RESULTS AND DISCUSSION

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The present study aimed at evaluating five treatments of seedbed preparation as well as three herbicides in relation to their effects on growth and yield characters of wheat under Middle Delta conditions. The effects of tillage treatments on soil properties were also considered.

The obtained results are presented and discussed under the following headings :

I. Effect of Tillage Treatments, Methods of Weed Control and Their Interaction on Growth Characters of Wheat.
II. Effect of Tillage Treatments, Methods of Weed Control and Their Interaction on Wheat Yield and its Components.
III. Effect of Tillage Treatments, Methods of Weed Control and Their Interaction on the Spread of Weeds in Wheat.
IV. Effect of Tillage Treatments on Soil Properties.

I. Effect of Tillage Treatments, Methods of Weed Control and Their Interaction on Growth Characters of Wheat :

I.1. Dry matter accumulation (g/0.05 m^2) at 60 days from sowing:

The results presented in Table (2) show the means of dry matter accumulation (g/0.05 m^2) of wheat at 60 days from sowing (DFS) as influenced by tillage treatments, methods of weed control and their interaction in 1997/98 and 1998/99 as well as their combined average.

The results indicated that dry matter accumulation was significantly affected by tillage practices in 1998/99 season only, whereas in 1997/98 season as well as in the two seasons average, no significant effect was detected.

Table (2) : Effect of tillage, herbicides and their interaction on dry matter accumulation of wheat in g/0.05 m^2 at 60 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	9.96	14.17	12.99	20.51	14.41	c 16.14	c 17.32	c 16.32	c 17.90	c 16.92	b 13.05	b 15.75	b 14.66	b 19.21	15.67
Chisel-plow (16-18 cm)	13.66	14.87	15.51	18.06	15.53	c 15.89	c 16.74	c 16.29	b 19.12	bc 17.01	b 14.77	b 15.81	b 15.90	b 18.59	16.27
Moldboard-plow (18-20 cm)	11.34	16.83	19.04	19.25	16.62	c 15.98	b 19.28	c 17.03	b 19.22	ab 17.88	b 13.66	b 18.06	b 18.03	ab 19.23	17.25
Subsoiling + Chisel plow (16-18 cm)	13.06	18.04	15.03	18.39	16.13	c 16.30	c 17.19	c 17.43	b 18.96	bc 17.47	b 14.68	b 17.61	b 16.23	b 18.68	16.80
Subsoiling + Moldboard-plow (18-20 cm)	11.55	19.19	15.39	21.66	16.95	c 16.58	c 17.62	c 19.01	a 21.80	a 18.75	b 14.07	b 18.40	b 17.20	a 21.73	17.85
Mean	11.91	16.62	15.59	19.57		c 16.18	b 17.63	b 17.22	a 19.40		14.08	17.13	16.40	19.49	
L.S.D. at 5% : Tillage (T.)	N.S.					S					N.S.				
Herbicides (H.)	N.S.					S					N.S.				
T x H	N.S.					S					S				

In 1998/99 season, the greatest dry matter acumulation was recorded by subsoiling + moldboard plow treatment, being 18.75 g/0.05 m^2. This value exceeded that recorded by no-till, chisel plow, moldboard plow and subsoiling + chisel plow by 10.82, 10.23, 4.87 and 7.33%, respectively.

The best treatment significantly surpassed all other treatments except moldboard plowing treatment, also the no-till treatment was significantly inferior to all treatments except chisel plowing one.

In 1997/98 season as well as in the combined average, the trend of the results was similar to that in the second season (1998/99). Also, no-till treatment recorded the lowest dry matter accumulation, whereas subsoiling + moldboard plow recorded the greatest dry matter accumulation of wheat plants (g/0.05 m^2) at 60 days from sowing, but the differences were below the level of significance.

It could be concluded that the intensive tillage (subsoiling + moldboard plowing) positively affected dry matter accumulation of the early stage of growth. On the other hand, no-till treatment was the worst treatment.

These results are similar with those reported by **Arshad *et al* (1994), Arshad and Gill (1997) and Gajri *et al* (1997)**.

Concerning the effect of weed control treatments, the significant influence of herbicidal treatments on dry matter accumulation (g/0.05 m^2) at 60 DFS was found in 1998/99 season only, whereas no significant effect was detected in 1997/98 season as well as in the combined analysis of both seasons.

In 1998/99, Arelon application recorded the highest dry matter accumulation which significantly surpassed that

recorded by Grasp, Granstar and the unweeded check by 10.04, 12.33 and 19.90%, respectively Also, Grasp and Granstar application were significantly superior to the unweeded check in affecting dry matter accumulation of wheat plants at this early stage of growth.

It is clear from Table (2) that all differences among the weed control treatment in the second season reached the level of significance.

It is worth mentioning that in 1997/98 season as well as in the two seasons average, a similar trend was evident for the effect of weed control treatments on dry matter accumulation as that observed in 1998/99 season. However, the differences were below the level of significance.

It could be generally concluded that herbicides in general and Arelon, in particular, positively affected dry matter accumulation of wheat at 60 DFS, due the reduction of weed competition.

Similar results were also obtained by **Assey *et al* (1983 a and b) and Moyer *et al* (1992).**

The effect of the interaction between tillage practices and weed control treatments on dry matter accumulation of wheat plants (g/0.05 m^2) at 60 DFS was significant in 1998/99 season as well as in the combined average, whereas this effect was not significant in 1997/98 season (Table, 2).

The significant interaction in the second season as well as in the combined average indicated that the greatest dry matter accumulation was recorded by combining subsoiling + moldboard plow and Arelon application, being 21.80 and 21.73 g/0.05 m^2 respectively. On the other hand, the lowest dry matter accumulation were 16.14 and 13.05 g/0.05 m^2 which was

produced by no-till + unweeding in 1998/99 season and the combined average respectively.

The significant interaction in 1998/99 season indicated also that Grasp application was more effective on dry matter accumulation than Granstar when it was combined by no-till, chisel plowing and moldboard plowing, whereas Granstar was superior to Grasp when it was combined with the two subsoiling treatments.

I.2. Dry matter accumulation (g/0.05 m^2) at 120 days from sowing:

Data in Table (3) show the effects of tillage practices, herbicidal treatments and their interaction on dry matter accumulation of wheat plants in g/0.05 m^2 at 120 DFS in 1997/98 and 1998/99 seasons and their combined average.

The results indicated that tillage treatments significantly affected dry matter accumulation in both seasons as well as in their combined average.

The best treatment in enhancing dry matter acumulation was subsoiling + moldboard plowing which significantly surpassed no-till and chisel plowing in both seasons and the combined average.

The two seasons average indicates a good illustration of the results, where subsoiling + moldboard plowing surpassed no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing in affecting dry matter accumulation (g/0.05 m^2) at 120 DFS by 10.27, 8.40, 3.93 and 8.02% respectively. All these increases were significant except that between the two moldboard plowing treatments.

Table (3) : Effect of tillage, herbicides and their interaction on dry matter accumulation of wheat in g/0.05 m^2 at 120 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	c 68.89	bc 77.45	c 72.07	bc 79.53	b 74.49	abc 70.01	ab 82.38	ab 81.41	ab 82.59	b 79.10	c 69.45	b 79.92	b 76.74	b 81.06	c 76.79
Chisel-plow (16-18 cm)	c 71.71	c 73.05	bc 79.07	b 81.83	b 76.42	a-c 76.04	ab 81.69	a-c 79.34	ab 82.23	b 79.83	bc 73.88	b 77.37	b 79.20	b 82.03	bc 78.12
Moldboard-plow (18-20 cm)	cd 56.44	b 83.39	bc 80.73	a 100.88	a 80.36	a-c 79.91	ab 83.65	ab 81.96	ab 84.92	a 82.61	c 68.17	b 83.52	b 81.34	a 92.90	ab 81.48
Subsoiling + Chisel plow (16-18cm)	cd 63.70	bc 78.86	c 68.28	a 94.51	b 76.34	a-c 69.91	a-c 76.86	ab 81.69	a 93.33	ab 80.45	c 66.81	b 77.86	bc 74.98	a 93.92	bc 78.39
Subsoiling + Moldboard-plow (18-20cm)	bc 80.64	cd 65.00	ab 93.52	a 101.36	a 85.13	a-c 69.51	ab 87.69	ab 89.51	ab 90.21	a 84.23	bc 75.07	b 76.34	ab 91.52	a 95.78	a 84.68
Mean	c 68.28	b 75.55	b 78.73	a 91.62		b 73.08	a 82.45	a 82.78	a 86.66		c 70.68	b 79.00	b 80.76	a 89.14	
L.S.D. at 5% :															
Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

It could be concluded that an intensive tillage system including subsoiling and moldboard plowing was effective in increasing dry matter accumulation of wheat plants at 120 day from sowing, probably due to a deeper penetration of the root system through the soil and more nutrient and water absorption.

The present results are in agreement with those reported by **Arshad *et al* (1994), Arshad and Gill (1997) and Gajri *et al* (1997)**.

Concerning weed control treatments, the results in Table (3) showed that dry matter accumulation of wheat plants was significantly increased by the application of the three herbicides compared with the unweeded check. The best effect was recorded by applying Arelon in both seasons, followed by Granstar and then Grasp.

The results were identical in both seasons as well as in the combined average.

In 1997/98 season, Arelon application significantly increased dry matter accumulation (g/0.05 m^2) of wheat plants at 120 DFS by 34.18, 21.27 and 16.37%, compared with the unweeded control, Grasp and Granstar, respectively. The corresponding increases in 1998/99 season were 18.58, 5.11 and 4.69%, respectively.

Also, the superiority of Arelon over the unweeded control, Grasp and Granstar in the combined analysis reached 26.12, 12.84 and 10.38%, respectively.

It could be concluded that the three herbicides in general, and Arelon in particular showed pronounced effect in increasing dry matter accumulation in wheat plants as a result of reduction in weed spread and competition.

Similar results were also reported by **Assey *et al* (1983 a and b) and Moyer *et al* (1992).**

In regard to the effect of the interaction between tillage practices and weed control treatments on dry matter accumulation of wheat at 120 DFS, data in Table (3) indicated a significant effect in both seasons and the combined average as well.

The best combination was recorded by subsoiling + moldboard plowing with Arelon in 1997/98 and the combined average with a value of 101.36 and 95.78 g/0.05 m^2, respectively. While in 1998/999 season, the highest value was recorded by subsoiling plus chisel plowing combined with Arelon, being 93.33 g.

The significant interaction between tillage practices and herbicidal treatments is evident in the combined analysis (Table, 3). Granstar was superior to Grasp when it was combined with chisel plow, and subsoiling + moldboard plow, whereas Grasp was superior to Granstar under no-till, moldboard plow, and subsoiling + chisel plow.

I.3. Leaf area index (LAI) at 60 days from sowing :

Means of leaf area index at 60 DFS in 1997/98 and 1998/999 seasons and their combined average as affected by tillage practices, herbicides and their interaction are presented in Table (4).

The results revealed that tillage treatments significantly affected LAI at 60 DFS in the two experimental seasons as well as in the combined analysis.

Table (4) : Effect of tillage, herbicides and their interaction on L.A.I. of wheat at 60 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	cd 4.56	cd 4.09	c 5.13	bc 6.28	ab 5.02	d 3.97	d 4.11	d 4.01	c 4.35	b 4.11	e 4.26	e 4.10	d 4.57	b 5.31	b 4.56
Chisel-plow (16-18 cm)	c 4.92	c 4.96	cd 4.36	c 4.89	b 4.78	d 3.71	d 4.06	d 3.83	cd 4.33	bc 3.98	d 4.31	cd 4.51	e 4.09	bc 4.61	bc 4.38
Moldboard-plow (18-20 cm)	c 5.02	cd 4.40	cd 4.16	a 6.67	ab 5.06	d 3.53	d 4.16	d 3.94	bc 5.11	b 4.19	e 4.27	d 4.28	e 4.05	a 5.89	b 4.62
Subsoiling + Chisel plow (16-18cm)	c 5.31	c 5.14	cd 4.69	cd 3.84	b 4.75	d 3.64	d 3.75	d 3.77	cd 4.18	c 3.84	e 4.47	d 4.44	e 4.23	e 4.01	c 4.29
Subsoiling + Moldboard-plow (18-20 cm)	c 4.86	b 6.58	c 5.30	cd 4.46	a 5.30	d 3.52	d 3.59	b 5.49	a 6.36	a 4.74	e 4.19	bc 5.08	b 5.39	ab 5.41	a 5.02
Mean	ab 4.93	ab 5.03	b 4.73	a 5.23		c 3.67	bc 3.93	b 4.21	a 4.87		b 4.30	b 4.48	b 4.47	a 5.05	
L.S.D. at 5% : Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

The best treatment was that including subsoiling + moldboard plowing in both seasons which was followed by moldboard plowing without significant difference in their effect on LAI at 60 DFS.

The combined analysis indicated a good illustration for the results where subsoiling + moldboard plowing significantly surpassed no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing by 10.09, 14.61, 8.66 and 17.02%, respectively in affecting LAT at 60 DFS.

It could be concluded that LAI of wheat was favourably affected by subsoiling + moldboard plowing as a result of higher dry matter accumulation at 60 DAS. On the other hand, chisel plowing and zero tillage were not efficient tillage systems for wheat as far as LAI is concerned.

The effect of tillage methods on LAI was also found by **Marwat *et al* (1989), Gajri *et al* (1992) and Arshad and Gill (1997).**

Concerning the effect of weed control treatments on LAI at 60 DFS, results showed that herbicides significantly increased LAI in both seasons as well as in the combined average.

Arelon application significantly surpassed all other treatments in affecting LAI at 60 DFS in both seasons as well as in the combined average.

Arelon induced significant increases of 7.84, 3.98 and 10.57% in LAI compared with unweeded check, Grasp and Granstar, respectively, in 1997/98 season.

The corresponding increases in 1998/99 season were 32.70, 23.92 and 15.68% compared with the three respective treatments. Also, in the combined average, Arelon significantly

increased LAI at 60 DFS by 17.44, 12.72 and 12.98% compared with the unweeded check, Grasp and Granstar, respectively.

The results indicated some differences in the efficiency of the 3 herbicides on LAI from one season to the other. Grasp was more effective in the first season compared with Granstar, whereas an opposite trend was observed in the second season where Granstar surpassed Grasp in affecting LAI.

This result may be due to the differences found in the weed flora in wheat plots in both seasons.

It could be concluded that Arelon proved promising in affecting wheat growth expressed in term of LAI at 60 DFS.

The present results are in close agreement with those obtained by **Assey *et al* (1983 b), and Shebl (1998)**.

The effect of the interaction between tillage practices and herbicidal treatments on LAI at 60 DFS was significant in both seasons as well as in the combined average (Table, 4).

The results showed a great variation for the efficiency of the 3 herbicides due to the different seedbed preparation treatments in both seasons.

For example, in 1997/98 season, Arelon was the best herbicide when it was combined with no-till and moldboard plowing, but it was the worst one with subsoiling + chisel plowing.

Also in 1998/99 season, Arelon was the best effective herbicide with all seedbed preparation treatments, followed by either Granstar or Grasp according to the tillage treatment.

The present results indicate clearly that the efficiency of the 3 herbicides was greatly dependent on the tillage treatment showing the significant interaction between the 2 experimental factors.

In general, the highest LAI at 60 DFS was 6.67 in 1997/98 and 5.89 in the combined analysis which were recorded by combining moldboard plowing and Arelon.

On the other hand, in 1998/99 season, combining subsoiling + moldboard plowing with Arelon recorded the maximum LAI, being 6.36 .

I.4. Leaf area index at 120 days from sowing :

The results presented in Table (5) show the means of LAI of wheat at 120 DFS as affected by tillage practices, herbicidal treatments and their interaction in 1997/98 and 1998/99 seasons and their combined average.

Concerning the effect of tillage treatments, the intensive treatment including subsoiling + moldboard plowing was the best treatment and markedly surpassed the 4 other treatments where significant increases of 32.76, 27.75, 17.88 and 23.47% were recorded by this treatment in LAI at 120 DFS in 1997/98 season, compared with no-till, chisel plowing, moldboard plowing, and subsoiling + chisel plowing, respectively.

Similarly, in 1998/99 season subsoiling + moldboard plowing surpassed the 4 respective treatments by 47.18, 6.17, 4.14 and 5.07%. The corresponding increases due to this intensive treatments in LAI in the two seasons average were 39.29, 16.33, 10.93 and 13.82% compared with no-till, chisel plowing, moldboard plowing and subsoiling + moldboard plowing, respectively.

The results in Table (5) indicate that subsoiling + moldboard plowing was superior compared with the 4 other treatments, whereas no-till treatments was significantly inferior

Table (5) : Effect of tillage, herbicides and their interaction on L.A.I. of wheat at 120 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments	1997 / 1998					1998 / 1999					Combined				
Tillage treatments	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	b 5.07	ab 6.22	b 5.69	ab 6.46	c 5.86	d 4.11	d 4.84	d 4.42	c 5.78	b 4.79	d 4.59	cd 5.53	cd 5.05	bc 6.12	c 5.32
Chisel-plow (16-18 cm)	b 5.11	b 5.94	b 5.42	a 7.90	bc 6.09	c 5.98	b 6.86	b 6.53	ab 7.17	a 6.64	cd 5.55	b 6.40	c 5.97	a 7.54	b 6.37
Moldboard-plow (18-20 cm)	b 5.20	b 5.65	ab 7.34	a 8.21	b 6.60	c 5.58	ab 7.57	b 6.26	a 7.66	a 6.77	cd 5.39	b 6.61	b 6.80	a 7.93	b 6.68
Subsoiling + Chisel plow (16-18cm)	b 5.72	ab 6.16	b 5.94	ab 7.36	bc 6.30	c 5.15	c 5.71	ab 7.51	a 8.46	a 6.71	cd 5.44	c 5.93	b 6.73	a 7.91	b 6.50
Subsoiling + Moldboard-plow (18-20 cm)	a 7.38	a 7.62	a 8.01	a 8.12	a 7.78	b 6.92	ab 7.00	ab 7.10	ab 7.16	a 7.05	ab 7.15	ab 7.31	a 7.55	a 7.64	a 7.41
Mean	c 5.70	b 6.32	b 6.48	a 7.61		c 5.55	b 6.40	b 6.36	a 7.25		c 5.62	b 6.36	b 6.42	a 7.43	
L.S.D. at 5% :															
Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

compared with the 4 other treatments in both seasons and in the combined average.

