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# INFLUENCE OF SOME SELECTIVE HERBICIDES ON CONTROLLING WEEDS AND WHEAT (*Triticum aestivum* L.) PRODUCTIVITY

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## ABSTRACT

Two field trials were conducted to study the effect of six post-emergence herbicides on controlling weeds and increasing wheat's productivity. Two herbicides (Sinal 10 SC & Lentagran 600 EC) were performed for controlling broad leave weeds, Iloxan EC and Grasp EC for grasses, meanwhile, Panther SC and Arelon FL were used for controlling both types of weed. The herbicides were applied as a foliar application either alone or followed by each other subsequently at different rates of concentration. Most of the herbicides substantially suppressed growth and development of a wide range of mono and dicotyledonous weeds associated with wheat. Spraying Panther and Arelon herbicides alone at 0.6 and 1.25 L/fed., respectively were the most effective for controlling broad (up to 98%) or narrow (up to 86%) leave weeds and increasing yield productivity by up to 71% as compared with other herbicides or control. Using Sinal 10 SC or Lentagran 600 EC subsequently with Iloxan EC and Grasp EC at low concentrations (< recommended dose) gave, to a large extent, similar results to those herbicides applied alone at high concentrations for reducing weed growth and increasing wheat grain yield (53-62%) as compared with control. Hand weeding once controlled broad leave weeds and grasses by 45-93% and increasing wheat yield by 47-53%. The herbicides increased the NPK contents in wheat's grain, irrespective of the rate and sort of application either compared with hand weeding or control. It has been suggested that applying more than one selective herbicide at low concentrations would be more efficient for controlling a wide range of weeds associated with wheat rather than being applied alone at higher concentrations.

## INTRODUCTION

Wheat (*Triticum aestivum* L.) is the master of cereal crops all over the world. Socially, in developing countries in particular, the crop has a very specially important value since it is widely used in several food industries of which making bread is the most popular and vital one. Weed amongst other pests attack wheat is considered the worst one, that serious problem which could be increased into foreseeable future particularly with world shifted from conventional to organic farming (Albrecht, 2005). The crop losses due to weed infestation were estimated by 10-50% or even to complete crop failure, based on the type and state of weedy infestation (Cheema *et al.*, 1997). The weed bade effect exceed that by affecting the quality of wheat grains and hence its safety for being used in human or even animals consumption as in many cases of heavy infestation by toxic weeds such as *Lolium* sp., foxtail barley, alsike clover, nettle and spurge (Goetz *et al.*, 2001; Dinelli *et al.*, 2002). Conventional methods as documented with many cereal crops, were effectively used for controlling weeds infested wheat, however, the highly cost and shortage in labor for hand weeding are eliminated such ways and

are no longer applied in many places (Olofsdotter et al., 1997; Sharara *et al.*, 2005).

Now days, herbicides use in wheat production are increasing dramatically for its efficiency and the reliability in controlling weeds. Numerous herbicides were successfully used for controlling weeds in wheat of which Arelon (Isoproturon), Grasp (Tralkoxydim) and Iloxan EC (Diclofop-methyl) were the most popular herbicides (Odiemah *et al.*, 1988; Tag-El-Din *et al.*, 1989; Punia *et al.*, 1993). Several other commercial herbicides e.g. X-pand, Brominal, Bazagran, Fusilade, Dicuran, Faneron, Ally 20 WG, Stomp, Buctril. 2,4-D amine and 2,4-D were also effectively used for controlling wheat's weeds (Adamczewski and Paradowski, 1988; Akhtar et al., 1991; Hassan *et al.*, 1994; Al-Marsafy and Hassanein, 1998; El-Kholi and Metwally, 2001; Adamczewski and Matysiak, 2002). Grasp and Iloxan has been registered for post-emergence grass control in cereals (Faris *et al.*, 1989; Tzamir *et al.*, 1988; Boutahar, 1994). Eschenbrenner (1990) reported that Grasp at 300 g/ha showed excellent selective control for *Avena* sp., *Lolium* sp. and *Alopecurus myosuroides* in wheat and barley. Nowicka and Rola (1994) showed that spraying Grasp (1-1.2 L/ha) in tank mixture with some adjuvant or herbicides such as Atplus 463 and Optica 600 SL, respectively would be more efficient for controlling weeds than applying it alone. Iloxan was far equal to Grasp for its efficiency in suppressing growth and development (DW) of weeds infested wheat which was estimated by 15.2-166.5 g/m against 192.8-394.5 for control (Punia *et al.*, 1993). Tamayo-Eesquer and Martinez-Carrillo (2002) demonstrated that using Iloxan 28 CE at 100% of recommended dose was good enough for controlling canarygrass (i.e. *Phalaris minor* and *P. paradoxa*) weeds. on converse with Grasp which needs to be applied at 200% of the recommended dose to obtain equal performance.

