed the other weed control treatments as shown in Table 3. This superior treatment caused a significant increase in biological yield/acre over the one hand weeding at 3 or 4 WAS by 12 and 10 % and in grain yield by 17 and 14 %, respectively. This may be attributed to the excellent control of weeds by two hoeings compare to one hoeing as shown in Tables 1 and 2. Weiner *et al.* (2001) and Dadari & Mani (2005) reported that there was a negative linear relationship between above-ground weed biomass and crop yield at harvest, so weed suppression was translated directly into yield. These results are coincided with those of Dadari & Mani (2005). Data also indicated that weed control treatments had no significant impact on spike length and harvest index. Similar results were reported by Barros *et al.* (2005). However, results of Ahmed (2001) are not in agreement with that. There is no significant differences were recorded between one hand hoeing at 3 or 4 WAS. However, removal weeds by hand or hand hoe at 4 WAS produced more biological and grain yields than that at 3 WAS by 2.4 and 2.1%, respectively (Table 3).

Effect of the interaction between ridge sowing methods and weed control treatments

It is noticed from data in Table 3 that the interaction between ridges sowing methods and weed control treatments had no significant effects on wheat yield and its attributes, except on number of grains per spike and harvest index (Table 4). The maximum values of number of grains per spike and harvest index were obtained under planting wheat in hills on ridges 70cm width and controlling weeds by metosulam or two hand hoeing, Among the weed control treatments at the same sowing method, the unweeded check gave significantly the lowest number of grains/spike and harvest index values. These results are supported by Singh & Singh (1996), Turk & Tawaha (2003) and Barros *et al.* (2005). Based on the previous results, it could be concluded that planting wheat crop in hills on 80cm ridges width with 3 rows and controlling weeds by hoeing twice at 3 and 6 weeks after planting produced the highest grain yield and could be adopted for wheat production.

TABLE 4. Effect of the interaction between ridge sowing methods and weed control treatments on number of grains per spike and harvest index of wheat plants at harvest (average of two seasons).

Treatments	Ridge width (cm)			Broadcast	Ridge width (cm)			Broadcast
	60	70	80		60	70	80	
	Number of grains per spike				Harvest index (%)			
Hand hoeing at 3 WAS	40.7	43.5	53.4	50.6	37.4	40.0	41.0	34.3
Hand hoeing at 4 WAS	37.4	53.5	52.4	50.1	36.0	40.3	48.3	33.0
Hand hoeing at 3 and 6 WAS	44.1	54.2	54.2	54.0	39.0	44.0	41.3	35.3
Isoproturon at 625 g.a.i./acre	40.1	48.2	52.7	50.1	40.0	40.0	41.7	32.3
Metosulam at 10 g.a.i./acre	45.3	54.3	46.5	50.2	36.3	39.3	36.3	38.3
Unweeded check	22.5	44.6	48.3	41.7	38.0	42.7	40.7	32.3
LSD at 0.05	8.9				4.9			

WAS: Weeks after sowing

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تقييم طريقة زراعة القمح فى جور على خطوط كطريقة جديدة لزيادة إنتاجية القمح تحت ظروف معاملات مكافحة الحشائش

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أجريت تجربتان حقليتان بمزرعة المركز القومي للبحوث بشلقان- محافظة القليوبية- مصر خلال موسم شتاء ٢٠٠٣ / ٢٠٠٤ ، ٢٠٠٤/ ٢٠٠٥ لتقييم طريقة زراعة القمح في جور متباعده ٢٠ سم على خطوط على إنتاجية محصول القمح تحت ظروف مكافحة الحشائش ميكانيكياً أو كيماوياً. تضمنت التجربة أربعة وعشرون معاملة عبارة عن التوافق بين أربع طرق للزراعة هى (الزراعة على خطوط عرض ٦٠ سم في جور على جانبي الخط ، الزراعة على خطوط عرض ٧٠ سم فى جور على جانبي الخط ، الزراعة على خطوط عرض ٨٠ سم في جور وفى ثلاثة صفوف (جوانب) على الخط ، طريقة البدار) و ستة معاملات لمكافحة الحشائش هي العزيق اليدوي بعد ٣ أو ٤ أو بعد ٣ + ٦ أسابيع من الزراعة ، مبيد ايزوبريتورون(اريلون) بمعدل (١,٢٥ لتر/ ايكر)، مبيد ميتوسيلام (سينال) بمعدل ٠،٠٤٠ لتر / ايكر، و معاملة بدون مكافحة للمقارنة. و تشير النتائج المتحصل عليها إلى :-