The superior treatment was followed by moldboard plowing, then subsoiling + chisel plowing, chisel plowing and subsoiling + chisel plowing in a descending order, in both seasons and the combined average.

It is worth noting that the best treatment surpassed all other treatments with significant differences in the first season as well as the combined average, whereas in the second season the significant differences were only those between the no-till treatment and the other 4 treatments.

It could be concluded that intensive tillage and the use of moldboard plow were effective in increasing wheat growth expressed in term of LAI at 120 DFS. The need of wheat plants to a good tillage system is clearly demonstrated.

Similar results were also found by **Marwat *et al* (1989), Gajri *et al* (1992) and Arshad and Gill (1997).**

The results presented in Table (5) showed also that herbicides application significantly increased LAI at 120 DFS in both seasons as well as in the combined average.

Arelon application was the best weed control treatment and induced significant increases in LAI at 120 DFS over the unweeded check as well the two other herbicides. The two other herbicides, i.e. Grasp and Granstar were effective in increasing LAI over the check treatment in both seasons and the combined average but no significant differences were detected between them, indicating a similar efficiency.

In 1997/98 season, Arelon application significantly increased LAI at 120 DFS by 33.51, 20.41 and 17.44%, compared with the unweeded check, Grasp and Granstar,

respectively. The corresponding increases in 1998/99 season were 30.63, 13.28 and 13.99%, respectively. Also in the two seasons average Arelon induced significant increases in LAI at 120 DFS of 32.21, 16.82 and 15.73% compared with unweeding, Grasp and Granstar, respectively.

The superior effect of Arelon is clearly demonstrated and this is mainly due to its effect on depressing weed infestation in wheat plots, which in turn reduced weed competition to wheat plants.

Similar results were also reported by **Assey *et al* (1983 b), Mayer *et al* (1992), Zaher (1996) and Shebl (1998)**.

Concerning the effect of the interaction between tillage practices and weed control treatments on LAI at 120 DFS, results in Table (5) showed that in both seasons as well as in the combined data, this character was significantly affected.

In 1997/98 as well as in the combined analysis the highest response was achieved by combining moldboard plowing + Arelon were the greatest LAI values were recorded being 8.21 and 7.93, respectively.

In 1998/99 season, the maximum LAI at 120 DFS was 8.46 which was recorded by combining subsoiling + chisel plowing with Arelon.

The significant interaction between tillage and herbicides was evident when comparing the efficiency of Grasp and Granstar.

For example, in the combined average, results in Table (5) showed that Grasp surpassed Granstar under no-till and chisel plowing, whereas under moldboard plowing, subsoiling + chisel

plowing and subsoiling + moldboard plowing, Granstar was more effective on LAI than Grasp.

I.5. Plant height at 60 days from sowing :

The data presented in Table (6) show the effects of tillage practices, weed control treatments and their interaction on wheat plant height at 60 days from sowing in 1997/98 and 1998/99 seasons and their combined average.

The results showed that seedbed preparation treatments significantly affected plant height in both seasons as well as in the combined analysis at this growth stage.

The tallest plants were obtained by subsoiling plus moldboard plowing in both seasons which were almost significantly taller than those plants produced by the 4 other tillage treatments.

In 1997/98 season, subsoiling + moldboard plowing increased plant height by 15.19, 7.98, 0.63 and 8.06%, compared with no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing, respectively.

Similarly, in 1998/99, subsoiling + moldboard plowing significantly increased wheat plant height at 60 DFS by 13.36, 11.36, 9.54 and 10.47%, compared with the 4 respective treatments.

The corresponding increases in the combined average were 14.44, 9.36, 4.45 and 9.07%, respectively due to applying subsoiling + moldboard plowing.

Moldboard plowing was the second ranking tillage treatment in its effect on plant height at 60 DFS which induced an increase in plant height of 14.48, 3.47 and 9.57% in 1997/98,

Table (6) : Effect of tillage, herbicides and their interaction on plant height (cm) of wheat at 60 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments	1997 / 1998					1998 / 1999					Combined				
Tillage treatments	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	e 23.12	d 24.41	d 26.21	cd 26.82	c 25.14	de 15.81	b 19.60	d 16.92	ab 21.02	b 18.34	e 19.47	cd 22.00	d 21.56	b 23.92	d 21.74
Chisel-plow (16-18 cm)	e 21.11	c 28.38	d 26.19	b 31.59	b 26.82	d 17.33	c 18.76	bc 19.12	b 19.47	b 18.67	e 19.22	c 23.57	c 22.66	a 25.53	c 22.75
Moldboard-plow (18-20 cm)	d 24.67	c 27.79	b 30.61	ab 32.03	a 28.78	e 14.12	b 20.48	b 20.16	b 20.67	b 18.98	e 19.39	b 24.14	ab 25.38	a 26.35	b 23.82
Subsoiling + Chisel plow (16-18cm)	de 23.95	c 28.42	d 24.38	b 30.43	b 26.80	d 17.53	c 18.88	d 19.10	b 19.76	b 18.82	de 20.74	bc 23.65	d 21.74	b 25.10	c 22.81
Subsoiling + Moldboard-plow (18-20 cm)	d 25.90	a 32.51	c 28.24	bc 29.19	a 28.96	b 19.54	a 21.33	b 19.80	a 22.48	a 20.79	c 22.72	a 26.92	b 24.02	a 25.84	a 24.88
Mean	c 23.75	b 28.30	b 27.13	a 30.01		c 16.87	ab 19.81	b 19.02	a 20.68		d 20.31	b 24.06	c 23.07	a 25.53	
L.S.D. at 5% :															
Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

1998/99 and the two seasons average, respectively compared with no-till treatment.

It could be concluded that moldboard plowing in general, and combined with subsoiling, in particular, positively affected wheat growth at 60 DFS probably due to greater root penetration and higher nutrient and water absorption. Similar results were also reported by **Marwat *et al* (1989)**.

Concerning the effect of weed control treatments, the results inTable (6) showed that plant height at 60 DFS was significantly increased in both seasons as well as in the combined average due to the application of the three herbicides, namely, Arelon, Grasp and Granstar. The greatest increase in plant height at 60 DFS was achieved by Arelon, followed by Grasp, then Granstar, in a descending order.

The application of Arelon in 1997/98 season significantly increased wheat plant height at 60 DFS by 26.36, 6.04, 10.62%, compared with the unweeded check, Grasp and Granstar, respectively. In 1998/99 season, the corresponding increases were 22.58, 4.39 and 8.73% compared with the respective treatments.

Also, Arelon surpassed the check treatment, Grasp and Granstar in affecting plant height by 24.82, 5.36 and 9.88%, respectively on the average of both seasons. In the combined average all differences among the 4 weed control treatments were significant.

It could be concluded that herbicides, in general, and Arelon, in particular, enhanced wheat growth expressed as plant height at 60 DFS, due to their effect in controlling weeds and reducing weed competition.

Similar results were also obtained by **Soroka *et al* (1995), Mady (1996) and Shebl (1998)** who reported that herbicides increased growth characters of wheat.

Concerning the interaction between tillage practices and weed control treatments, the results in Table (6) showed that wheat plant height at 60 DFS was significantly affected by this interaction in both seasons.

The results revealed that the highest response value was recorded by controlling subsoiling + moldboard plowing with Grasp in the first season as well as in the combined average, whereas in 1998/99 season, subsoiling + moldboard plowing combined with Arelon produced the maximum plant height at 60 DFS.

The highest values recorded by these combinations were 32.51, 22.48 and 26.92 cm in the first, second and the two seasons average, respectively.

The significant interaction between tillage and herbicides is quite evident from Table (6) where the efficiency of herbicides was dependant on the tillage treatment.

In 1997/98 season Grasp surpassed Granstar when it was combined with chisel plowing, subsoiling + chisel plowing and subsoiling + moldboard plowing, while Granstar was more effective when it was combined with no-till and moldboard plowing.

Also in 1998/99 season, Grasp was more effective than Granstar under no-till, and subsoiling + moldboard plowing, while Granstar surpassed Grasp under chisel plowing, but under moldboard plowing and subsoiling + chisel plowing, both herbicides were of similar effect.

I.6. Plant height at 120 days from sowing :

The means of plant height of wheat at 120 DFS as affected by tillage treatments, herbicides and their interaction in 1997/98 and 1998/99 seasons as well as their combined average are presented in Table (7).

The results indicated a similar trend for the effect of tillage treatments on plant height of wheat at 120 as that observed at 60 DFS.

The intensive seedbed preparation treatment including subsoiling + moldboard plowing was the best treatment in both seasons and surpassed significantly, in 1997/98 season, no-till, chisel plowing, moldboard plowing, subsoiling + chisel plowing by 5.55, 4.73, 2.49 and 3.57%, respectively corresponding to 10.90, 6.38, 0.65 and 5.91%, compared with the respective treatments in 1998/99 season. On the average of both seasons, subsoiling + moldboard plowing significantly increased wheat plant height at 120 DFS by 8.01, 5.49, 1.61 and 4.68% compared with no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing, respectively.

The results revealed that the 5 tillage treatments could be arranged in a descending order in regard to their effect on wheat plant height at 120 DFS in the following order : Subsoiling + moldboard plowing, moldboard plowing, subsoiling + chisel plowing, chisel plowing and no-tll. All differences in plant height at 120 DFS were significant in the combined average except that between the two chisel plowing treatments.

It could be concluded that a good tillage system including the use of modlboard plow plus subsoiling, positively

Table (7) : Effect of tillage, herbicides and their interaction on plant height (cm) of wheat at 120 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments	1997 / 1998					1998 / 1999					Combined				
Tillage treatments	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	c 88.05	ab 99.24	bc 93.11	a 100.86	d 95.32	d 73.71	c 85.82	cd 75.86	b 87.70	c 80.77	g 80.88	bc 92.53	e 84.48	b 94.28	d 88.04
Chisel-plow (16-18 cm)	c 88.54	b 98.14	b 98.26	a 99.34	cd 96.07	cd 77.20	bc 86.32	c 85.32	b 87.96	b 84.20	eg 82.87	c 92.23	c 91.79	b 93.65	c 90.14
Moldboard-plow (18-20 cm)	c 91.45	a 100.02	a 99.79	a 101.40	b 98.17	bc 86.92	b 88.22	b 90.11	b 90.69	a 88.99	cd 89.19	b 94.12	b 94.95	a 96.05	b 93.58
Subsoiling + Chisel plow (16-18cm)	b 95.30	b 97.66	b 96.97	b 98.55	bc 97.12	cd 75.32	b 88.47	cd 80.39	a 94.08	b 84.57	de 85.31	b 93.07	cd 88.68	a 96.31	c 90.84
Subsoiling + Moldboard-plow (18-20 cm)	b 95.08	a 102.95	a 99.94	a 104.46	a 100.61	c 85.39	b 88.22	b 92.28	ab 92.37	a 89.57	c 90.24	ab 95.58	a 96.11	a 98.41	a 95.09
Mean	d 91.68	b 99.60	c 97.61	a 100.92		c 79.71	ab 87.41	b 84.79	a 90.56		c 85.70	a 93.51	b 91.20	a 95.74	
L.S.D. at 5% :															
Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

affected wheat growth at 120 DFS. Similar results have been reported by **Marwat *et al* (1989)**.

Concerning the effect of weed control treatments, the results indicated a similar trend at 120 DFS as that observed at 60 DFS, where a significant positive effect was detected for herbicides application in general, and Arelon, in particular, on wheat plant height.

The superiority of Arelon application was evident in both seasons and the combined average, on plant height, followed by Grasp then Granstar. However, the three herbicides induced significant increases in plant height over the unweeded check in both seasons.

The results revealed that Arelon application significantly increased plant height at 120 DFS by 10.08, 1.33 and 3.39% compared with the unweeded check, Grasp and Granstar, in the first season, corresponding to 13.61, 3.60 and 6.55%, in the second season. The superiority of Arelon in the combined analysis averaged 11.72, 2.38 and 4.98% compared with the same respective treatments.

The positive effect of the herbicides on plant height is a result of depressing the spread of weeds in wheat plots and the reduction in weed competition for nutrients, water and light.

Similar results were also reported by **El-Ghonemi (1969), Mady (1996) and Shebl (1998). Also Shebl (1998)** found that Arelon application was more effective on wheat plant height at 60 and 90 DFS compared with hand weeding.

Concerning the effect of the interaction between tillage treatments and herbicides application on plant height at 120 DFS, the results in Table (7) showed a significant effect in both seasons as well as in the combined average.

The interaction effect is evident when comparing the efficiency of Grasp and Granstar in 1997/98 season in their effect on plant height at 120 DFS. Grasp surpassed Granstar under no-till, subsoiling + chisel plowing and subsoiling + moldboard plowing, whereas under chisel plowing as well as modlboard plowing, both herbicides were equally effective.

Also, in 1998/99 season, Grasp was more efficient than Granstar on plant height when it was combined with no-till, chisel plowing, subsoiling + chisel plowing, whereas an opposite trend was observed with moldboard plowing and subsoiling + moldboard plowing where Granstar surpassed Grasp with significant differences.

In general, the best combination that recorded the highest response value was that including subsoiling plus modlboard plowing + Arelon in 1997/98 season as well as in the combined average, whereas in 1998/99, combining subsoiling + chisel plowing with Arelon recorded the highest value of wheat plant height at 120 DFS. The maximum values recorded by the forementioned combinations were 104.46, 94.08 and 98.41 cm, in 1997/98, 1998/99 and the combined average, respectively.

II. Effect of Tillage Treatments, Methods of Weed Control and Their Interaction on Yield and its Components :

II.1. Number of spikes per one square meter :

The means of number of spikes/m^2 at harvest as affected by tillage treatments, herbicidal application and their interaction in 1997/98 and 1998/99 seasons as well as their

combined average are presented in Table (8) and illustrated in Fig. (1 and 2).

The results indicated the superiority of an intensive tillage system including subsoiling + moldboard plowing on tillering capacity of wheat which was followed by moldboard plowing, subsoiling + chisel plowing, chisel plowing alone and then no-till treatment, in a descending order.

The results showed a similar trend for the effect of tillage treatments in both seasons as well as their combined average. In 1997/98 season, subsoiling + moldboard plowing increased number of spikes/m^2 by 11.18, 10.67, 1.32 and 4.35% respectively, compared with no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing, respectively. The differences between the 2 moldboard plowing as well as between no-till and chisel plowing were not significant.

In 1998/99 season, also subsoiling + moldboard plowing significantly surpassed the four respective tillage treatments in its effect on number of spikes/m^2 by 32.52, 27.19, 23.96 and 25.12%. The best treatment, i.e., subsoiling + moldboard plowing significantly surpassed the 4 other treatments, whereas the control treatment (no-till) was significantly inferior compared with the other tillage treatments in that season.

The results of the two seasons average showed also the superiority of subsoiling + moldboard plowing which significantly surpassed the four other treatments by 21.47, 18.79, 12.09 and 14.33%, respectively. The differences in number of spikes/m^2 between no-till and chisel plowing as well as between modlboard plowing and subsoiling + chisel plowing were not significant in the combined average.

Table (8) : Effect of tillage, herbicides and their interaction on No. of spikes per square meter of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments	1997 / 1998					1998 / 1999					Combined				
Tillage treatments	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	f 395.25	bc 511.25	e 456.50	b 535.25	c 474.56	e 395.50	d 452.00	d 435.00	c 484.00	c 441.63	h 395.38	ef 481.63	g 445.75	d 509.63	c 458.10
Chisel-plow (16-18 cm)	f 427.75	d 475.25	ef 430.00	a 574.00	c 476.75	e 393.00	c 481.00	d 474.00	c 492.50	bc 460.13	h 410.38	f 478.13	g 452.00	cd 533.25	c 468.44
Moldboard-plow (18-20 cm)	d 477.00	c 539.25	cd 464.00	a 572.75	a 520.75	d 441.00	c 498.00	c 443.50	cd 506.00	ab 472.13	fg 459.00	d 518.63	f 468.75	c 539.38	b 496.44
Subsoiling + Chisel plow (16-18 cm)	de 464.75	c 505.75	c 503.25	ab 548.75	b 505.63	de 412.00	c 480.00	cd 476.00	c 503.00	b 467.75	g 438.38	e 492.88	e 489.63	d 525.88	b 486.69
Subsoiling + Moldboard-plow (18-20 cm)	d 471.25	b 540.75	bc 519.25	a 579.25	a 527.63	cd 538.00	ab 600.00	bc 569.00	a 634.00	a 585.25	de 504.63	b 570.38	bc 544.13	a 606.63	a 556.44
Mean	d 446.80	b 514.45	c 481.00	a 562.00		c 435.90	ab 502.20	b 479.50	a 523.90		d 441.55	b 508.33	c 480.05	a 542.95	
L.S.D. at 5% :															
Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

Fig. (1): Effect of tillage treatments on number of spikes per square meter of wheat in 1997/98, 1998/99 and their combined average

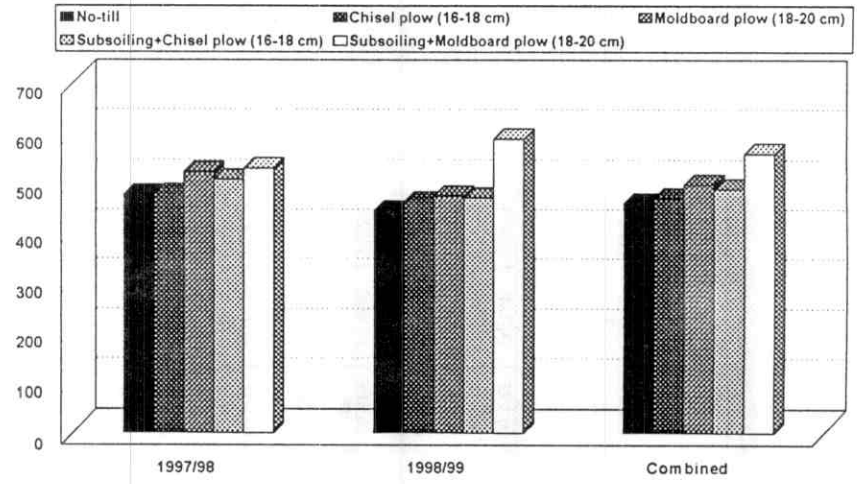
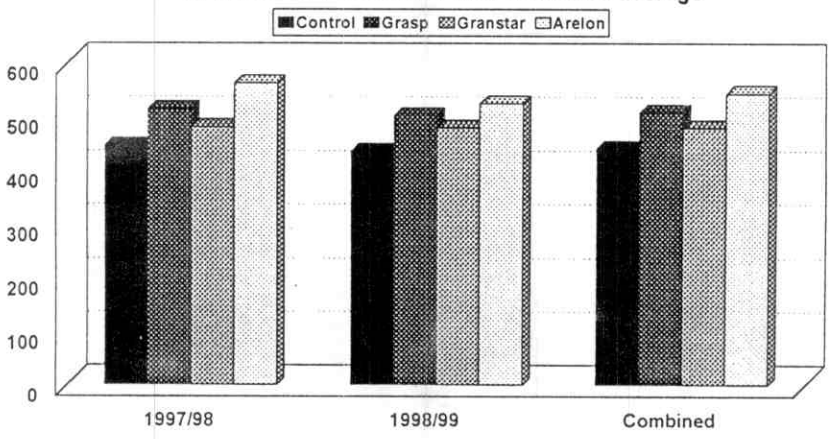


Fig. (2): Effect of weed control treatments on number of spikes per square meter of wheat in 1998/99 and their combined average



It could be concluded that moldboard plowing, in general, and when combined with subsoiling, in particular, induced a marked increase in the production of fertile tillers in wheat due to a better growth, greater dry matter accumulation, and higher LAI. Similar results were also reported by **Gomaa (1995)** who found that moldboard plowing at 18-20 and 28-30 cm depths alone or in combination with subsoiling recorded the highest values of number of tillers/m^2 of wheat.