Lentagran and Sinal are amongst the most popular herbicides for controlling broad- leaved weeds associated with cereal crops such as wheat and barley. Swed (1991) found that Lentagran plus (Dichlorprop+Pyridate) at 3 kg/ha were the most effective (>80% growth reduction) amongst nine herbicides were examined for its efficiency in controlling weeds infested spring wheat, however, the greatest yields were obtained with applying Aminopielik D (3 kg/ha), Chisel (50 g/ha), Granstar 75 DP (20 g/ha) and Granstar (20g)+Suffix BW (3 kg/ha) herbicides. Ratajczyk (1991) declared that using Lentagran in a mixture with Siarkol fungicide was useful to increase the herbicidal efficiency of that herbicide for controlling weeds in winter weeds. However, the highly phytotoxic effect of Lentagrn on the growth and hence yield productivity of wheat crop are discouraging (Drazic *et al.*, 1987). Recently, Metwally and Hassan (2001) reported that using Sinal gave excellent results for controlling weeds infested wheat, particularly when applied in combination with 1% urea or ammonium sulphate at rates less than recommended dose (0.04 kg/fed.). El-Metwally (2002) mentioned that Sinal is a reliable herbicide for controlling broad-leaved weeds not the grassy weeds mainly because of certain functional selectivity reasons.

Arelon (Isoproturon) was used as pre or post-emergence herbicide for controlling wide range of broad and narrow- leaved weeds in cereals

(Gunnarson, 1989, Punia *et al.*, 1989). The compound has been used in different formations (e.g. Nocilon 50 WP, Tolkan 50 WP and Arelon WP), which in comparison with other relevant herbicides were more efficient either for suppressing weed growth or increasing wheat productivity (Rao and Duhoon, 1986; Balyan *et al.*, 1987). Rapparini *et al.*, (1987) referred that Arelon DS at (2.5 kg/ha) was the best overall 28 postemergance herbicides has been tested for controlling *Bromus sterilis*, which aggressively invade Italy land causing a great damage to wheat field. Mosad and El-Hamid (1998) found that spraying Arelon at 1.25 L/fed. either alone or followed by hand weeding was promising for reducing weed infestation in particular grassy weeds than other weedicide treatments. Recently, Dabek-Gad and Bujak (2002a) found that Arelon Dyspersyjny 500 SC were more effective in controlling troublesome canopy weed in wheat rather than traditional tillage methods such as ploughing, and caused grain yield increase by up to 37% (Dabek-Gad and Bujak, 2002b).

In Egypt, wheat is considered one of the most strategic crops, since bread creates the daily basic source of nutrients of the majority of population. Concerted efforts has recently been forward to increasing wheat productivity by all means of increasing land area, breeding for highly yield varieties, genetic modification of local varieties and controlling pests (Kroll, 2001; Wu *et al.*, 2001; Wicks *et al.*, 2002). Therefore, the aim of the present work was to study the effect of six selective weed killers on controlling weeds and increasing wheat productivity under field condition.