سجل اقل وزن جاف للحشائش النامية عند زراعة القمح بطريقة البدار أو فى ثلاث صفوف من الجور على خطوط عرض ٨٠ سم، ولم يظهر فرق جوهري بين الطريقتين المتفوقتين. لم يكن لطرق الزراعة تأثير جوهري على الوزن الجاف لحشيشة الجعضيض أو على الحشائش النجيلية. تم الحصول على أعلى كفاءة فى مكافحة الحشائش المصاحبة باستخدام العزيق اليدوي مرتين بعد ٣ و ٦ أسابيع من الزراعة . أدى استخدام مبيدي الحشائش ايزوبروتيرون ، ميتوسولام في مكافحة الحشائش إلى تحقيق نتائج مرضية و مساوية لكفاءة النقاوة(في البدا ر نقاوة يدوية وفى طريقة الزراعة بالجور عزيق) اليدوية مرة واحدة سواء أجريت بعد ٣ أو بعد ٤ أسابيع من زراعة القمح. أعطت النباتات المزروعة بدار أعلى محصول بيولوجي / ايكر. لم تظهر فروق جوهرية في المحصول البيولوجى بين طريقة الزراعة بدار وطريقة الزراعة على خطوط عرض ٨٠ سم وكذلك بين طريقتي الزراعة على خطوط عرض ٦٠ أو ٧٠ سم . أمكن الحصول على أعلى محصول حبوب / ايكر من القطع المزروعة بطريقة الخطوط عرض 80 سم (وثلاث صفوف من الجور على الخط) و سجلت هذه المعاملة زيادة جوهرية في محصول الحبوب مقدارها ١٠ ، ١٤ ، ٢٣٪ ، مقارنة بطرق الزراعة بدار ، الخطوط عرض ٧٠ سم ، الخطوط عرض ٦٠ سم على الترتيب . أحدثت معاملات مكافحة الحشائش زيادة جوهرية فى محصول الحبوب ، مقارنة بمعاملة بدون مكافحة. أدى مكافحة الحشائش بالعزيق(مرتين) إلى تحقيق زيادة جوهرية في محصول الحبوب / ايكر مقدارها ٥٢٪ مقارنة بالكونترول، وتفوقت معاملة العزيق على باقي معاملات مكافحة الحشائش في هذا الصدد. أظهر التفاعل بين طرق الزراعة في جور على خطوط ومعاملات مكافحة الحشائش تأثيراً معنوياً على صفتي عدد الحبوب بالسنبلة ودليل الحصاد .

بناءاً على النتائج السابقة يمكن القول أنه للحصول على أعلى محصول من الحبوب بوحدة المساحة يلزم زراعة القمح في جور متباعدة ٢٠ سم وفى ثلاث صفوف على خطوط عرض ٨٠ سم مع مكافحة الحشائش ميكانيكياً مرتين بعد ٣ و ٦ أسابيع من الزراعة. وتتميز طريقة الزراعة على خطوط بأن عمليات التسميد ومكافحة الحشائش ميكانيكيا أسهل وأكثر كفاءة، ويمكن زراعة أكثر من محصول في وقت واحد سواء كمحاصيل مصاحبة أو مؤقتة أو تحميل بالإضافة للاستفادة بالخطوط القائمة في المحاصيل اللاحقه.