Concerning the effect of weed control treatments on number of spikes/m^2, the results in Table (8) and Fig. (2) showed that herbicidal application significantly increased this trait in both seasons and the combined average.

In 1997/98, Arelon application significantly increased number of spikes/m^2 by 25.78, 9.24 and 16.84%, respectively compared with the unweeded check, Grasp and Granstar.

Similarly, in 1998/99 season, Arelon surpassed significantly the unweeded check, Grasp and Granstar, by 20.12, 4.32, and 9.26%, respectively, in its effect on spikes number/m^2. The corresponding increases in spikes/m^2, in the two seasons average were 22.16, 6.81 and 13.10%, respectively.

It could be concluded that, Arelon proved as an effective treatment for reducing weed competition in wheat field. The increase in spikes/m^2 is mainly due to positive effect of herbicides, in general, and Arelon, in particular, on dry matter accumulation as well as LAI.

Similar results for the positive effects of herbicides on spikes number/m^2 were also reported by **El-Ghonemi (1969), Assey *et al* (1983 b), Mady (1996) and Shebl (1998)**.

The results in Table (8) showed also that the interaction between tillage treatments and herbicides significantly affected

number of spikes/m^2 in both seasons as well as their combined average.

The best combination that produced the highest response value of spikes/m^2 was that including subsoiling plus moldboard plowing + Arelon in both seasons and the combined average. The maximum numbers of spikes/m^2 were 579.25, 634.00 and 606.63, respectively in the first, second and the combined average.

II.2. Weight of 1000 grains (g) :

The means of grain index of wheat as affected by tillage treatments, herbicidal application and their interaction in 1997/98, 1998/99 and their combined average are presented in Table (9) and illustrated in Fig. (3 and 4).

The results showed that in the first season as well as the combined average, 1000-grain weight was significantly influenced by tillage treatments. A similar trend was observed for the effect of tillage treatments where subsoiling + moldboard plowing and moldboard plowing alone were the best treatments followed by subsoiling + chisel plowing, then chisel plowing and the worst treatment was no-till.

In 1997/98 season, subsoiling + moldboard plowing surpassed, no-till, chisel plowing, moldboard plowing, subsoiling + chisel plowing in their effect on 1000-grain weight by 6.84, 5.49, 1.17 and 2.17%, respectively. The significant difference was only observed between no-till and subsoiling + moldboard plowing as the two extremes.

In the second season, about the same trend was observed and the difference between the best and worst treatments was 8.48%. However, this difference was not significant.

Table (9) : Effect of tillage, herbicides and their interaction on weight of 1000 grains (g) of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	d 55.28	c 61.28	d 57.04	a 69.20	b 60.70	c 51.82	b 55.43	bc 54.11	b 57.40	a 54.69	d 53.55	c 58.35	cd 55.57	b 63.30	b 57.69
Chisel-plow (16-18 cm)	d 55.94	c 61.27	d 59.67	a 69.38	ab 61.57	c 47.73	b 59.27	b 57.69	b 60.18	a 56.22	d 51.83	b 60.27	c 58.68	a 64.78	b 58.89
Moldboard-plow (18-20 cm)	cd 60.53	b 66.83	c 62.13	ab 67.30	a 64.20	b 56.11	ab 60.48	b 57.20	a 61.20	a 58.75	c 58.32	ab 63.65	bc 59.67	a 64.25	a 61.47
Subsoiling + Chisel plow (16-18 cm)	d 57.67	b 66.35	bc 63.40	b 66.84	ab 63.57	b 54.84	b 56.78	b 56.58	b 58.46	a 56.67	c 56.25	b 61.56	b 59.99	b 62.65	ab 60.11
Subsoiling + Moldboard-plow (18-20 cm)	d 60.12	b 66.04	c 61.51	a 72.11	a 64.95	b 58.55	b 59.49	b 59.01	b 60.26	a 59.33	c 59.33	b 62.77	b 60.26	a 66.19	a 62.14
Mean	c 57.91	b 64.35	bc 60.75	a 68.97		b 53.81	a 58.29	ab 56.92	a 59.50		c 55.86	b 61.32	b 58.83	a 64.23	
L.S.D. at 5% : Tillage (T.)	S					N.S.					S				
Herbicides (H.)	S					S					S				
T x H	S					S					S				

Fig. (3): Effect of tillage treatments on 1000-grain weight (g) of wheat in 1997/98, 1998/99 and their combined average

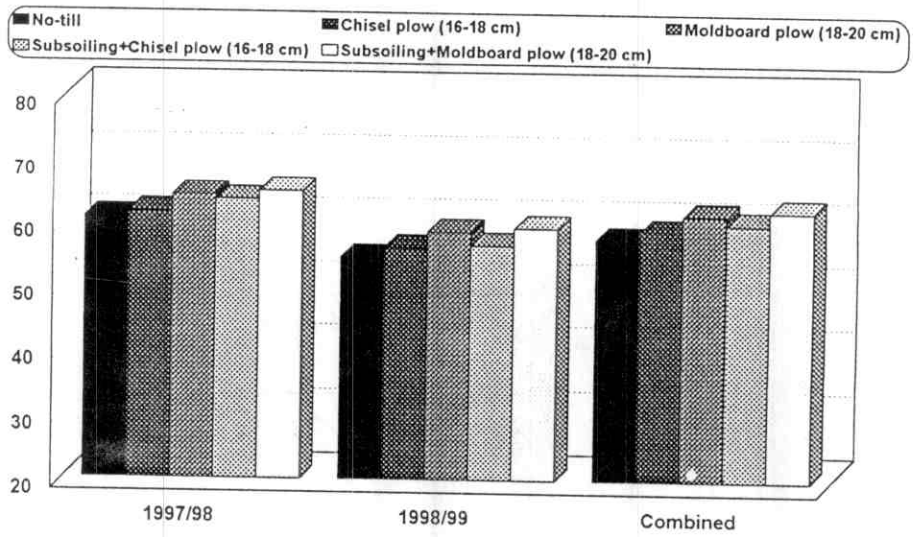
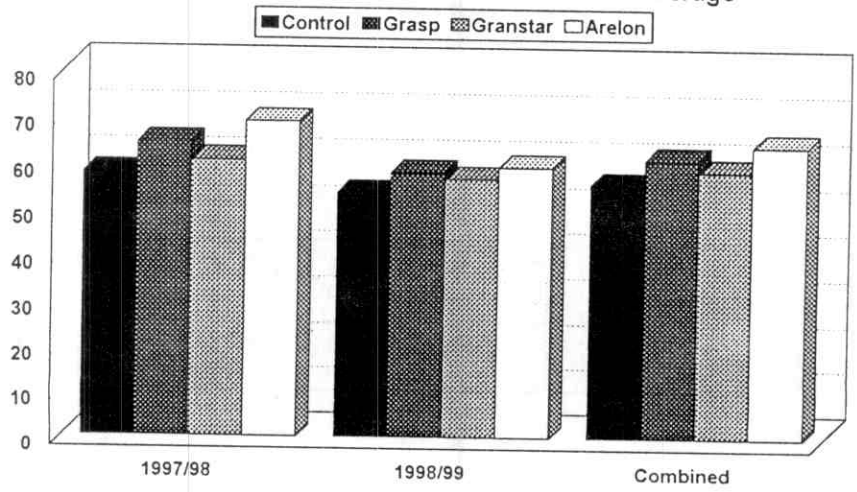


Fig. (4): Effect of weed control treatments on 1000-grain weight (g) of wheat in 1997/98, 1998/99 and their combined average



In the combined average, also subsoiling + moldboard plowing was the best treatment followed by modlboard plowing, and subsoiling + chisel plowing without significant differences. The worst treatment was the check treatment (no-till) but without significant differences when compared with the two chisel plowing treatments.

The superiority of subsoiling + moldboard plowing over the four respective tillage treatments combined over both seasons reached 7.31, 5.52, 1.09 and 3.38%, respectively.

It could be concluded that moldboard plowing, in general, and when combined with subsoiling encouraged the production of heavy grains as a result of its favourable effects on plant growth. Similar results were also reported by **Gill and Aulakh (1990)**.

Concerning the effect of herbicidal application on grain index, the results in Table (9) and Fig. (4) revealed that the three applied herbicides, in general, and Arelon in particular, significantly increased this trait in both seasons as well as in their combined average.

In 1997/98 season, Arelon significantly surpassed in its effect on grain index, the unweeded check, Grasp and Granstar by 19.10, 7.18 and 13.53%, respectively.

In 1998/99 season, also Arelon application surpassed in its effect on 1000-grain weight the 3 respective treatments by 10.57, 2.08 and 4.53%. The significant differences in that season were those between the check treatment and each of Grasp and Arelon, whereas no significant differences were observed among the three herbicides.

In the combined two seasons average, Arelon surpassed the check treatment, Grasp and Granstar by 14.98, 4.75 and

9.18%, respectively. All differences were significant except that between Grasp and Granstar.

It could be concluded that herbicides, particularly, Arelon significantly increased grain index of wheat due to the reduction of the spread of weeds and encouraging plant growth, LAI and dry matter accumulation as a result of the reduction of weed competition.

Similar results were also reported by **Assey *et al* (1983 b), Mady (1996) and Shebl (1998)**. The superior effect of Arelon on grain index of wheat was evident from the results of **Shebl (1998)** who found that Arelon application increased grain index of wheat by 5.51 and 11.44% compared with hand weeding and unweeded check, respectively on the average of three bread wheat varieties over 1994/95 and 1995/96 seasons.

The interaction between tillage treatments and herbicidal application significantly affected 1000-grain of wheat in both seasons and their combined average (Table 9). The highest response value was achieved by combining Arelon application with subsoiling + moldboard plowing in 1997/98 season, Arelon with modlboard plowing in 1998/99 season, and Arelon with subsoiling + moldboard plowing in the combined average, where the highest values were 72.11, 61.20 and 66.19 g, respectively.

II.3. Number of spikelets per spike :

Data for the effects of tillage treatments, herbicides and their interaction on number of spikelets/spike in 1997/98 and 1998/99 seasons as well as their combined average are presented in Table (10).

Table (10) : Effect of tillage, herbicides and their interaction on No. of spikelets/spike of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	a 18.34	a 18.37	b 15.44	a 18.69	17.71	b 19.73	b 20.06	b 19.94	b 22.33	b 20.52	b 19.03	b 19.22	b 17.69	a 20.51	b 19.11
Chisel-plow (16-18 cm)	b 17.17	a 18.71	a 18.14	a 18.57	18.15	b 20.45	b 21.33	b 21.13	b 21.80	ab 21.18	b 18.81	a 20.02	a 19.63	a 20.19	ab 19.66
Moldboard-plow (18-20 cm)	b 17.40	a 18.47	b 17.90	ab 18.00	17.94	b 20.60	a 22.73	b 20.60	b 22.34	ab 21.57	b 19.00	a 20.60	b 19.25	a 20.17	ab 19.76
Subsoiling + Chisel plow (16-18cm)	b 17.07	a 18.97	b 17.72	a 18.77	18.13	b 21.32	b 21.90	b 21.34	b 21.51	ab 21.52	b 19.20	a 20.44	ab 19.53	a 20.14	ab 19.83
Subsoiling + Moldboard-plow (18-20 cm)	b 17.07	a 18.91	a 18.44	a 19.50	18.48	b 21.42	ab 22.44	b 22.31	a 22.73	a 22.23	b 19.25	a 20.67	a 20.37	a 21.12	a 20.35
Mean	17.41	18.69	17.53	18.71		20.70	21.69	21.06	22.14		b 19.06	a 20.19	b 19.29	a 20.26	
L.S.D. at 5% : Tillage (T.)	N.S.					S					S				
Herbicides (H.)	N.S.					N.S.					S				
T x H	S					S					S				

The results revealed that tillage practices significantly affected number of spikelets/spike in the second season as well as in the combined analysis.

The best treatment was subsoiling + moldboard plowing and the worst one was the check (no-till).

In 1998/99 season, subsoiling + moldboard plowing surpassed the 4 respective treatments by 8.33, 4.96, 3.06 and 3.30%. The only significant difference in that season was that between the check treatment and subsoiling + moldboard plowing, being 8.33%.

In the combined average a similar trend as that shown in the second season where subsoiling + moldboard plowing significantly surpassed the check treatment in their effect on number of spikelets/spike by 6.49%, as the only significant difference.

It could be concluded that moldboard plowing combined with subsoiling positively affected spikelets/spike as a result of enhancing growth characters of wheat plants.

Similar results were also reported by **Gomaa (1995)** who found that moldboard plowing at two depths (18-20 cm and 28-30 cm) and moldboard plowing at the same depths in combination with subsoiling produced the highest values in grain and straw yields of wheat and its attributes.

Concerning the effect of herbicides on number of spikelets/spike, the results in Table (10) showed that herbicides had significant effect in the two seasons average only.

In 1997/98 season, Arelon, Grasp and Granstar application insignificantly increased spikelets/spike by 7.47, 7.35 and 0.70%, respectively compared with the unweeded control.

Similarly in 1998/99 season, the 3 herbicides Arelon, Grasp and Granstar insignificantly increased spikelets/spike by 6.96, 4.78 and 1.74% compared with the unweeded control, respectively.

The significant differences were found only in the combined average where Arelon significantly increased spikelets/spike compared with control treatment and Granstar.

Arelon produced increases in spikelets/spike in the combined analysis of 6.30, 0.35 and 5.03%, respectively compared with the unweeded control, Granstar and Grasp, respectively.

It could be concluded that Arelon proved to be the best herbicide for wheat and its positive effect on spikelets/spike is mainly due to its good effects on wheat growth by reducing weed competition.

Similar results were also reported by **Mady (1996) and Shebl (1998)** who found that herbicidal application increased number of spikelets/spike.

Concerning the effect of the interaction between tillage practices and herbicidal treatments, the results in Table (10) showed that this interaction significantly affected number of spikelets/spike in both seasons and their combined average as well.

The highest response value was recorded by combining subsoiling + moldboard plowing with Arelon in both seasons and the combined analysis. In the second season, also moldboard plowing with Grasp produced the same value of spikelets/spike which was recorded by the best combination.

The maximum number of spikelets/spike which was recorded by the best combination reached 19.50, 22.73 and

21.12 spikelets/spike in 1997/98, 1998/99 and the combined analysis, respectively.

II.4. Spike length :

Data on the effects of tillage practices, weed control treatments and their interaction on spike length of wheat in 1997/98, 1998/99 and their combined average are presented in Table (11). The results revealed that tillage treatments significantly affected spike length in the first season as well as in the combined average, whereas in the second season no significant differences were detected in spike length due to tillage treatments.

In 1997/98 season, the best treatment was subsoiling + moldboard plowing but with only one significant difference compared with the check treatments. The four tillage treatments including the two chisel plowing and the two modlboard plowing treatments did not differ significantly in affecting this trait. The increase in spike length due to applying subsoiling + moldboard plowing compared with no-till, chisel plowing, modlboard plowing and subsoiling + chisel plowing reached 10.13, 5.37, 0.18 and 2.33%, respectively. The significant differences in 1997/98 season were only those between the check treatment and each of moldboard plowing, subsoiling + chisel plowing and subsoiling + moldboard plowing.

In 1998/99 season, no significant differences were detected in spike length among the 5 tillage treatments, but the superiority of moldboard plowing was also observed.

In the combined average, subsoiling + moldboard plowing was the best tillage treatments but only when compared with the check treatment. Subsoiling + moldboard

Table (11) : Effect of tillage, herbicides and their interaction on length of spike (cm) of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	b 9.53	b 10.96	b 9.60	b 9.79	b 9.97	10.10	10.77	10.27	11.15	10.57	b 9.81	ab 10.86	b 9.94	b 10.47	b 10.27
Chisel-plow (16-18 cm)	b 9.44	b 10.45	b 10.18	a 11.60	ab 10.42	10.69	10.75	10.74	11.37	10.89	b 10.07	b 10.60	b 10.46	a 11.48	ab 10.65
Moldboard-plow (18-20 cm)	b 10.47	a 11.40	b 10.65	a 11.30	a 10.96	10.91	11.10	10.96	11.67	11.16	b 10.69	a 11.25	b 10.81	a 11.49	a 11.06
Subsoiling + Chisel plow (16-18 cm)	b 9.85	b 10.82	b 10.83	a 11.41	ab 10.73	10.55	11.31	10.73	11.51	11.03	b 10.20	a 11.07	b 10.78	a 11.46	a 10.88
Subsoiling + Moldboard-plow (18-20 cm)	b 10.13	ab 11.09	b 10.68	a 12.03	a 10.98	11.32	11.42	11.40	11.65	11.45	b 10.73	a 11.26	a 11.04	a 11.84	a 11.22
Mean	b 9.88	a 10.94	ab 10.39	a 11.23		N.S. 10.71	N.S. 11.07	N.S. 10.82	N.S. 11.47		b 10.30	ab 11.01	ab 10.61	a 11.35	
L.S.D. at 5% :															
Tillage (T.)			S					N.S.					S		
Herbicides (H.)			S					N.S.					S		
T x H			S					N.S.					S		

plowing surpassed no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing in its effect on spike length by 9.25, 5.35, 1.45 and 3.13%, respectively.