## MATERIALS AND METHODS

Two field experiments were conducted in two successive seasons (2004/2005) at the experimental station of National Research Center, Shalakan, Kalubia, Egypt. Wheat (*Triticum aestivum* L. c.v. Geza 168) grains were obtained from Agricultural Research Center, Ministry of Agriculture. The grains were sown by hand spreading at 60 kg/fed. on 7$^{th}$ November in both seasons. An area of about 1/4 fed. (504 m$^2$) was divided into 48 experimental units; each was about 10.5 m$^2$ (3x3.5 m). The soil texture was a clay loam (pH=7.8, organic matter=1.89) with medium fertility. The wheat plants were received all necessary farming practices from irrigation, fertilization to controlling insect and microbial pathogen according to recommendations. Six selective post-emergence herbicides were applied as a foliar application, either alone or subsequently after 30 days from sowing (3-4 leaf stage) in comparison with control and hand weeding once. The herbicides were sprayed using a Knapsack sprayer equipped with one nozzle boam and water volume of 200 L/fed. Four replicates were used for each treatment in a completely block design. The chemical structure, common/chemical name, type, date and rate of applications of each treatment are shown in Table (1).

Weed samples were collected randomly from one square meter/plot after three weeks of spraying. The weeds were identified and classified into two groups, e.g. broad and narrow- leaved weeds.

## Table (1): Chemical structure, common name and concentration of herbicides.

| Treatments (Trade name) | Common name | Chemical name | Rate of application (L/fed. *) | Active ingredient (a. i. /fed.) | Selectivity | Manufactory | Type of application | Time of application (Days after sowing) | Physiological stage |
|---|---|---|---|---|---|---|---|---|---|
| Panther 55% SC | Isoproturon +Diflufenican | N-(4-isopropylphenyl)- N,N-dimethyl-urea + N-(2,4-difluorophenyl)-2-(3-trifluoromethylphenox)-3-pyridinecarboxamide | 0.60 | 330.0 | Broad and narrow leaves | Bayer Crop Science | Post- emergence | 30 days | Seedling stage |
| Arelon 50% FL | Isoproturon | N-(4-isopropylphenyl)- N,N-dimethyl-urea | 1.25 | 625.0 | Broad and narrow leaves | Hoechst | Post- emergence | 30 days | Seedling stage |
| Sinal 10 SC | Metosulam | (N-[2,6-dichloro-3-methyl phenyl]-5,7-dimethoxy-[1,2,4] Triazolo[1,5a] pyrimidine-2-sulphonamide) | 0.04 | [illegible] | Broad leaves | Dow | Post- emergence | 30 days | Seedling stage |
| Lentagran 600 EC | Pyridate | (O(6-chloro-3-phenyl-4-pyridazinyl-S-octyl carbonothioate) | 0.70 | 315.0 | Broad leaves | CIBA-Geigy | Post- emergence | 30 days | Seedling stage |
| Iloxan EC | Diclofop-methyl | methyl-2-[4-(2,4-dichlorophenoxy)phenoxy]propanoate | 1.00 | 360.0 | Narrow leaves | AgrEvo | Post- emergence | 30 days | Seedling stage |
| Grasp 10% EC | Tralkoxydim | (2[1-ethoximino propyl]-3-hydroxyl-5(2,4,6 trimethyl-1-phenyl-1-cylohox-2-enone) | 1.00 | 100.0 | Narrow leaves | Dow | Post- emergence | 30 days | Seedling stage |
| Sinal + Grasp | -- | -- | 0.027+0.66 | 2.7+66.0 | Broad and narrow leaves | -- | Post- emergence | 30 days | Seedling stage |
| Sinal + Iloxan | -- | -- | 0.027+0.66 | 2.7+237.6 | Broad and narrow leaves | -- | Post- emergence | 30 days | Seedling stage |
| Lentagran + Grasp | -- | -- | 0.23+0.66 | 103.5+66.0 | Broad and narrow leaves | -- | Post- emergence | 30 days | Seedling stage |
| Lentagran + Iloxan | -- | -- | 0.23+0.66 | 103.5+237.6 | Broad and narrow leaves | -- | Post- emergence | 30 days | Seedling stage |
| Hand weeding once | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Control | -- | -- | -- | -- | -- | -- | -- | -- | -- |

*fed.=feddan=4200 $m^2$

The fresh and dry weights of shoot biomass ($g/m^2$) of both groups were estimated in the two successive seasons. Wheat samples (10 plants/plot) were taken randomly at heading stage (60 days from sowing) from each plot to determine certain vegetative characteristics i.e. plant height and flag leaf area. At harvesting stage (150 days from sowing), samples of one square meter were taken from the mid-plot/treatment to determine the total grain yield per Ardab/fed. (Ardab=150 kg) and its constituents including number of spikes/$m^2$, spike length (cm), number of spikelets/spike, number of grains/spike, grain weight/spike (g) as well as the straw yield by per ton/fed.).

The total crude protein content was determined in treated and untreated grains according to A.O.A.C. (1980). While, phosphorus and potassium contents were estimated according to Cottenie *et al.*, (1982).

The biological activity of applying herbicides either alone or subsequently on suppressing weeds growth and increasing grain yield, yield components and NPK contents of wheat grains was estimated according to the equation of Itokawa *et al.*, (1982). The data obtained during the two successive seasons were subjected to analyzing variation between different treatments at 5% probability according to Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

### Effect of herbicides on growth and development of weeds

The effect of the six selective post-emergence herbicides either applied alone or followed by each other subsequently at different rates of application on growth and development of weeds associated with wheat is shown in Table (2). It was obvious that the herbicides were fluctuated in their effects on controlling such annual weeds infested wheat either they applied alone or subsequently within the two successive seasons. Foliar application of the herbicides alone killed a wide range of broad and narrow leaved weeds such as beet (*Beta vuligars* L.), sweetclover (*Melilotus indica* L.), lambsquarter (*Chenopodium album* L.), ammi (*Ammi majus* L.), Dock (*Rumex dentatus* L.), oat (*Avena fatua* L.), ryegrass (*Lolium temulentum* L.) and canarygrass (*Phalaris minor* L.). Spraying Panther (0.6 L/fed.) and Arelon (1.25 L/fed.) alone gave excellent results for controlling either broad or narrow leave weeds, which were estimated by up to 98 and 86%, respectively as compared with control. Less response was obtained with applying broad (Sinal; Lentagran) or narrow (Iloxan; Grasp) herbicides. In this regards, applying Sinal and Lentagran at 0.04 and 0.7 L/fed., respectively was good for controlling broad- leaved weeds such as *C. album*, *B. vuligars*, *M. indica*, *A. majus* and *R. dentatus*; no phytotoxicity was observed with grassy weeds. Meanwhile, spraying Iloxan and Grasp at (1 L/Fed./each) were only effective on controlling narrow leaved weeds such as *A. fatua*, *L. temulentum* and *P minor*.

**Table (2): Effect of herbicides on growth and development of weeds associated with wheat in the two successive seasons.**