It could be concluded that moldboard plowing, particularly combined with subsoiling induced an increase in spike length over the check treatment in one season out of two.

Similar results were also reported by **Gomaa (1995) and Frederick and Philip (1996)**.

With regard to weed control treatments, the results showed that herbicides, in general, and Arelon, in Particular, positively affected spike length with significant differences in the first season as well in the combined average. Also Grasp surpassed the check treatment in affecting spike length in both seasons, whereas Granstar effect did not differ compared with the check treatment.

The increase in spike length due to the application of Arelon in 1997/98 season compared with the check treatment, Grasp and Granstar valued 13.66, 2.65 and 8.08%, respectively.

The corresponding increases in the combined analysis were 10.19, 3.09 and 6.97%, respectively. The significant difference was only that between Arelon and the unweeded control.

It could be concluded that Arelon application induced a favourable effect on spike length compared with the check treatment due to depressing weed competition.

The results obtained by **Shebl (1998)** showed that Arelon application increased spike length by 6.21% compared with unweeded check on the average of 1994/95 and 1995/96 seasons.

Concerning the interaction between tillage treatments and herbicides, the results in Table (11) showed that spike length was significantly affected in 1997/98 season as well as in the combined analysis. The highest response value was recorded by combining subsoiling + moldboard plowing with Arelon application in 1997/98 as well as in the combined analysis, being 12.03 and 11.84 cm, respectively.

No significant interaction was detected in 1998/99 season which indicates that each experimental factor acted independently in affecting this trait.

II.5. Number of grains per spike :

The means of number of grains/spike as affected by tillage practices, weed control treatments and their interaction in 1997/98 and 1998/99 seasons as well as their combined average are presented in Table (12) and Fig. (5 and 6).

The results indicated the superiority of subsoiling + moldboard plowing and moldboard plowing as the best treatments in their effect of this trait.

In 1997/98 season subsoiling + moldboard plowing surpassed no-till, chisel plowing, moldboard plowing, and subsoiling + chisel plowing in affecting number of grains/spike by 6.78, 4.17, 1.07, and 9.70%, respectively. The corresponding increases in 1998/99 season due to applying the best treatment were 17.55, 7.54, 2.36 and 3.74% compared with the respective treatments.

Similarly, the combined analysis revealed that subsoiling + moldboard plowing surpassed no-till, chisel plowing, moldboard plowing, and subsoiling + chisel plowing by 12.79, 7.64, 1.83 and 8.22%, respectively in affecting grains/spike.

Table (12) : Effect of tillage, herbicides and their interaction on No. of grains per spike of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Grans.ar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	e 31.17	b 41.49	d 36.22	b 42.74	b 37.91	c 41.07	b 54.80	b 51.07	ab 56.87	c 50.95	e 36.12	c 48.14	d 43.64	b 49.80	c 44.43
Chisel-plow (16-18 cm)	d 35.30	c 37.87	d 36.14	a 46.14	ab 38.86	b 51.41	b 55.75	b 54.63	b 55.69	b 54.37	d 43.36	c 46.81	cd 45.38	b 50.91	b 46.62
Moldboard-plow (18-20 cm)	de 32.37	b 43.10	c 39.91	b 44.81	a 40.05	b 51.34	a 60.20	a 61.00	a 61.49	ab 58.51	d 41.85	ab 51.65	b 50.45	a 53.15	a 49.28
Subsoiling + Chisel plow (16-18cm)	e 32.37	c 40.14	e 30.27	ab 44.83	b 36.90	b 54.00	b 56.30	b 55.27	a 57.73	b 55.83	d 43.19	bc 48.22	d 42.77	b 51.28	bc 46.37
Subsoiling + Moldboard-plow (18-20 cm)	cd 36.27	b 41.90	bc 40.33	b 43.40	a 40.48	a 58.55	a 60.56	a 59.77	a 60.67	a 59.89	c 47.41	b 51.23	b 50.05	a 52.04	a 50.18
Mean	d 33.50	b 40.90	c 36.57	a 44.38		b 51.27	a 57.52	a 56.35	a 58.49		d 42.39	b 49.21	c 46.46	a 51.44	
L.S.D. at 5% : Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

Fig. (5): Effect of tillage treatments on number of grains/spike of wheat in 1997/98, 1998/99 and their combined average

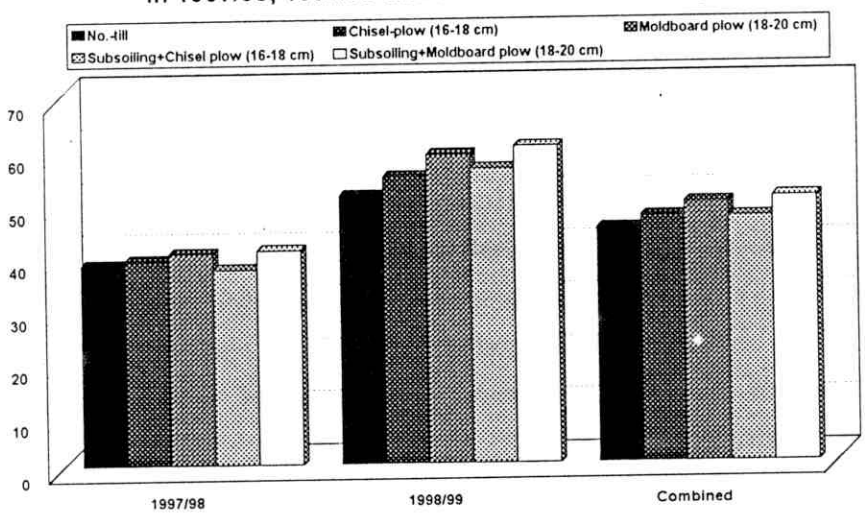
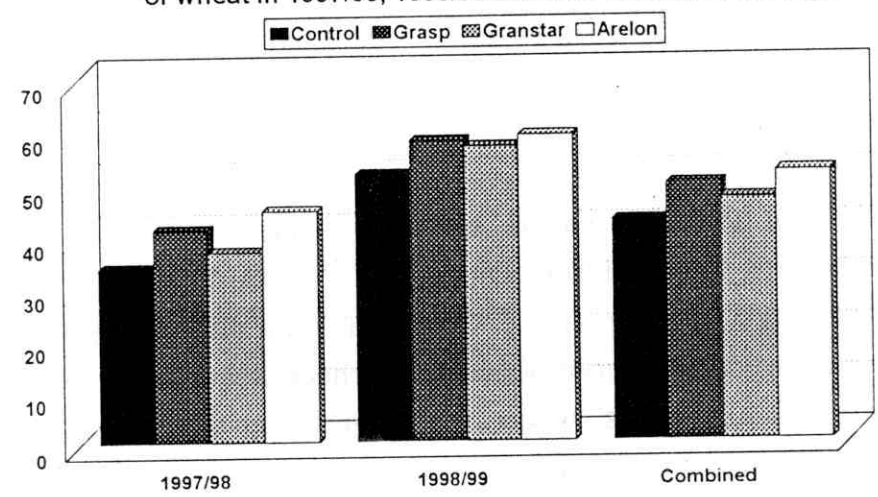


Fig. (6): Effect of weed control treatments on number of grains/spike of wheat in 1997/98, 1998/99 and their combined average



In the combined analysis all differences among the tillage treatments were significant except those between the two chisel plowing treatments as well as between the two moldboard plowing ones.

It could be concluded that moldboard plowing, in general, and when it followed subsoiling, in particular, positively affected grains/spike probably due to its effect on growth characters as a result of improving soil properties. The effect of a good seedbed preparation of wheat is clearly demonstrated.

Similar results were also obtained by **Gomaa (1995) and Frederick and Philip (1996)**.

Concerning the effect of weed control treatments on number of grains/spike, the results in Table (12) and Fig. (6) revealed the superiority of Arelon application as the best herbicidal treatment compared with Grasp and Granstar. Also, the 3 herbicides significantly increased grains/spike compared with the unweeded check.

In 1997/98 season, Arelon application significantly increased number of grains/spike by 32.48, 8.51 and 21.36%, compared with unweeded check, Grasp and Granstar, respectively. All differences among the 4 treatments were significant.

In 1998/99 season, similarly Arelon surpassed the 3 respective weed control treatments by 14.08, 1.69 and 3.98%, in its effect on grains/spike. The significant differences in that season were only those between the check treatments and each of the 3 herbicides, whereas no significant differences were detected among the 3 herbicides.

The combined analysis indicated the superiority of Arelon compared with the other 3 treatments, unweeding, Grasp and Granstar in their effect on number of grains/spike where increases of 21.35, 4.53 and 10.72% due to Arelon application compared with the 3 respective treatments. In the combined analysis all differences among the 4 treatments were significant .

It could be concluded that herbicides, particularly Arelon, were effective in inducing an increase in kernels/spike as a result of its positive effects on growth character and weed control.

Similar results were also obtained by **Assey *et al* (1983 b), El-Mashad *et al* (1993), Mady (1996) and Shebl (1998)**. The results reported by Shebl (1998) indicated that Arelon application increased number of grains/spike by 10.84% over the unweeded check on the average of 1994/95 and 1995/96 seasons.

The interaction between tillage treatments and herbicides significantly affected number of kernels/spike in both seasons as well as in their combined average (Table 12). The results showed that the best combination in 1997/98 season was recorded by combining chisel plowing with Arelon with an average number of 46.14 grains/spike. While in 1998/99 season as well as in the two seasons average, the highest response value was recorded by combining moldboard plowing with Arelon being 61.49 and 55.15 grains/spike, respectively.

II.6. Weight of spike (g) :

Means of weight of spike as affected by tillage practices, weed control treatments and their interaction in 1997/98 and

1998/99 seasons as well as their combined average are presented in Table (13).

The results indicated that spike weight was significantly affected by tillage treatments in both seasons and their combined average. The best treatment was that including subsoiling + moldboard plowing which surpassed no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing by 10.13, 9.09, 4.19 and 5.14%, in 1997/98 season, respectively, corresponding to 19.90, 11.44, 4.57 and 4.57, in 1998/99 season, respectively.

Similarly, in the combined average of both seasons, subsoiling + moldboard plowing was the best treatment which significantly surpassed no-till, chisel plowing, moldboard plowing and subsoiling + moldboard plowing by 15.47, 10.41, 4.40 and 4.95%, respectively in affecting spike weight of wheat.

The best treatment, including subsoiling + moldboard plowing, differed significantly in its effect on spike weight when compared with no-till and chisel plowing in the first and second seasons, whereas in the combined analysis this treatment was significantly superior compared with the rest 4 tillage treatments.

It could be concluded that a well seedbed preparation including subsoiling followed by moldboard plowing was an effective treatment in producing heavier spikes. This result is mainly due to the increase in growth characters as probably resulting from improving physical soil characters.

The present results are in general agreement with those reported by **B e l l i dbal (1996) and Gajri *et al* (1997).**

Table (13) : Effect of tillage, herbicides and their interaction on weight of spike (g) of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments	1997 / 1998					1998 / 1999					Combined				
Tillage treatments	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	cd 2.72	c 3.40	c 3.13	c 3.40	b 3.16	c 3.67	bc 4.16	c 3.67	c 3.76	c 3.82	d 3.20	bc 3.78	d 3.40	c 3.58	d 3.49
Chisel-plow (16-18 cm)	d 2.68	c 3.15	cd 3.10	ab 3.82	b 3.19	c 3.81	c 3.91	b 4.24	b 4.46	b 4.11	d 3.24	c 3.53	c 3.67	a 4.14	c 3.65
Moldboard-plow (18-20 cm)	d 2.51	c 3.34	c 3.33	a 4.17	a 3.34	c 4.03	b 4.48	b 4.44	b 4.56	a 4.38	d 3.27	b 3.91	b 3.88	a 4.36	b 3.86
Subsoiling + Chisel plow (16-18 cm)	d 2.69	c 3.22	c 3.14	a 4.18	ab 3.31	b 4.26	b 4.47	b 4.34	b 4.43	a 4.38	cd 3.47	b 3.84	c 3.74	a 4.30	b 3.84
Subsoiling + Moldboard-plow (18-20 cm)	cd 2.71	b 3.77	bc 3.46	a 3.98	a 3.48	b 4.23	ab 4.67	ab 4.61	a 4.81	a 4.58	cd 3.47	a 4.22	ab 4.03	a 4.40	a 4.03
Mean	c 2.66	b 3.38	bc 3.23	a 3.91		b 4.00	a 4.34	ab 4.26	a 4.40		c 3.33	b 3.86	b 3.74	a 4.16	
L.S.D. at 5% :															
Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

Concerning the effect of weed control treatments, the results in Table (13) indicated the superiority of Arelon application compared with the other treatments almost with significant differences.

In 1997/98 season, Arelon application increased spike weight compared with unweeded check, Grasp and Granstar by 46.99, 15.68 and 21.05%, respectively, corresponding to 10.00, 1.38 and 3.29% in 1998/99 seasons.

The combined average of both seasons indicated clearly the superiority of Arelon in affecting spike weight where significant increases were recorded in spike weight of 24.92, 7.77 and 11.23% compared with the unweeded check, Grasp and Granstar, respectively. In the combined analysis both Grasp and Granstar were nearly similar in their effect on spike weight and significantly surpassed the unweeded check.

It could be concluded that Arelon application is an efficient treatment for growing wheat, and this herbicide was superior to the other two herbicides tested in this study.

The positive effects of herbicides on this trait was also reported by **El-Mashad *et al* (1993), Soroka *et al* (1995), Mady (1996) and Shebl (1998)**. According to the investigation carried out by **Shebl (1998)** he recorded a significant increase in spike weight of 16.80% due to the application of Arelon as compared with the unweeded check on the average of 1994/95 and 1995/96 seasons.

The effect of herbicidal application on spike weight is a result of the positive effects previously discussed on growth characters, as well as due to depressing weed infestation as will be discussed in the following topics.

The results presented in Table (13) indicated that spike weight was significantly influenced by the interaction between tillage treatments and herbicidal application in both seasons and their combined average.

The highest response value was recorded by combining subsoiling + chisel plowing with Arelon in 1997/98 season and subsoiling + moldboard plowing with Arelon in 1998/99 season as well as in the two seasons average, being 4.18, 4.81 and 4.40 g, respectively.

II.7. Grain weight per spike (g) :

Means of grain weight per spike (g) as affected by tillage treatments, herbicides and their interaction in 1997/98 and 1998/99 seasons and their combined average are presented in Table (14).

The results revealed that tillage treatments significantly affected grain weight/spike in the second season and in the two seasons average where moldboard plowing, subsoiling + chisel plowing and subsoiling + moldboard plowing, as one group, surpassed significantly in their effect on grain weight/spike the two other treatments, i.e. no-till and chisel plowing.

In 1998/99 season, subsoiling + moldboard plowing surpassed no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing by 22.35, 14.13, 4.19 and 4.87%, respectively, in affecting grain weight/spike.

The corresponding increases in the combined average were 14.34, 9.54, 2.87 and 3.99% when comparing subsoiling + moldboard plowing with the 4 respective treatments.

It could be concluded the moldboard plowing alone or combined with subsoiling positively affected grain yield of

Table (14) : Effect of tillage, herbicides and their interaction on grain weight per spike (g) of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	d 1.88	c 2.27	c 2.23	a 3.14	2.38	2.51	2.76	2.59	2.71	b 2.64	e 2.20	d 2.52	de 2.41	b 2.92	b 2.51
Chisel-plow (16-18 cm)	d 1.89	b 2.59	bc 2.49	b 2.72	2.42	2.57	2.91	2.63	3.19	b 2.83	e 2.23	c 2.75	cd 2.56	b 2.95	b 2.62
Moldboard-plow (18-20 cm)	cd 2.13	b 2.62	c 2.29	a 2.86	2.48	2.67	3.19	3.13	3.42	a 3.10	e 2.40	b 2.90	c 2.71	a 3.14	a 2.79
Subsoiling + Chisel plow (16-18 cm)	d 1.84	b 2.56	c 2.38	a 2.95	2.43	2.84	3.29	3.02	3.17	a 3.08	e 2.34	b 2.92	c 2.70	ab 3.06	a 2.76
Subsoiling + Moldboard-plow (18-20 cm)	d 1.98	ab 2.77	bc 2.49	a 2.88	2.53	3.05	3.40	3.14	3.31	a 3.23	d 2.51	a 3.08	bc 2.81	a 3.09	a 2.87
Mean	c 1.94	b 2.56	b 2.38	a 2.91		b 2.73	a 3.11	b 2.90	a 3.16		d 2.34	b 2.83	c 2.64	a 3.03	
L.S.D. at 5% : Tillage (T.)	N.S.					S					S				
Herbicides (H.)	S					S					S				
T x H	S					N.S.					S				

spike as a result of producing heavier and longer spikes and heavier grain index. These effects are the result of a better growth which was achieved by a good seedbed preparation and better soil physical characters.

Similar results are also reported by **Bellido *et al* (1996) and Gajri *et al* (1997).**

Concerning the effect of herbicidal application on grain weight/spike, the result presented in Table (14) indicated a significant effect of herbicides, in general, and Arelon, in particular on this trait compared with the unweeded control in both seasons as well as their combined average.

In 1997/98 season, Arelon application significantly increased grain weight/spike, compared with unweeded check, Grasp and Granstar by 50.00, 13.67 and 22.29%, respectively, corresponding to 15.75, 1.61 and 8.97%, respectively, in 1998/99 season.

No significant differences were found between Arelon and Grasp as well as between Granstar and the unweeded check in their effect on grain yield/spike in 1998/99 season.