| Treatments | Conc. (L/ fed.) | 1st season (2004) | | | | | | | | 2nd season (2005) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fresh weight (g/m²) | | | | Dry weight (g/m²) | | | | Fresh weight (g/m²) | | | | Dry weight (g/m²) | | | |
| | | Broad leaf | Inhibition (%) of control | Narrow leaf | Inhibition (%) of control | Broad leaf | Inhibition (%) of control | Narrow leaf | Inhibition (%) of control | Broad leaf | Inhibition (%) of control | Narrow leaf | Inhibition (%) of control | Broad leaf | Inhibition (%) of control | Narrow leaf | Inhibition (%) of control |
| Panther 55%SC | 0.60 | 10.00 | 97.50 | 10.00 | 85.76 | 1.58 | 97.48 | 2.50 | 85.79 | 15.25 | 96.08 | 20.00 | 80.03 | 2.37 | 96.11 | 5.03 | 79.97 |
| Arelon 50% FL | 1.25 | 12.10 | 96.98 | 19.75 | 71.88 | 1.87 | 97.01 | 4.98 | 71.70 | 16.00 | 95.89 | 23.75 | 76.36 | 2.50 | 95.89 | 5.95 | 76.31 |
| Sinal 10 SC | 0.04 | 5.00 | 98.75 | 62.50 | 11.03 | 0.80 | 98.72 | 15.65 | 11.07 | 7.00 | 98.20 | 72.50 | 27.86 | 1.10 | 98.19 | 18.13 | 27.82 |
| Lentagran 600 EC | 0.70 | 5.00 | 98.75 | 65.00 | 7.47 | 0.80 | 98.72 | 16.25 | 7.670 | 8.00 | 97.94 | 80.00 | 20.39 | 1.28 | 97.89 | 20.02 | 20.30 |
| Iloxan EC | 1.00 | 240.0 | 40.18 | 5.00 | 92.88 | 37.50 | 40.19 | 1.3.00 | 92.61 | 250.2 | 35.83 | 15.00 | 84.97 | 39.10 | 35.82 | 3.78 | 84.95 |
| Grasp 10% EC | 1.00 | 250.0 | 37.69 | 5.00 | 92.88 | 39.08 | 37.67 | 1.3.00 | 92.61 | 260.0 | 33.33 | 16.25 | 83.83 | 40.63 | 33.31 | 4.07 | 83.79 |
| Sinal + Grasp | 0.027 +0.66 | 18.00 | 95.51 | 23.00 | 67.25 | 2.83 | 95.48 | 5.77 | 67.21 | 19.75 | 94.93 | 30.00 | 70.14 | 3.08 | 94.94 | 7.52 | 70.06 |
| Sinal + Iloxan | 0.027 +0.66 | 23.50 | 94.14 | 32.50 | 53.73 | 3.68 | 94.13 | 8.15 | 53.69 | 25.50 | 93.46 | 40.25 | 59.95 | 4.00 | 93.43 | 10.10 | 59.79 |
| Lentagran + Grasp | 0.23+ 0.66 | 25.00 | 93.76 | 37.00 | 47.33 | 3.90 | 93.77 | 9.28 | 47.27 | 29.0 | 92.56 | 44.00 | 56.21 | 4.53 | 92.56 | 11.02 | 56.13 |
| Lentagran + Iloxan | 0.23+ 0.66 | 26.00 | 93.52 | 38.00 | 45.90 | 4.10 | 93.46 | 9.50 | 46.02 | 30.00 | 92.30 | 45.25 | 54.97 | 4.70 | 92.28 | 11.35 | 54.81 |
| Hand weeding once | | 27.50 | 93.14 | 38.75 | 44.83 | 4.30 | 93.14 | 9.73 | 44.71 | 32.75 | 91.60 | 46.00 | 54.22 | 5.13 | 91.58 | 11.52 | 54.14 |
| Control | | 401.2 | -- | 70.25 | -- | 62.70 | -- | 17.6 | -- | 390 | -- | 100.5 | -- | 60.93 | -- | 25.12 | -- |
| L.S.D. at | | 18.31 | -- | 3.30 | -- | 2.05 | -- | 0.58 | -- | 6.30 | -- | 4.05 | -- | 1.03 | -- | 0.83 | -- |

Applying Sinal or Lentagran followed by Iloxan and Grasp at low concentrations (< recommended dose) gave, to a large extent, similar results Firstly to the same herbicides when applied alone at higher concentrations for controlling broad and narrow leave weeds, Secondly to Panther and Arelon herbicides those being used as a selective herbicides for controlling both types of weed as compared with control. Hand weeding in comparison with other weedicides treatment was consistently effective in controlling broad- leaved weeds by up to 93%, but relatively was less efficient in reducing grassy weeds (up to 54%).

**Effect of herbicides on wheat growth, yield and its components**

It was found that applying the six herbicides substantially increased the vegetative growth of wheat plants including plant height and flag leaf area either they applied alone or subsequently as compared with control (Figure 1). No much significant differences were observed between applying single, duplicated herbicides or hand weeding treatment on increasing plant height or flag leaf area in the two successive seasons. Panther (0.6 L/fed.) and Arelon (1.25 L/fed.) were the most effective amongst other treatments in increasing plant height and flag leaf area, which was estimated by up to 22%, while, applying Sinal and Lentagran or Grasp and Iloxan alone showed less response in this issue. Spraying Sinal (0.027 L/fed.) or Lentagran (0.23 L/fed.) followed by Grasp and Iloxan at (0.66 L/fed./each) potentially increased the wheat vegetative growth by up to 20%, meanwhile, hand weeding once resulted in increasing growth by 12% within the two successive seasons.

The effect of applying the herbicides either alone or subsequently followed by each other on increasing wheat yield and its components are given in Table (3) and Figure (2). It was clear that all herbicides and hand weeding treatment substantially increased the grain yields and its constituents e.g. number of spikes/$m^2$, spike length, number of spikelets/spike, number of grains/spike and grain weight/spike. Foliar application of Sinal (0.04 L/fed.) and Lentagran (0.7 L/fed.) or Grasp (1 L/fed.) and Iloxan (1 L/fed.) alone were superficially the lowest efficient in increasing wheat yield and its components as compared with other treatments or control. Using Sinal or Lentagran in consequence with Grasp and Iloxan showed superiority as much as applying Panther and Arelon at 0.6 and 1.25 L/fed., respectively on increasing grain yield (54-62%) and its components (19-53%). Hand weeding fairly increased the grain yield and its constituents by up to 53% as compared with other weedicides treatment. Overall, the herbicides or hand weeding significantly increased the straw yield by 10-41% as compared with control; irrespective of the sort of application within the two successive seasons.

**Effect of herbicides on NPK contents in grain of wheat**

The results on increasing protein, phosphorus and potassium contents (NPK) in grains of wheat in response to weedy control treatments are shown in Figure (2).

**Table (3): Effect of herbicides on wheat yield and its components in the two successive seasons.**

| Treatments | Conc. (L/ fed.) | 1st season (2004) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NO. of spikes/m² | Spike length (cm) | No. of spikelets/ spike | No. of grains/ spike | Weight of grains/ spike (g) | Straw yield (Ton/fed.) | Grain yield (Ardab/ fed.) | Increasing (%) of control | | | | | |
| | | | | | | | | | NO. of spikes/m² | Spike length | No. of spikelets/ spike | No. of grains/ spike | Weight of grains/ spike | Straw yield | Grain yield |
| Panther 55%SC | 0.60 | 465.00 | 12.00 | 21.75 | 56.00 | 3.00 | 5.07 | 23.68 | 31.26 | 41.17 | 31.81 | 35.75 | 71.42 | 40.83 | 65.47 |
| Arelon 50% FL | 1.25 | 461.50 | 11.75 | 21.25 | 55.00 | 2.83 | 5.04 | 23.43 | 30.27 | 38.23 | 28.78 | 33.33 | 61.71 | 40.00 | 63.73 |
| Sinal 10 SC | 0.04 | 447.50 | 10.25 | 19.50 | 50.00 | 2.40 | 4.35 | 20.23 | 26.32 | 20.58 | 18.18 | 21.21 | 37.14 | 20.83 | 41.36 |
| Lentagran 600EC | 0.70 | 445.50 | 10.00 | 19.25 | 49.00 | 2.38 | 4.26 | 19.50 | 25.75 | 17.64 | 16.66 | 18.78 | 36.00 | 18.33 | 36.26 |
| Iloxan EC | 1.00 | 443.25 | 9.75 | 18.75 | 48.00 | 2.33 | 4.20 | 19.20 | 25.12 | 14.70 | 13.63 | 16.36 | 33.14 | 16.66 | 34.17 |
| Grasp 10% EC | 1.00 | 437.50 | 9.50 | 18.00 | 47.25 | 2.24 | 3.97 | 19.00 | 23.50 | 11.76 | 9.09 | 14.54 | 28.00 | 10.27 | 32.77 |
| Sinal+Grasp | 0.027+ 0.66 | 460.00 | 11.50 | 21.00 | 54.50 | 2.68 | 4.95 | 23.09 | 29.85 | 35.29 | 27.27 | 32.12 | 53.14 | 37.50 | 61.35 |
| Sinal+Iloxan | 0.027+ 0.66 | 456.25 | 11.25 | 20.75 | 54.00 | 2.63 | 4.92 | 22.69 | 28.79 | 32.35 | 25.75 | 30.90 | 50.28 | 36.66 | 58.56 |
| Lentagran+Grasp | 0.23+ 0.66 | 454.25 | 11.00 | 20.50 | 53.00 | 2.60 | 4.89 | 22.50 | 28.22 | 29.41 | 24.24 | 28.48 | 48.57 | 35.83 | 57.23 |
| Lentagran+Iloxan | 0.23+ 0.66 | 452.00 | 10.75 | 20.25 | 52.25 | 2.50 | 4.65 | 22.00 | 27.59 | 26.47 | 22.72 | 26.66 | 42.85 | 29.16 | 53.73 |
| Hand weeding once | | 450.00 | 10.50 | 20 | 51.25 | 2.48 | 4.50 | 20.97 | 27.02 | 23.52 | 21.21 | 24.24 | 41.71 | 25.00 | 46.54 |
| Control | | 354.25 | 8.50 | 16.5 | 41.25 | 1.75 | 3.60 | 14.31 | -- | -- | -- | -- | -- | -- | -- |
| L.S.D. 5% | | 1.90 | 0.66 | 0.60 | 2.04 | 0.034 | 0.07 | 0.49 | -- | -- | -- | -- | -- | -- | -- |