A more clear effect for herbicidal application is shown in combined analysis of both seasons where all differences among the 4 weed control treatments were significant. Arelon application in the combined average significantly surpassed the unweeded check, Grasp and Granstar by 29.49, 7.07 and 14.77%, in their effect on grain weight/spike, respectively.

The good effect of herbicidal application on this trait is mainly due to its effects on the other yield component characters previously discussed (spike length, spike weight, number of kernels and spikelets/spike and grain index). Also the reduction of weed density by herbicides reduces the weed

competition. The positive effects of herbicides on grain weight/spike were also reported by **Assey *et al* (1983 a), Soroka *et al* (1995), Mady (1996) and Shebl (1998).**

The results reported by **Shebl (1998)** revealed that grain weight/spike significantly increased by 18.35% due to Arelon application compared with the check treatment on the average of 1994/95 and 1995/96 seasons.

The results in Table (14) indicated that in 1997/98 season as well as in the combined average, the interaction between tillage treatments and herbicidal application significantly affected grain weight/spike.

The highest response value was recorded by combining moldboard plowing with Arelon in the combined average, being 3.14 g, and the lowest value was 2.20 g which was produced by no-till combined with the unweeded check.

II.8. Grain yield (kg/fad) :

Means of grain yield of wheat (kg/fad) as affected by tillage practices, weed control treatments and their interaction in 1997/98 and 1998/99 seasons as well as their combined average are presented in Table (15) and in Fig. (7 and 8).

The results indicated that tillage treatments significantly affected grain yield/fad in both seasons as well as in the combined average. The best treatment was the most intensive one including subsoiling + moldboard plowing and the worst treatment was no-till.

In 1997/98 season, subsoiling + moldboard plowing outyielded significantly no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing by 46.15, 36.94, 28.81 and 36.32%, respectively.

Table (15) : Effect of tillage, herbicides and their interaction on grain yield (kg/fad) of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments	1997 / 1998					1998 / 1999					Combined				
Tillage treatments	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	d 1700	c 2290	d 1750	b 2570	c 2080	c 2120	b 2370	c 2190	b 2440	b 2280	d 1910	c 2330	d 1970	b 2500	c 2180
Chisel-plow (16-18 cm)	d 1870	c 2420	c 2300	c 2280	bc 2220	c 2190	c 2240	c 2230	b 2350	b 2250	d 2030	c 2330	c 2260	c 2310	bc 2230
Moldboard-plow (18-20 cm)	d 1610	b 2630	bc 2450	ab 2750	b 2360	c 2010	b 2760	b 2410	b 2520	ab 2430	d 1810	b 2700	b 2430	b 2630	b 2390
Subsoiling + Chisel plow (16-18 cm)	cd 2000	b 2550	c 2160	c 2210	bc 2230	c 1850	a 2990	bc 2340	b 2510	ab 2420	d 1930	ab 2770	ab 2250	c 2360	bc 2330
Subsoiling + Moldboard-plow (18-20 cm)	c 2400	a 3290	a 3150	a 3300	a 3040	c 1780	a 2970	ab 2930	a 3010	a 2670	cd 2090	a 3130	a 3040	a 3160	a 2860
Mean	c 1920	a 2640	b 2360	a 2620		b 1990	a 2670	a 2420	a 2570		c 1950	a 2650	b 2390	a 2590	
L.S.D. at 5% :															
Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

Fig. (7): Effect of tillage treatments on grain yield (kg/fad) of wheat in 1997/98, 1998/99 and their combined average

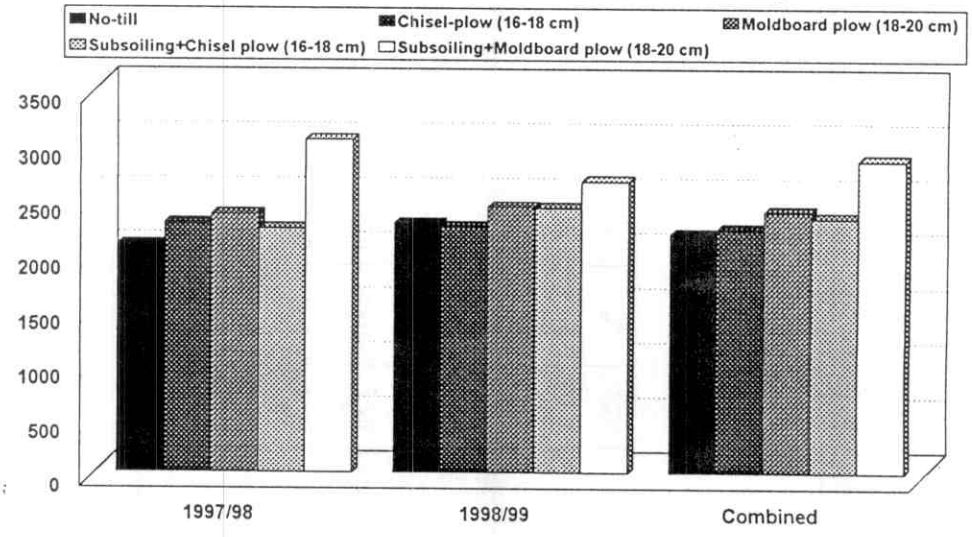
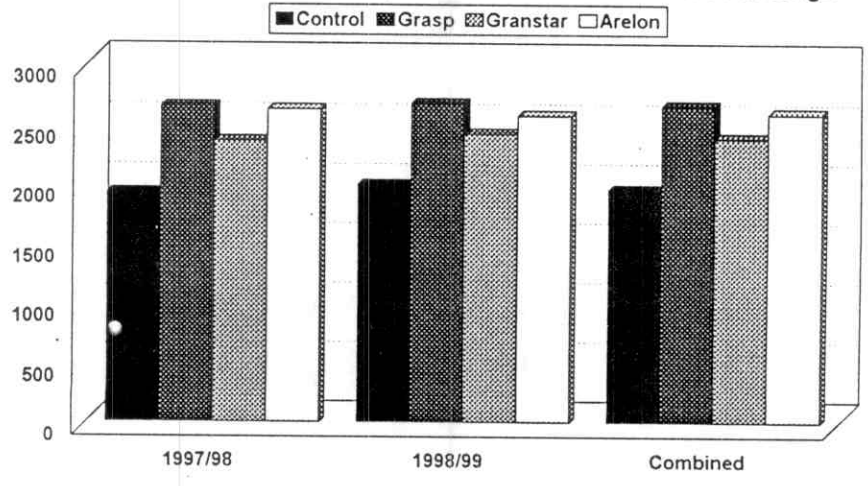


Fig. (8): Effect of weed control treatments on grain yield (kg/fad) of wheat in 1997/98, 1998/99 and their combined average



No significant differences were observed in the first season among chisel plowing, moldboard plowing and subsoiling + chisel plowing, as well as among no-till, chisel plowing and subsoiling + chisel plowing.

Similarly, in 1998/99 season, the best treatment that favourably affected grain yield of wheat was subsoiling + moldboard plowing treatment which outyielded the 4 other respective treatments by 17.11, 18.67, 9.88 and 10.33%. The significant differences in that season were only those between the best treatment (subsoiling + moldboard plowing) and each of no-till and chisel plowing.

The combined analysis of both seasons showed also the superiority of subsoiling + moldboard plowing which significantly outyielded the 4 respective treatments by 31.19, 28.25, 19.67 and 22.75%, respectively.

The combined analysis indicated clearly the superiority of subsoiling + moldboard plowing as an intensive seedbed preparation treatment and all differences in comparing this treatment with the rest ones reached the level of significance.

The differences between no-till, chisel plowing and subsoiling + chisel plowing as well as between chisel plowing, moldboard plowing and subsoiling + chisel plowing in the combined average were below the level of significance.

It is worth noting here that subsoiling was an effective treatment when it was followed by moldboard plowing (18-20 cm).

It could be concluded that an intensive treatment including subsoiling positively affected all growth characters as well as yield components. This treatment improved the physical soil properties such as soil bulk density and soil porosity which

in turn improve soil aeration and drainage. The improved soil characters contributed markedly in enhancing growth characters of wheat plants. Also the intensive soil tillage helps in reducing weed density in wheat fields.

The present results are in harmony with those obtained by **Bellied *et al* (1996), Gajri *et al* (1997) and Bordovsky *et al* (1998)**.

Concerning the effect of weed control treatments on grain yield of wheat, the results in Table (15) and Fig. (8) indicated a significant effect of the three applied herbicides on grain yield where marked and significant increases were obtained by herbicidal application in both seasons as well as their combined average.

Grasp and Arelon were of equal efficiency in their effects on grain yield and surpassed the efficiency of Granstar in the first season and the combined average.

The results revealed that Grasp, Arelon and Granstar significantly outyielded the unweeded check by 37.50, 36.46 and 22.92%, respectively in 1997/98 season, corresponding to 34.17, 29.15 and 21.61%, respectively in 1998/99 season. The same trend was also evident in the combined average where Grasp, Arelon and Granstar significantly increased grain yield by 35.90, 32.82 and 24.10%, respectively. Nevertheless, Arelon and Grasp were of similar efficiency on grain yield and surpassed the effect of Granstar in the combined average.

It could be concluded that herbicides, in general, and Arelon as well as Grasp, in particular, produced marked grain yield increases due to their positive effects on growth and yield component characters. Also, the reduction of weed

competition due to the use of herbicides contributes much in the increase in grain yield.

Similar results were reported by **El-Mashad *et al* (1993), El-Wekil *et al* (1993), Soroka *et al* (1995), Mady (1996), Yenish *et al* (1997) and Shebl (1998)**.

The grain yield increase due to Arelon application reported by **Shebl (1998)** reached 14 and 94.24% compared with hand weeding and unweeded control, respectively, on the average of 1994/95 and 1995/96 seasons.

Concerning the interaction between tillage treatments and herbicides on grain yield of wheat, the results indicated a significant effect of the interaction in both seasons as well as in the combined average (Table 15).

The significant interaction is evident when comparing the efficiency of Grasp and Arelon in both seasons and the combined average. In 1997/98 season, the efficiency of these two herbicides were dependent on the tillage treatment. The results showed that under no-till, Arelon outyielded Grasp significantly, whereas under subsoiling + chisel plowing, an opposite trend was observed and Grasp significantly outyielded Arelon. But under chisel plowing, modlboard plowing and subsoiling + moldboard plowing, both herbicides were similar in affecting grain yield. Also, in 1998/99 season, Arelon significantly outyielded Grasp under chisel plowing, whereas under subsoiling + chisel plowing an opposite trend was recorded and Grasp outyielded Arelon. While under no-till, moldboard plowing and subsoiling + moldboard plowing, both herbicides showed no significant differences in their effect on grain yield.

The combined analysis indicated also a similar trend as that observed in 1997/98 season and the superiority of Arelon was evident when combined with no-till, whereas the superiority of Grasp was recorded with subsoiling + chisel plowing, while under the rest three treatments both herbicides were equally effective.

In general, the highest response value was recorded by combining subsoiling + moldboard plowing with Arelon, being 3300, 3010 and 3160 kg/fad in 1997/98, 1998/99 and the two seasons average, respectively.

II.9. Straw yield per faddan (t) :

Means of straw yield (t/fad) as affected by tillage practices, herbicides and their interaction in 1997/98 and 1998/99 seasons as well as their combined average are presented in Table (16).

Tillage treatments significantly affected straw yield in a similar trend as shown with grain yield/fad. This result hold true in both seasons as well as with the combined analysis.

The best treatment was that including subsoiling + moldboard plowing, which significantly outyielded all treatments with one exception in 1997/98 season when compared with moldboard plowing alone.

This treatment was followed by moldboard plowing which was similar in its effect on straw yield as that including subsoiling + chisel plowing. The worst treatment was the check (no-till) which was inferior compared with the 2 moldboard plowing treatments.

Subsoiling followed by moldboard plowing outyielded no-till, chisel plowing, moldboard plowing and subsoiling +

Table (16) : Effect of tillage, herbicides and their interaction on straw yield (ton/fad) of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	b 3.99	b 3.97	b 3.99	b 4.36	b 4.08	d 3.77	cd 4.28	d 4.24	c 4.81	c 4.28	d 3.88	cd 4.13	d 4.11	c 4.59	c 4.18
Chisel-plow (16-18 cm)	b 3.70	b 4.38	b 3.72	a 4.83	b 4.16	d 3.45	c 4.48	c 4.46	c 4.81	c 4.30	d 3.58	c 4.43	d 4.09	b 4.82	c 4.23
Moldboard-plow (18-20 cm)	b 4.13	a 4.86	b 4.22	ab 4.44	ab 4.41	c 4.64	c 4.93	c 4.89	c 4.93	b 4.85	c 4.39	b 4.89	c 4.56	c 4.68	b 4.63
Subsoiling + Chisel plow (16-18cm)	b 3.95	b 4.25	b 4.05	a 4.73	b 4.25	d 4.17	bc 5.22	c 4.87	c 5.05	b 4.83	d 4.06	bc 4.73	c 4.46	b 4.89	cb 4.54
Subsoiling + Moldboard-plow (18-20 cm)	a 4.51	a 4.77	a 4.72	a 5.18	a 4.80	b 5.27	b 5.95	b 5.79	a 6.72	a 5.93	b 4.89	ab 5.36	b 5.25	a 5.95	a 5.36
Mean	b 4.06	ab 4.45	b 4.14	a 4.71		b 4.26	a 4.97	a 4.85	a 5.26		c 4.16	ab 4.71	b 4.49	a 4.99	
L.S.D. at 5% : Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

chisel plowing by 17.65, 15.38, 8.11 and 12.92%, respectively in 1997/98 season, corresponding to 38.55, 39.91, 22.27 and 22.77% in 1998/99 season, in their effect on straw yield/fad.

The two seasons average showed also that the best treatment increased straw yield by 28.23, 26.71, 15.77 and 18.06% compared with the 4 respective treatment.

It could be concluded that subsoiling + moldboard plowing was an effective seedbed preparation treatment for wheat which was reflected in increasing growth characters of wheat and consequently straw yield.

Similar results were also reported by **Marwat *et al* (1989), Unger (1994), Gomaa (1995) and Hammed and Battikhi (1995)**.

Concerning the effect of weed control treatments on straw yield/fad, the results in Table (16) revealed that herbicides, in general, increased straw yield in both seasons as well as in the combined average. The best result was that achieved by Arelon but without significant difference when compared with Grasp.

The application of Arelon, Grasp and Granstar increased straw yield/fad over the unweeded check by 16.01, 9.61 and 1.97%, respectively in 1997/98 season, corresponding to 23.47, 16.67 and 13.85% in 1998/99 season and 19.95, 13.22 and 7.93%, in the combined data.

It could be concluded that Arelon application followed by Grasp positively affected straw yield/fad of wheat due to their positive effects on all growth characters and in depressing weed competition.

The present results are in harmony with those reported by **El-Mashad *et al* (1993), El-Wekil *et al* (1993), Mady (1996), Zaher (1996) and Shebl (1998).**

The results of **Shebl (1998)** showed that Arelon application significantly increased biological yield/fad by 8.06 and 24.45% compared with hand weeding and the unweeded control, respectively, on the average of two seasons.

The results presented in Table (16) showed a significant effect for tillage x herbicides on straw yield/fad in both seasons as well as in the combined average. The results indicated that the efficiency of herbicides was markedly dependent on the tillage treatment.

For example, in 1997/98 season, no significant differences were detected among the 4 weed control treatments under no-till as well as subsoiling + moldboard plowing, whereas under chisel plowing either alone or following subsoiling, Arelon application significantly outyield the other 3 treatments.

Also, in 1998/99 season, Arelon application outyielded the 2 other herbicides when it was combined with subsoiling + moldboard plowing, but no significant differences were detected among the 3 herbicides under chisel plowing, moldboard plowing and subsoiling + chisel plowing.

In the combined analysis, it was also evident that the superiority of Arelon was clear when it was combined with chisel plowing, but under the other treatments, Arelon application was equally effective as Grasp (with no-till, subsoiling + chisel plowing and subsoiling + moldboard plowing), and even, under moldboard plowing, Grasp application significantly outyuielded Arelon.

In general, the highest response value was recorded by combining subsoiling + moldboard plowing with Arelon in both seasons as well as their combined average, being 5.18, 6.72 and 5.95 t/fad, in 1997/98, 1998/99 and the combined analysis, respectively.

II.10. Plant height at harvest (cm) :

The data on plant height of wheat plant at harvest as affected by tillage treatments, herbicidal application and their interaction in 1997/98 and 1998/99 seasons as well as their combined average are given in Table (17).

The results showed that tillage treatments did not significantly affect plant height at harvest in both seasons as well as in the combined average.

The results showed some differences in this trait and the tallest plants were those produced from the most intensive tillage treatment, i.e. subsoiling + moldboard plowing, being 106.98, 98.81 and 102.89 cm, in 1997/98, 1998/99 and the combined average, respectively.

Also, the shortest plants were those of the no-till treatment in both seasons and the 2 seasons average, being 104.27, 97.27 and 100.77 cm, in 1997/98, 1998/99 and the combined average, respectively. However the differences between these two extremes were too slight to reach the level of significance.

It could be concluded that plant height at harvest showed no apparent response to tillage treatments under the conditions of the present investigation.

Table (17) : Effect of tillage, herbicides and their interaction on plant height at harvest (cm) of wheat in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	99.75	105.50	104.37	107.44	104.27	94.93	98.23	96.65	99.27	97.27	97.34	101.87	100.51	103.35	100.77
Chisel-plow (16-18 cm)	100.34	106.83	103.72	107.01	104.48	95.30	99.30	98.60	99.50	98.18	97.82	103.07	101.16	103.25	101.33
Moldboard-plow (18-20 cm)	104.37	106.80	105.67	108.55	106.35	98.25	98.77	98.70	99.13	98.71	101.30	102.78	102.18	103.84	102.53
Subsoiling + Chisel plow (16-18cm)	100.83	106.30	105.13	106.40	104.67	97.70	89.97	98.15	99.73	98.64	99.27	102.64	101.64	103.07	101.66
Subsoiling + Moldboard-plow (18-20 cm)	105.86	107.40	106.90	107.77	106.98	98.55	99.10	98.70	98.87	98.81	102.20	103.25	102.80	103.32	102.98
Mean	b 102.23	ab 106.57	b 105.16	a 107.43		96.94	98.87	98.16	99.30		99.59	102.72	101.66	103.37	
L.S.D. at 5% : Tillage (T.)	N.S.					N.S.					N.S.				
Herbicides (H.)	S					N.S.					N.S.				
T x H	N.S.					N.S.					N.S.				

The present results are in agreement with those reported by **El-Hattab (1962)** who found that the frequency of plowing did not affect wheat plant height.

On the other hand, **Marwat *et al* (1989)** found considerable differences in wheat plant height due to different tillage treatments including no-tillage, moldboard plow, cultivator, and local plow.

Concerning the effect of herbicides on plant height at harvest, the results in Table (17) indicated a significant effect for herbicides in the first season only, whereas in the second one as well as in the combined average, no significant effect was observed.

In 1997/98 season, applying Arelon, Grasp and Granstar increased plant height at harvest by 5.09, 4.25 and 2.87%, respectively compared with unweeded control. The significant difference was that between Arelon and each of Granstar and the check treatment.

A similar trend was observed in the second season for the effect of herbicides but the differences were below the level of significance.

The positive effects of herbicides on wheat plant height were also reported by **Mady (1996) and Shebl (1998)**.

The effect of the interaction between tillage practices and herbicidal treatments on plant height of wheat at harvest was not significant in both seasons as well as in the combined analysis (Table 17). This result indicates that each experimental factor acted independently in affecting plant height at harvest.

III. Effect of Tillage Treatments, Methods of Weed Control and Their Interaction on the Spread of Weeds in Wheat :

III.1. Number of weeds/m^2 at 60 days from sowing :

Means of weeds number/m^2 at 60 DFS as affected by tillage practices, weed control treatments and their interaction in 1997/98 and 1998/99 and their combined average are presented in Table (18).

Weed survey at the three sampling dates showed that weed species dominating were found in the following descending order: *Polypogon monspeliensis, Ammi majus, Torilis neglecta, Beta vulgaris, Medicago polymorpha, Sphaeranthus suaveolens, Oxalis corniculata, Convolvulus arvensis* and *Chenopoduium album.*

The spread of these weeds was nearly similar in both seasons in the experimental plots. The results showed that tillage practices reduced weed population at 60 DFS in both seasons.

In 1997/98 season, the greatest reduction in weeds number was achieved by subsoiling + moldboard plowing followed by moldboard plowing then subsoiling + chisel plowing, where a significant reduction of 41.25, 30.70 and 18.65%, in weed density was recorded compared with no-till treatment, respectively.

In 1998/99 season, subsoiling + moldboard plowing, moldboard plowing, subsoiling + chisel plowing and chisel plowing reduced weed population by 47.43, 29.14, 23.92 and 9.60%, respectively compared with no-till treatment.

All differences among the tillage treatments were significant except those between no-till and chisel plowing as

Table (18) : Effect of tillage, herbicides and their interaction on total No. of weeds/m² in wheat at 60 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	b 28.00	f 14.75	b 28.00	fg 12.25	a 20.75	a 18.25	b 13.50	a 17.75	d 8.00	a 14.38	b 23.13	f 14.13	bc 22.88	gh 10.13	a 17.57
Chisel-plow (16-18 cm)	a 32.00	f 13.75	d 20.25	f 14.25	a 20.06	a 18.50	bc 12.50	b 13.75	d 7.25	a 13.00	a 25.25	f 13.13	c 17.00	g 10.75	a 16.53
Moldboard-plow (18-20 cm)	d 20.25	fg 12.25	e 18.00	h 7.00	c 14.38	b 13.25	cd 10.50	c 11.00	de 6.00	b 10.19	c 16.75	g 11.38	e 14.50	i 6.50	c 12.28
Subsoiling + Chisel plow (16-18cm)	a 32.75	h 8.25	de 19.25	h 7.25	b 16.88	a 19.50	d 8.50	c 11.25	e 4.50	b 10.94	a 26.13	hi 8.38	e 15.25	j 5.88	b 13.91
Subsoiling + Moldboard-plow (18-20 cm)	c 22.25	g 11.25	fg 12.25	i 3.00	d 12.19	cd 10.00	de 6.50	d 8.00	e 5.75	c 7.56	c 16.13	h 8.88	gh 10.13	k 4.38	d 9.88
Mean	a 27.05	c 12.05	b 19.55	d 8.75		a 15.90	c 10.30	b 12.35	d 6.30		a 21.48	c 11.18	b 15.95	d 7.53	
L.S.D. at 5% : Tillage (T.)	S					S					S				
Herbicides (H.)	S					S					S				
T x H	S					S					S				

well as between moldboard plowing and subsoiling + chisel plowing.

The two seasons average indicated also the effect of tillage treatments in reducing the spread of weeds at 60 DFS where reductions of 43.83, 30.11, 20.83 and 6.03% were induced by subsoiling + moldboard plowing, moldboard plowing, subsoiling + chisel plowing and chisel plowing, compared with no-till, respectively.

All differences among the tillage treatments in their effect on weed number/m^2 at 60 DFS were significant except that between no-till and chisel plowing.

It could be concluded that tillage practice by means of moldboard plowing is an effective procedures for reducing weed population in wheat field.

Similar results were also reported by **Gomaa (1995), Skorda *et al* (1997) and Arshad *et al* (1998).**

Concerning the effect of herbicides on weed population at 60 DFS, the results in Table (18) showed that herbicides in general, and Arelon, in particular, markedly reduced number of weeds at 60 DFS.

The efficiency of the three herbicides could be arranged in a descending order as follows: Arelon, Grasp, and Granstar. This trend hold true in both seasons and their average.

The results indicated that Arelon, Grasp and Granstar application significantly reduced the number of weeds by 67.65, 55.45 and 27.73% compared with the unweeded check in 1997/98 season, respectively. The corresponding reductions in 1998/99 season were 60.38, 35.22 and 22.33% for the 3 respective herbicides, being 64.94, 47.95 and 25.74% in the combined analysis.

It could be concluded that Arelon was an effective herbicide in reducing weed population in wheat at the early stage of growth.

Similar results were also reported by Varshney and **Singh (1990), Hooda and Agrawal (1991), Mady (1996) and Shebl (1998).**

The interaction between tillage treatments and herbicides significantly affected number of weeds at 60 DFS in both seasons and their combined average (Table 18).

The results revealed that in 1997/98 season, combining subsoiling + moldboard plowing with Arelon application was the best treatment in reducing weeds in wheat plots at 60 DFS where number of weeds/m^2 was only 3.00. On the other hand, the combination between subsoiling + chisel plowing and Arelon was the best treatment in 1998/99 season with a minimum number of weeds/m^2, being 4.50 at 60 DFS. The first season combination was also the best treatment with combined analysis with a minimum number of 4.38 weeds/m^2.

III.2. Number of weeds at 90 days from sowing :

Data in Table (19) present the means of number of weeds/m^2 at 90 DFS as affected by tillage treatments, herbicides application and their interaction in 1997/98 and 1998/99 seasons as well as their combined average.

The results showed a positive effect for tillage treatments in reducing weed population at this growth stage compared with the check treatment (no-till). The effect of tillage practices was more evident in the first season.

In 1997/98 season, subsoiling + moldboard plowing, subsoiling + chisel plowing, moldboard plowing and chisel

Table (19) : Effect of tillage, herbicides and their interaction on total No. of weeds/m² in wheat at 90 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	b 29.00	d 23.00	d 24.00	f 17.00	a 23.25	a 9.25	c 6.50	c 6.50	c 6.50	a 7.19	b 19.13	d 14.75	d 15.25	e 11.75	a 15.22
Chisel-plow (16-18 cm)	a 36.75	g 15.00	c 25.75	i 10.75	b 22.06	ab 8.00	b 7.00	b 7.25	c 5.25	ab 6.88	a 22.38	f 11.00	cd 16.50	gh 8.00	b 14.47
Moldboard-plow (18-20 cm)	d 24.00	e 20.25	e 21.00	fg 16.75	c 20.50	b 7.25	c 6.00	b 7.75	c 5.50	ab 6.63	cd 15.63	de 13.13	de 14.38	ef 11.13	c 13.57
Subsoiling + Chisel plow (16-18cm)	c 27.00	e 20.00	e 21.00	g 16.00	c 21.00	b 7.75	d 4.50	ab 8.00	4.00	b 6.06	c 17.38	e 12.25	d 14.50	fg 10.00	c 13.53
Subsoiling + Moldboard-plow (18-20 cm)	g 15.00	h 13.25	h 13.25	j 9.00	d 12.63	c 5.50	cd 5.00	d 4.75	cd 5.00	c 5.06	f 10.25	g 9.13	gh 9.00	h 7.00	d 8.85
Mean	a 26.35	c 18.30	b 21.00	d 13.90		a 7.55	b 5.80	a 6.85	b 5.25		a 16.95	c 12.05	b 13.93	d 9.58	
L.S.D. at 5% : Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

plowing reduced the weed population by 45.68, 9.68, 11.83 and 5.12%, respectively compared with no-till. The corresponding reductions in 1998/99 season in weed density were 29.62, 15.72, 7.79 and 4.31%, for the 4 respective treatments, being 41.83, 11.10, 10.84 and 4.93% in the combined average of both seasons. The differences in weed number/m^2 due to tillage treatments were almost significant.

It could be concluded that subsoiling + moldboard plowing was the best tillage treatment for depressing weed population. The present results are in general agreement with those reported by **Gomaa (1995), Skorda *et al* (1997), and Arshad *et al* (1998).**

The results in Table (19) show also that herbicides in general and Arelon, in particular, markedly reduced the spread of weeds in wheat plots at 90 DFS. Second to Arelon was Grasp which was followed by Granstar.

The three tested herbicides Arelon, Grasp and Granstar reduced significantly weed population compared with the unweeded check on the combined average of both seasons by 43.48, 28.91 and 17.82%, respectively.

It could be concluded that Arelon application markedly reduced number of weeds (43.48%) at 90 DFS and was superior to the other two herbicides. Similar results were also reported by **Varshney and Singh (1990), El-Maghraby *et al* (1993), Mady (1996) and Shebl (1998).**

The interaction between tillage treatments and herbicides significantly affected weeds number per m^2 in both seasons and their average. The highest response value was recorded in the first season as well as in the combined average by combining subsoiling + moldboard plowing with Arelon where the lowest

number of weeds was recorded, being 9.00 and 7.00 weeds/m^2, respectively. On the other hand in 1998/99 season, subsoiling + chisel plowing combined with Arelon was the most effective treatment in depressing weed population at 90 DFS where number of weeds was reduced to 4 weed plants per one square meter.

III.3. Number of weeds at 120 days from sowing :

The results in Table (20) show the effects of tillage practices, herbicidal treatments and their interaction on number of weeds/m^2 at 120 DFS in 1997/98, 1998/1999 seasons and their combined average.

The results showed that tillage treatments significantly affected weed population at 120 DFS in the first season as well as in the combined average of both seasons. In the second season, the differences in weeds number were below the level of significance.

In 1997/98 season, subsoiling + moldboard plowing significantly reduced weeds number/m^2 by 17.60, 27.10, 29.02 and 45.51%, respectively, compared with moldboard plowing, subsoiling + chisel plowing, chisel plowing and no-till. All differences were significant except that between the two chisel plowing treatments.

The combined analysis of both seasons showed the same response of weeds number to tillage treatments. The efficiency of the best tillage practice including subsoiling + moldboard plowing over the 4 respective treatments was evident by achieving the greatest reduction in weeds number. The reduction in weed spread reached 17.91, 25.45, 29.19 and

Table (20) : Effect of tillage, herbicides and their interaction on total No. of weeds/m² in wheat at 120 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	a 22.75	b 20.00	a-b 20.50	e 12.00	a 18.81	ab 6.00	b 5.00	b 5.50	bc 4.50	5.25	a 14.38	b 12.50	b 13.00	ef 8.25	a 12.03
Chisel-plow (16-18 cm)	b 20.00	c 17.00	bc 17.75	h 5.00	b 14.99	ab 6.00	bc 4.50	b 5.50	c 4.00	5.00	b 13.00	cd 10.75	c 11.63	g 4.50	b 9.97
Moldboard-plow (18-20 cm)	ab 20.75	f 8.75	e 12.75	g 7.50	c 12.44	b 5.50	b 5.00	b 5.00	c 3.50	4.75	ab 13.13	f 6.88	de 8.88	fg 5.50	c 8.60
Subsoiling + Chisel plow (16-18 cm)	c 17.50	de 13.00	d 14.75	e 11.00	b 14.06	a 7.00	bc 4.50	b 5.00	c 3.00	4.88	bc 12.25	e 8.75	d 9.88	f 7.00	b 9.47
Subsoiling + Moldboard-plow (18-20 cm)	de 13.00	fg 8.00	e 11.00	gh 6.00	d 10.25	a 6.50	c 3.50	b 5.50	c 3.00	4.63	d 9.75	fg 5.75	ef 8.25	g 4.50	d 7.06
Mean	a 18.80	c 13.35	b 15.35	d 8.30		a 6.20	b 4.50	b 5.30	c 3.60		a 15.63	c 8.93	b 10.33	d 5.95	
L.S.D. at 5% : Tillage (T.)	S					N.S.					S				
Herbicides (H.)	S					S					S				
T x H	S					S					S				

41.41% compared with moldboard plowing, subsoiling + chisel plowing, chisel plowing and no-till, respectively at 120 DFS.

It could be concluded that the intensive tillage treatment including subsoiling + moldboard plowing reduced 41.41% of the weed population in wheat plots at 120 DFS compared with the no-till treatment.

Similar results were also reached by **Gomaa (1995), Skorda *et al* (1997) and Spandl *et al* (1998).**

The effect of weed control treatments on weeds number/m^2 at 120 DFS was significant in both seasons as well as in the combined average, Table (20). Nevertheless, Arelon significantly surpassed the two other herbicides, in depressing weed population. Also, Grasp and Granstar were significantly superior to the check treatment in reducing weed population. The two seasons average indicated that the application of Arelon, Grasp and Granstar significantly reduced the number of weeds/m^2 compared with the unweeded check by 61.93, 42.87 and 33.91%, respectively. It could be concluded that Arelon proved to be an efficient herbicide for wheat and about 62% reduction in weed population was achieved at 120 DFS which contributed markedly in increasing grain yield of wheat.

The results in Table (20) indicated a significant interaction effect for tillage x herbicides on weeds number/m^2 at 120 DFS in both seasons and their combined average.

In both seasons as well as their combined average the most effective treatments were achieved by the inclusion of Arelon. In 1997/98 season, chisel plowing + Arelon was the best combination recording a minimum number of weeds/m^2 being 5 weed plants.

In 1998/99 season, two treatments, including subsoiling + either chisel or moldboard plowing, both with Arelon, were the best ones with a minimum weeds number/m^2, being only 3 weed plants.

The combined analysis indicated that the minimum value of weeds/m^2 at 120 DFS was 4.50 which was recorded by two treatments including Arelon with either chisel plowing or subsoiling + moldboard plowing.

III.4. Fresh weight of total weeds (g/m^2) at 60 days from sowing :

Data on fresh weight weeds (g/m^2) at 60 DFS as affected by tillage treatments, herbicides and their interaction in 1997/98, 1998/99 and their combined average are shown in Table (21). The results revealed that tillage treatments had significant effect on fresh weight of total weeds at 60 DFS in 1998/99 season, whereas in 1997/98 season, no considerable differences in weed density were observed.

In 1998/99 season, both treatments including moldboard plowing significantly reduced weed density at 60 DFS compared with the two chisel plowing treatments as well as the check treatment.

The combined analysis of both seasons showed also that the two moldboard plowing treatments as well as subsoiling + chisel plowing reduced the spread of weeds compared with no-till. The results indicated significant reductions of 12.77, 9.56 and 6.43% in total fresh weight of weeds (g/m^2) due to subsoiling + moldboard plowing, moldboard plowing and subsoiling + chisel plowing when compared with no-till treatment. The effect of moldboard plowing in depressing

Table (21) : Effect of tillage, herbicides and their interaction on fresh weight of weeds (g/m^2) in wheat at 60 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments	1997 / 1998					1998 / 1999					Combined				
Tillage treatments	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	a 70.00	e 36.75	d 44.13	f 28.00	44.72	a 27.28	c 18.80	b 20.84	c 12.86	a 19.95	a 48.64	g 27.77	ef 32.48	h 20.43	a 32.33
Chisel-plow (16-18 cm)	ab 65.88	f 28.00	ab 64.00	g 20.25	44.53	a 26.02	c 18.74	b 20.68	c 11.90	a 19.34	b 45.95	h 23.37	bc 42.34	i 16.08	ab 31.94
Moldboard-plow (18-20 cm)	b 54.13	ef 34.63	bc 51.00	ef 30.31	42.53	b 20.72	c 12.87	cd 16.34	cd 13.91	b 15.96	cd 37.42	h 23.75	e 33.67	h 22.11	bc 29.24
Subsoiling + Chisel plow (16-18cm)	ab 55.50	cd 44.50	c 49.25	g 25.75	43.75	a 25.28	c 17.91	b 20.71	c 13.13	a 19.26	c 40.39	f 31.20	d 34.98	i 14.44	bc 30.25
Subsoiling + Moldboard-plow (18-20 cm)	b 53.63	de 37.50	d 38.50	e 34.75	41.10	b 20.03	c 11.83	bc 18.98	c 10.37	b 15.30	d 36.83	gh 24.67	fg 28.74	h 22.56	c 28.20
Mean	a 59.83	c 36.28	b 49.38	d 27.81		a 23.87	c 16.03	b 19.51	d 12.43		a 41.85	c 26.15	b 34.44	d 19.12	
L.S.D. at 5% : Tillage (T.)	N.S					S					S				
Herbicides (H.)	S					S					S				
T x H	S					S					S				

weeds was also reported by **Arshad *et al* (1998) and Spandl *et al* (1998).**

Furthermore, results in Table (21) indicate a significant effect for herbicides on weed density at 60 DFS in both seasons as well as their combined average. The differences among the four weed control treatments were significant. The combined analysis indicated that the three herbicides could be arranged in a descending order in their efficiency in controlling weeds in the following order : Arelon, Grasp and Granstar. These three herbicides significantly reduced weed density expressed as fresh weight of total weeds/m^2 at 60 DFS by 54.31, 37.51 and 17.71%, respectively compared with the unweeded check. It could be concluded that Arelon was the most effective herbicides in reducing the spread of weeds.

Similar results for the effect of herbicides in reducing weed flora in wheat fields at early growth stage were also reported by **El-Marsafy *et al* (1992), El-Mashad *et al* (1993 b), Kasem *et al* (1993) and Shebl (1998).**

The interaction between tillage and herbicides on fresh weight of weeds at 60 DFS was significant in both seasons and their average as shown in Table (21).

The application of Arelon either with chisel plowing (in the first season), or with subsoiling + moldboard plowing (in the second season) or with subsoiling + chisel plowing (in the combined average) recorded the lowest values of fresh weight of weeds/m^2, being 20.25, 10.37 and 14.44 g/m^2, respectively.

III.5. Fresh weight of total weeds (g/m^2) at 90 days from sowing :

The means of fresh weight of total weeds (g/m^2) at 90 DFS as affected by tillage treatments, herbicides and their interaction in 1997/98, 1998/99 seasons as well as their combined average are presented in Table (22).

The results revealed that tillage treatments significantly affected weed spread at 90 DFS in both seasons and their average. The best treatment in reducing weed density was subsoiling + moldboard plowing and the worst one was the check treatment (no-till), and the rest three treatments were inbetween. The trend of the results is about the same in both seasons, and the combined average is therefore a good illustration for the result.

The two seasons average showed that subsoiling + moldboard plowing, subsoiling + chisel plowing, moldboard plowing, and chisel plowing significantly reduced weed density expressed as fresh weight of weeds (in g/m^2) compared with no-till by 25.87, 15.95, 12.90 and 6.36%, respectively. The present results show the positive effects of subsoiling and moldboard plowing in reducing the spread of weeds in wheat fields.

Similar results were also reached by **Arshad *et al* (1998) and Spandl *et al* (1998)**. The results also revealed that weed control treatment significantly affected weed density at 90 DFS in both seasons and their average. Arelon was the more effective herbicide followed by Grasp and Granstar. The trend of the results was nearly similar in both seasons.

In the combined data, the application of Arelon, Grasp and Granstar, significantly reduced weed density expressed as

Table (22) : Effect of tillage, herbicides and their interaction on fresh weight of weeds (g/m^2) in wheat at 90 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	ab 149.53	d 128.10	b 145.27	d 119.39	a 135.57	b 80.50	c 65.51	c 68.32	f 52.62	a 66.74	a 115.02	b 96.81	ab 106.79	cd 86.00	a 101.16
Chisel-plow (16-18 cm)	b 142.54	de 118.63	c 138.62	ef 108.73	b 127.13	a 94.99	g 46.78	b 82.12	i 25.41	b 62.33	a 118.76	de 82.70	a 110.37	g 67.07	b 94.73
Moldboard-plow (18-20 cm)	cd 137.25	f 106.60	e 118.10	h 84.26	d 111.55	b 81.57	d 61.71	de 58.79	ef 56.60	a 64.67	ab 109.41	d 84.16	c 88.45	f 70.43	c 88.11
Subsoiling + Chisel plow (16-18cm)	a 155.25	fg 100.47	bc 138.87	g 92.17	c 121.69	e 57.06	h 43.04	fg 51.00	h 42.31	c 48.35	ab 106.16	f 71.75	b 94.94	fg 67.24	d 85.02
Subsoiling + Moldboard-plow (18-20 cm)	a 153.81	i 81.95	f 107.83	i 81.55	e 106.29	f 52.76	g 47.43	fg 47.97	i 26.68	d 43.71	ab 103.28	g 64.69	e 77.90	h 54.12	e 74.99
Mean	a 147.68	c 107.15	b 129.74	d 97.22		a 73.38	c 52.89	b 61.64	c 40.72		a 110.53	c 80.02	b 95.69	d 68.97	
L.S.D. at 5% :															
Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

fresh weight of weeds (g/m^2) at 90 DFS compared with the unweeded check by 37.60, 27.60 and 13.43%, respectively.

Similar results for the effect of herbicides on weed flora in wheat fields were also reported by **Al-Marsafy *et al* (1992), El-Mashad *et al* (1993 a), Kasem *et al* (1993) and Shebl (1998).**

The interaction between tillage and herbicidal treatments significantly affected fresh weight of weeds/m^2 at 90 DFS in both seasons and their combined average. Nevertheless, the greatest reduction in weed density was achieved by Arelon application, either when combined with subsoiling + moldboard plowing in the first season and the combined average or with chisel plowing in the second season.

The lowest values of fresh weight of total weeds (g/m^2) in 1997/98, 1998/99 and the combined average were 81.55, 25.41 and 54.2 g/m^2, respectively.

III.6. Fresh weight of total weeds (g/m^2) at 120 days from sowing :

Means of fresh weight of total weeds in g/m^2 at 120 DFS as affected by tillage practices, weed control treatments and their interaction in both seasons of experimentation as well as their combined analysis are presented in Table (23). The effect of tillage treatments on weed density was significant in both seasons and the combined average. The most effective treatment in reducing weed density at 120 DFS was the most intensive treatment including subsoiling + moldboard plowing, also all tillage operations were better than the check treatment (no-till). The results at 120 DFS hold true as those observed at 60 as well as 90 DFS.

Table (23) : Effect of tillage, herbicides and their interaction on fresh weight of weeds (g/m²) in wheat at 120 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	ab 109.51	bc 100.11	b 105.52	g 62.45	a 94.40	a 104.03	d 61.62	b-d 63.37	de 56.56	a 71.40	a 106.77	c 80.87	bc 84.45	g 59.50	a 82.90
Chisel-plow (16-18 cm)	a 111.58	d 79.93	bc 94.59	f 73.33	b 89.86	bc 70.35	f 49.35	d 61.24	f 44.44	b 56.35	b 90.97	f 64.64	cd 77.91	g 58.87	b 73.10
Moldboard-plow (18-20 cm)	c 87.83	cd 85.60	c 87.34	d 82.94	c 85.93	b 75.33	f 48.74	g 38.47	h 33.70	c 49.06	bc 81.58	e 67.17	fg 62.90	g 58.32	c 67.49
Subsoiling + Chisel plow (16-18 cm)	a 113.84	d 82.05	c 90.84	f 70.34	b 89.27	cd 62.22	ef 50.93	d 62.17	fg 43.28	b 54.65	b 88.03	f 66.49	d 76.50	h 56.81	b 71.96
Subsoiling + Moldboard-plow (18-20 cm)	c 92.09	de 77.84	d 81.45	e 74.72	d 81.53	e 52.56	gh 36.31	f 50.50	h 29.40	d 42.17	de 72.32	gh 57.07	f 65.92	h 52.06	d 61.84
Mean	a 102.97	c 85.11	b 91.95	d 72.76		a 72.90	c 49.39	b 55.13	d 41.48		a 87.93	c 67.25	b 73.54	d 57.11	
L.S.D. at 5% : Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

The combined analysis showed a good illustration for the results where subsoiling + moldboard plowing significantly reduced weed density expressed as fresh weight of total weeds (g/m^2) at 120 DFS by 25.40, 15.40, 8.37 and 14.04%, compared with no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing, respectively.

It could be concluded that an intensive seedbed preparation for wheat is a good procedure contributing in the reduction of weed density. The results are in agreement with those reported by **Arshad *et al* (1998) and Spandl *et al* (1998).**

Concerning weed control treatment, the results in Table (23) show a similar trend as that recorded at 60 as well as 90 DFS, where Arelon was the best herbicide in controlling weeds followed by Grasp, then Granstar. The results had true in both seasons and their combined average.

The two seasons average revealed that Arelon, Grasp and Granstar significantly reduced fresh weight of total weeds at 120 DFS, compared with the unweeded check by 35.05, 23.52 and 16.37%, respectively. It could be concluded that Arelon is an effective herbicide compared with the two other herbicides in reducing weed density in wheat.

Similar results were also reached by **Al-Marsafy *et al* (1992), Kasem *et al* (1993), Mady (1996) and Shebl (1998).**

The interaction between tillage practices and weed control treatments significantly affected fresh weight of total weeds in wheat at 120 DFS as shown in Table (23). The combined analysis of the two seasons indicated that the lowest weed density was achieved by combining subsoiling + moldboard plowing with Arelon, being 52.06 g/m^2 of fresh

weight of total weeds. On the other hand, the greatest weed density was 106.77 g/m^2 which was recorded with no-till combined with the unweeded control.

III.7. Dry weight of total weeds (g/m^2) at 60 days from sowing :

Means of dry weight of total weeds (g/m^2) at 60 DFS as affected by tillage practices, weed control treatments and their interaction in the two experimental seasons as well their combined average are shown in Table (24) and in Fig. (9 and 10).

The results indicated a significant effect of tillage treatments on weed density at 60 DFS in both seasons and their average. Moldboard plowing, particularly when it was preceded by subsoiling was the best treatment. The results showed about the same trend in both seasons. The combined analysis indicated that subsoiling + moldboard plowing significantly reduced weeds dry weight by 19.27, 10.29, 5.29 and 6.85%, compared with no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing, respectively.

It is worth noting that the results of dry weight of weeds was more or less identical with those of fresh weight.

The present results are expected since tillage treatments significantly affected weeds fresh weight and weeds number/m^2.

The results here are in line with those reported by **Arshad *et al* (1998) and Spandl *et al* (1998).**

Weed control treatments significantly affected weeds dry weight at 60 DFS. The results indicated the superiority of Arelon in depressing weeds followed by Grasp, then Granstar.

Table (24) : Effect of tillage, herbicides and their interaction on dry weight of weeds (g/m^2) in wheat at 60 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	a 9.15	de 4.61	d 4.83	e 3.93	a 5.63	a 3.36	c 2.61	ab 2.94	de 1.87	a 2.70	a 6.25	b 3.61	b 3.89	c 2.90	a 4.16
Chisel-plow (16-18 cm)	b 6.95	de 4.62	bc 6.35	e 3.73	ab 5.41	a 3.32	cd 2.11	ab 2.95	de 0.84	b 2.31	a 5.13	bc 3.37	a 4.65	c 2.28	b 3.79
Moldboard-plow (18-20 cm)	c 5.64	d 5.16	cd 5.39	e 3.73	b 4.98	c 2.65	d 1.97	c 2.50	de 1.69	bc 2.20	a 4.14	b 3.57	ab 3.94	c 2.71	b 3.59
Subsoiling + Chisel plow (16-18cm)	c 5.66	d 4.86	d 5.36	e 4.22	ab 5.03	b 2.89	d 1.95	bc 2.66	de 1.58	b 2.27	a 4.27	b 3.41	a 4.01	c 2.90	b 3.65
Subsoiling + Moldboard-plow (18-20 cm)	b 6.93	e 4.31	c 5.75	e 2.22	b 4.80	c 2.58	de 1.75	de 1.74	de 1.89	c 1.99	a 4.75	c 3.03	c 3.75	c 2.05	b 3.40
Mean	a 6.87	c 4.71	b 5.54	d 3.57		a 2.96	c 2.08	b 2.56	d 1.57		a 4.91	c 3.40	b 4.05	d 2.57	
L.S.D. at 5% : Tillage (T.)			S					S					S		
Herbicides (H.)			S					S					S		
T x H			S					S					S		

Fig. (9): Effect of tillage treatments on the dry weight of total weeds (g/m^2) in wheat plots combined over 1997/98 and 1998/99 seasons

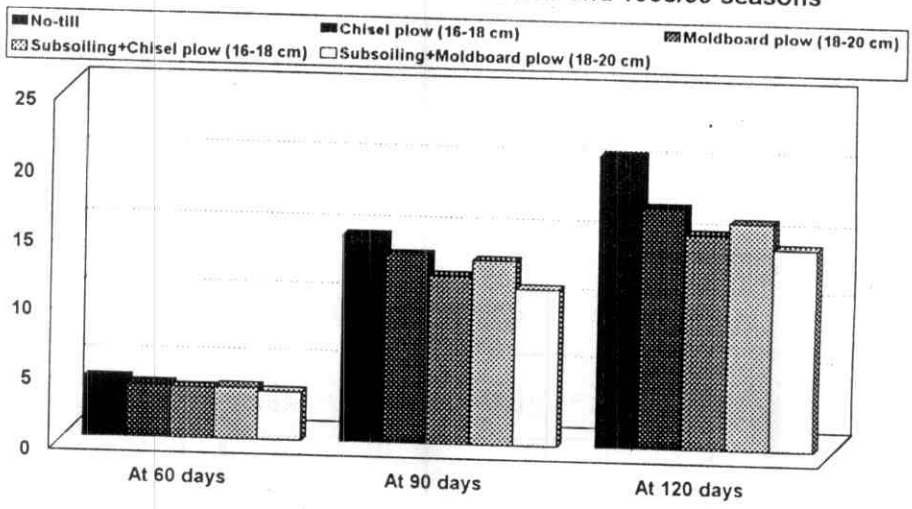
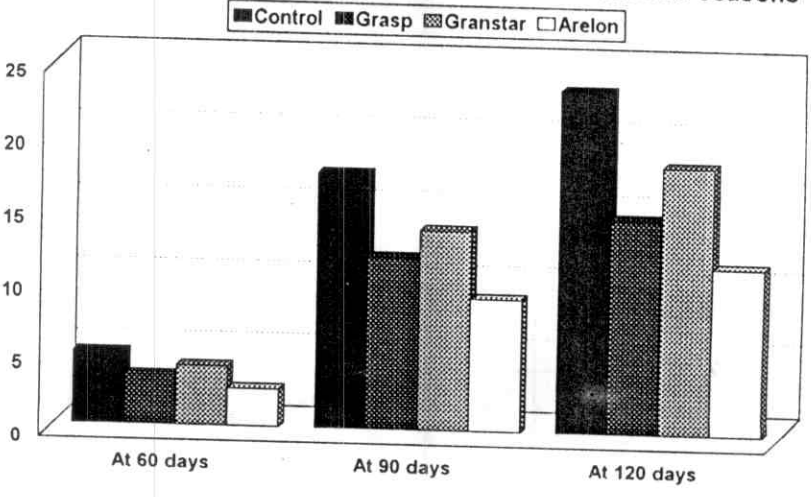


Fig. (10): Effect of weed control treatments on the dry weight (g/m^2) of total weeds in wheat plots combined over 1997/98 and 1998/99 seasons



The herbicidal application in general were effective in reducing weed density when compared with the unweeded check.

The combined analysis indicates a good illustration for the results, where Arelon, Grasp and Granstar significantly reduces dry weight of total weeds by 47.66, 30.75 and 11.52%, compared with the unweeded check, respectively. The results here are similar with those recorded with weeds fresh weight at this growth stage.

The positive effects of herbicides in depressing weed spread are also reported by **Mady (1996) and Shebl (1998)**.

The results in Table (24) revealed a significant effect of tillage x herbicides on dry weight of total weeds at 60 DFS in the two successive seasons and their combined average. The application of Arelon combined with subsoiling + moldboard plowing was the best treatment as shown in the two seasons average where the lowest dry weight of total weeds was recorded being 2.05 g/m^2. On the other hand the greatest weed density was 6.25 g/m^2 which was recorded with no-till combined with the unweeded check.

III.8. Dry weight of total weeds (g/m^2) at 90 days from sowing :

The results in Table (25) and in Fig. (9 and 10) show the effects of tillage treatments, herbicidal application and their interaction on dry weight of total weeds (g/m^2) at 90 DFS in the two experimental seasons (1997/98 and 1998/99) and their combined average. The results are similar as those shown with the date of fresh weight of total weeds at the same growth stage. The effect of tillage treatments is nearly similar in both seasons.

Table (25) : Effect of tillage, herbicides and their interaction on dry weight of weeds (g/m^2) in wheat at 90 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	b 25.03	c 22.38	c 22.37	d 18.13	a 21.98	a 16.63	d 5.30	cd 7.07	f 2.14	a 7.79	a 20.83	ef 13.84	de 14.72	gh 10.13	a 14.88
Chisel-plow (16-18 cm)	a 27.41	de 17.35	ab 26.06	f 12.86	b 20.92	b 10.77	e 4.68	de 5.02	e 4.46	b 6.23	b 19.09	gh 11.01	d 15.54	hi 8.66	b 13.58
Moldboard-plow (18-20 cm)	c 22.81	d 18.62	cd 21.22	e 15.70	c 19.59	d 5.55	e 4.99	d 5.37	f 2.44	d 4.59	e 14.18	g 11.81	f 13.30	hi 9.07	c 12.09
Subsoiling + Chisel plow (16-18cm)	b 25.98	cd 21.88	d 20.08	de 16.19	ab 21.03	c 8.25	e 4.97	cd 5.87	f 2.80	c 5.47	c 17.12	f 13.42	f 12.98	h 9.50	b 13.26
Subsoiling + Moldboard-plow (18-20 cm)	b 25.48	ef 15.38	d 19.17	ef 14.19	d 18.56	cd 6.77	f 2.48	e 4.59	f 1.94	e 3.95	cd 16.13	i 8.91	g 11.88	i 8.06	d 11.25
Mean	a 25.34	c 19.12	b 21.78	d 15.41		a 9.59	c 4.48	b 5.58	d 2.76		a 17.47	c 11.80	b 13.68	d 9.08	
L.S.D. at 5% : Tillage (T.)	S					S					S				
Herbicides (H.)	S					S					S				
T x H	S					S					S				

The combined average indicates a good illustration for the positive effect of moldboard plowing in reducing weed density in wheat. The data showed that on the average of both seasons, subsoiling + moldboard plowing reduced dry weight of total weeds at 90 DFS by 24.60, 17.16, 6.95 and 15.16%, compared with no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing, respectively.

The results here are in general agreement with those reported by **Arshad *et al* (1998) and Spandl *et al* (1998)**.

The results showed also the superiority of Arelon in reducing weed spread, particularly in 1998/99 season, where a reduction of 71.22% in total weed dry weight was observed due to Arelon application compared with the unweeded check. The trend of the results hold true as that observed with fresh weight of weeds at 90 DFS in both seasons.

The combined average revealed that the application of Arelon, Grasp and Granstar significantly reduced dry weight of weeds by 48.03, 32.46 and 21.69%, compared with the unweeded check, respectively.

It could be concluded that Arelon is the most efficient herbicide, followed by Grasp and Granstar.

The results are in agreement with those reported by **El-Desoky (1990), Panwar *et al* (1995) and Aly *et al* (1998)**.

The results in Table (25) showed also that the interaction between tillage and herbicidal treatments significantly affected dry weight of weeds/m^2 at 90 DFS in both seasons and their combined average.

The most efficient combination in depressing weeds was subsoiling + moldboard plowing with Arelon as shown in the combined average with a value of 8.06 g/m^2 for dry weight of

total weeds, and greatest weed density was recorded with the check treatment (no-till + unweeded control), being 20.83 g/m^2.

III.9. Dry weight of total weeds (g/m^2) at 120 days from sowing :

Data on the effects of tillage, herbicides and their interaction on dry weight of total weeds at 120 DFS in both seasons of experimentation and their average are given in Table (26) and in Fig (9 and 10).

The results revealed a great similarity with those observed with fresh weight of total weeds at the same growth stage, also with those of dry weight of total weeds at the two previous growth stages concerning the effect of tillage treatment. It is worth noting that the results are nearly similar in their trend in both seasons.

The combined analysis indicated that subsoiling + moldboard plowing reduced dry weight of total weeds by 30.47, 16.32, 6.06, and 11.22%, compared with no-till, chisel plowing, moldboard plowing and subsoiling + chisel plowing, respectively.

The significant differences were those between the check treatment and the other four ones, and also between chisel plowing and the best treatment (subsoiling + moldboard plowing). It could be concluded that intensive tillage contributed in reducing the spread of weeds in wheat at later growth stage as previously shown at the advanced stages.

The results in Table (26) showed also a similar trend for the effect of herbicides on weed density at 120 DFS as that observed at 60 and 90 DFS. Also, the results of the dry weight

Table (26) : Effect of tillage, herbicides and their interaction on dry weight of weeds (g/m^2) in wheat at 120 days from sowing in 1997/1998, 1998/1999 and their combined average

Herbicide treatments / Tillage treatments	1997 / 1998					1998 / 1999					Combined				
	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean	Control	Grasp	Granstar	Arelon	Mean
No-till	b 21.59	bc 19.54	b 21.42	bc 19.46	a 20.50	a 39.06	cd 16.39	c 19.43	f 10.67	a 21.39	a 30.32	d 17.96	c 20.42	e 15.06	a 20.94
Chisel-plow (16-18 cm)	a 25.09	cd 13.69	bc 20.29	e 11.66	b 17.68	b 22.70	d 15.39	d 16.21	e 14.17	b 17.12	b 23.90	e 14.54	d 18.25	fg 12.91	b 17.40
Moldboard-plow (18-20 cm)	bc 20.55	c 17.31	c 17.62	de 12.66	b 17.04	c 18.99	f 11.29	c 18.79	g 6.92	bc 13.99	d 19.77	f 14.30	d 18.20	g 9.74	bc 15.50
Subsoiling + Chisel plow (16-18cm)	ab 23.88	d 13.32	bc 20.85	e 10.89	b 17.24	bc 19.97	e 13.58	c 19.02	fg 9.72	bc 15.57	bc 21.92	f 13.45	cd 19.93	fg 10.30	bc 16.40
Subsoiling + Moldboard-plow (18-20 cm)	bc 20.91	cd 16.37	bc 18.72	e 9.92	b 16.48	bc 21.22	f 10.26	f 10.58	fg 8.50	c 12.64	c 21.07	f 13.32	f 14.65	g 9.21	c 14.56
Mean	a 22.40	c 16.05	b 19.78	d 12.92		a 24.39	c 13.38	b 16.81	d 9.99		a 23.40	c 14.71	b 18.29	d 11.44	
L.S.D. at 5% : Tillage (T.)	S					S					S				
Herbicides (H.)	S					S					S				
T x H	S					S					S				

are nearly identical with those of fresh weight of total weeds at 120 DFS.

The combined analysis of the two seasons average indicated that Arelon, Grasp and Granstar application significantly reduced dry weight of total weeds at 120 DFS by 51.12, 37.14 and 21.84%, compared with the check treatment, respectively.

The positive effect of herbicides in depressing weed density was also reported by **Mady (1996) and Shebl (1998)**.

The interaction between tillage and herbicides significantly affected dry weight of weeds at 120 DFS in both seasons as well as in the combined average (Table 26).

The combined data indicated that the most efficient weed reduction was achieved by subsoiling + moldboard plowing with Arelon where weed dry weight was 9.21 g/m^2 and the greatest density was observed with the check, being 30.32 g/m^2.

IV. Effect of Tillage Treatments on Soil Properties at Harvest :

IV.1. Soil bulk density at harvest :

Means of soil bulk density (g/cm^3) at different soil depths as affected by tillage practices at harvest in 1997/98 and 1998/99 seasons are presented in Table (27) and in Fig. (11).

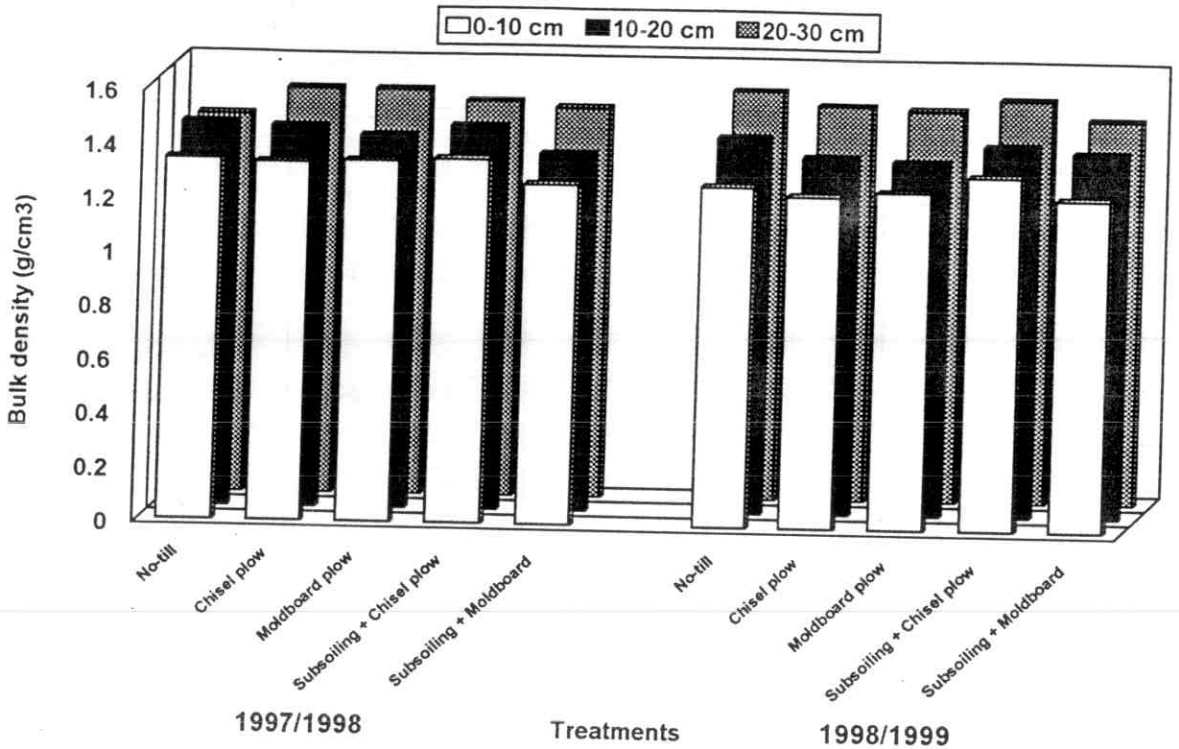
The results showed that tillage treatments did not significantly affect soil bulk density in both seasons.

However, the intensive tillage treatment including subsoiling + moldboard plowing recorded the lowest bulk density averaged over the three soil depth, and was lower than

Table (27) : Effect of tillage practices on bulk density (g/m³) at different soil depths at harvest in 1997/1998 and 1998/1999 seasons

Tillage treatments	1997 / 1998				1998 / 1999			
	Soil Depth " cm "							
	0-10	10-20	20-30	Mean	0-10	10-20	20-30	Mean
No-till	c-e 1.34	a-d 1.42	a-d 1.40	1.39	gh 1.26	b-f 1.39	a 1.51	1.39
Chisel-plow (16-18 cm)	c-e 1.33	a-d 1.41	a 1.50	1.41	h 1.23	e-h 1.32	a-c 1.46	1.34
Moldboard-plow (18-20 cm)	c-e 1.34	b-d 1.38	a 1.50	1.41	gh 1.25	f-h 1.31	a-d 1.45	1.34
Subsoiling + Chisel plow (16-18 cm)	c-e 1.35	a-d 1.42	ab 1.46	1.41	f-h 1.31	c-f 1.37	ab 1.49	1.39
Subsoiling + Moldboard-plow (18-20 cm)	e 1.26	de 1.32	a-c 1.44	1.34	h 1.23	d-g 1.35	a-e 1.42	1.33
Mean	**c 1.32**	**b 1.39**	**a 1.46**		**c 1.26**	**b 1.35**	**a 1.47**	
L.S.D. at 5%								
Tillage (T)	**N.S.**				**N.S.**			
Soil depth (D)	**S**				**S**			
T x D	**S**				**S**			

Fig. (11): Effect of tillage practices on bulk density (g/cm^3) at different soil depths at harvest in 1997/98 and 1998/99 seasons



that of the no-till treatment by 3.60 and 4.32% in the first and second seasons, respectively. Although, these reductions were below the level of significance.

Soil depth significantly affected bulk density at harvest in both seasons (Table, 27). The increase in soil depth from 0-10 to 10-20 and 20-30 cm significantly increased soil bulk density by 5.30 and 10.61%, in the first season, respectively, corresponding to 7.14 and 16.67% in the second season.

The effect of the interaction between tillage treatments and soil depth on soil bulk density was significant in both seasons.

In 1997/98 season, the lowest bulk density was 1.26 g/cm^3 which was recorded by subsoiling + moldboard plowing at 0-10 cm depth, whereas the greatest bulk density was 1.50 g/cm^3 which was recorded by chisel as well as moldboard plowing at 20-30 cm depth.

In 1998/99 season, the lowest soil bulk density was 1.23 g/cm^3 which was recorded by chisel plowing as well as subsoiling + moldboard plowing at 0-10 cm depth, while no-till at 20-30 cm depth recorded the greatest bulk density, being 1.51 g/cm^3.

Similar results were also reported by **Taieb (1998), Shafshak *et al* (1996) and Khedr *et al* (1998).**

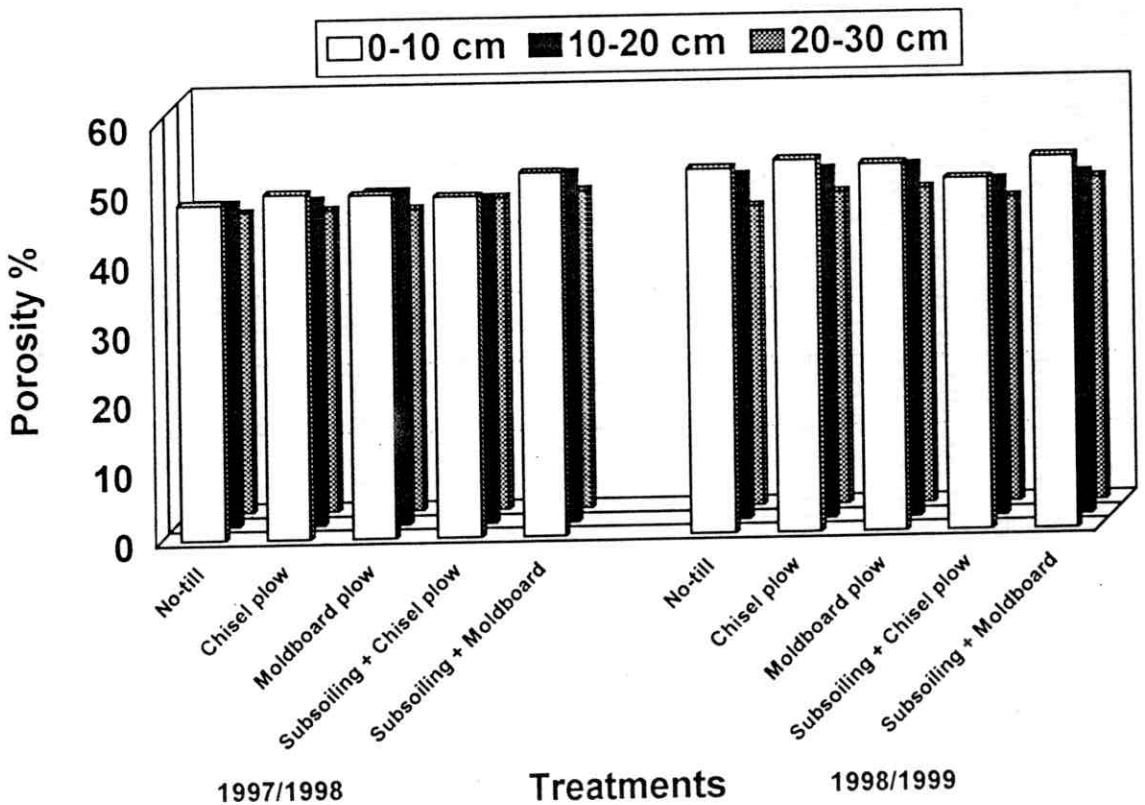
IV.2. Soil porosity percentage at harvest :

Data in Table (28) and in Fig. (12) show the effects of tillage practices, soil depths and their interaction on soil porosity percentage at harvest in both seasons of experimentation.

Table (28) : Effect of tillage practices on porosity % at different soil depths at harvest in 1997/1998 and 1998/1999 seasons

Tillage treatments	1997 / 1998				1998 / 1999			
	Soil Depth " cm "							
	0-10	10-20	20-30	Mean	0-10	10-20	20-30	Mean
No-till	a 48.30	ab 46.42	ab 43.14	b 45.95	ab 52.45	a-d 49.44	f 43.02	48.30
Chisel-plow (16-18 cm)	a 49.68	a 46.79	ab 43.40	ab 46.62	a 53.58	a-c 50.16	d-f 44.91	49.55
Moldboard-plow (18-20 cm)	a 49.43	a 47.92	ab 43.40	ab 46.91	ab 52.83	a-c 50.57	d-f 45.28	49.56
Subsoiling + Chisel plow (16-18 cm)	a 49.06	ab 46.42	ab 44.91	ab 46.80	a-c 50.57	b-e 48.30	ef 43.77	47.55
Subsoiling + Moldboard-plow (18-20 cm)	a 52.33	a 50.19	ab 45.66	a 49.39	a 53.58	a-d 49.06	c-f 46.42	49.69
Mean	**a 49.76**	**b 47.55**	**c 44.10**		**a 52.60**	**b 49.51**	**c 44.68**	
L.S.D. at 5%								
Tillage (T)			S				N.S.	
Soil depth (D)			S				S	
T x D			S				S	

Fig. (12): Effect of tillage practices on porosity % at different soil depths at harvest in 1997/98 and 1998/99 seasons



The results showed that tillage treatments significantly affected porosity % in the first season where subsoiling + moldboard plowing recorded the highest porosity (49.39%) which surpassed the other 4 tillage systems, but with one significant difference when compared with the check treatment (no-till).

In 1998/99 season, also the most intensive soil tillage recorded the highest porosity %, being 49.69% but without any significant differences when compared with the 4 other tillage treatments.

The results in Table (28) showed that in both seasons, soil depth significantly affected porosity %. Porosity % significantly and consistently reduced with the increase in soil depth.

The interaction between tillage systems and soil depths significantly affected porosity % in both seasons.

The greatest porosity % was observed in 1997/98 season with subsoiling + moldboard plowing at 0-10 cm soil depth, being 52.33%. Also, in 1998/99 season the same formentioned treatment as well as chisel plowing at 0-10 cm depth recorded the maximum porosity %, being 53.58%.

The lowest porosity % in both seasons were observed with the no-till treatment at 20-30 cm soil depth, being 43.14 and 43.02% in the two successive seasons, respectively.

Similar results were also reported by **El-Tohamy (1963), El-Gohary (1978), Gomaa and El-Naggar (1995 a) and Miller *et al* (1999).**

IV.3. Soil salinity at harvest :

Means of electrical conductivity (E.C.) at a standard temperature of 25 °C of the soil saturation extract in mmohs/cm as affected by tillage treatments at harvest at the 3 different soil depths in 1997/98 and 1998/99 seasons are presented in Table (29).

The results indicated that E.C. was not significantly affected by either tillage treatments or soil depths in both seasons.

The highest salinity values were recorded with no-till averaged over the 3 soil depths, being 2.14 and 1.32 mmohs/cm in the first and second seasons, respectively.

On the other hand, the lowest salinity values at harvest was recorded by subsoiling + moldboard plowing, being 1.60 and 1.06 mmohs/cm in the first and second seasons, respectively. However, the differences between these values were not significant.

The results showed also that neither soil depth nor tillage x depth had significant effect on soil salinity in both seasons.

The present results are not in agreement with those reported by **Omran (1995)** who found that seedbed preparation treatments, soil depth and their interaction significantly affected soil salinity at harvest.

Table (29) : Effect of tillage practices E.C. at 25 °C at different soil depths at harvest in 1997/1998 and 1998/1999 seasons

Tillage treatments	1997 / 1998				1998 / 1999			
	Soil Depth " cm "							
	0-10	10-20	20-30	Mean	0-10	10-20	20-30	Mean
No-till	2.36	2.06	1.99	2.14	1.41	1.40	1.14	1.32
Chisel-plow (16-18 cm)	2.00	1.87	1.89	1.92	1.25	1.40	1.03	1.14
Moldboard-plow (18-20 cm)	2.25	1.84	1.61	1.90	1.15	1.40	1.06	1.12
Subsoiling + Chisel plow (16-18 cm)	1.79	1.74	1.70	1.74	1.06	1.20	1.04	1.10
Subsoiling + Moldboard-plow (18-20 cm)	1.69	1.55	1.55	1.60	1.08	1.05	1.05	1.06
Mean	**2.02**	**1.81**	**1.75**		**1.19**	**1.19**	**1.06**	
L.S.D. at 5%								
Tillage (T)	**N.S**				**N.S**			
Soil depth (D)	**N.S**				**N.S**			
T x D	**N.S**				**N.S**			