**Table (3): Effect of herbicides on wheat yield and its components in the two successive seasons.**

| 2nd season (2005) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Increasing (%) of control | | | | | | |
| NO. of spikes/m² | Spike length (cm) | No. of spikelets/ spike | No. of grains/ spike | Weight of grains/ spike (g) | Straw yield (Ton/fed.) | Grain yield (Ardab/fed.) | NO. of spikes/m² | Spike length | No. of spikelets/ spike | No. of grains/ spike | Weight of grains/ spike | Straw yield | Grain yield |
| 468.00 | 12.25 | 22.25 | 57.00 | 3.13 | 5.00 | 24.39 | 26.40 | 40.00 | 28.98 | 34.91 | 65.60 | 36.98 | 66.37 |
| 466.25 | 12.00 | 21.50 | 56.25 | 2.86 | 4.97 | 24.13 | 25.92 | 37.14 | 24.63 | 33.13 | 51.32 | 36.16 | 64.59 |
| 450.00 | 10.50 | 19.75 | 50.50 | 2.48 | 4.40 | 19.83 | 21.53 | 20.00 | 14.49 | 19.52 | 31.21 | 20.54 | 35.26 |
| 448.00 | 10.25 | 19.00 | 49.50 | 2.45 | 4.30 | 19.58 | 20.99 | 17.14 | 10.14 | 17.15 | 29.62 | 17.80 | 33.56 |
| 445.00 | 10.00 | 18.75 | 48.75 | 2.43 | 4.17 | 19.18 | 20.18 | 14.28 | 8.69 | 15.38 | 28.57 | 14.24 | 30.83 |
| 442.00 | 9.75 | 18.50 | 47.5 | 2.38 | 4.12 | 18.14 | 19.37 | 11.42 | 7.24 | 12.42 | 25.92 | 12.87 | 23.73 |
| 462.50 | 11.75 | 21.25 | 55.00 | 2.75 | 4.93 | 23.81 | 24.91 | 34.28 | 23.18 | 30.17 | 45.50 | 35.06 | 62.41 |
| 460.50 | 11.50 | 21.00 | 54.50 | 2.73 | 4.85 | 23.63 | 24.37 | 31.42 | 21.73 | 28.99 | 44.44 | 32.87 | 61.18 |
| 457.50 | 11.25 | 20.75 | 53.75 | 2.68 | 4.82 | 23.40 | 23.56 | 28.57 | 20.28 | 27.21 | 41.79 | 32.05 | 59.61 |
| 455.50 | 11.00 | 20.50 | 52.50 | 2.58 | 4.75 | 22.50 | 23.02 | 25.71 | 18.84 | 24.26 | 36.50 | 30.13 | 53.47 |
| 453.75 | 10.75 | 20.25 | 52.00 | 2.53 | 4.56 | 22.41 | 22.55 | 22.85 | 17.39 | 23.07 | 33.86 | 24.93 | 52.86 |
| 370.25 | 8.75 | 17.25 | 42.25 | 1.89 | 3.65 | 14.66 | -- | -- | -- | -- | -- | -- | -- |
| 1.62 | 0.52 | 0.52 | 1.76 | 0.02 | 0.06 | 0.41 | -- | -- | -- | -- | -- | -- | -- |

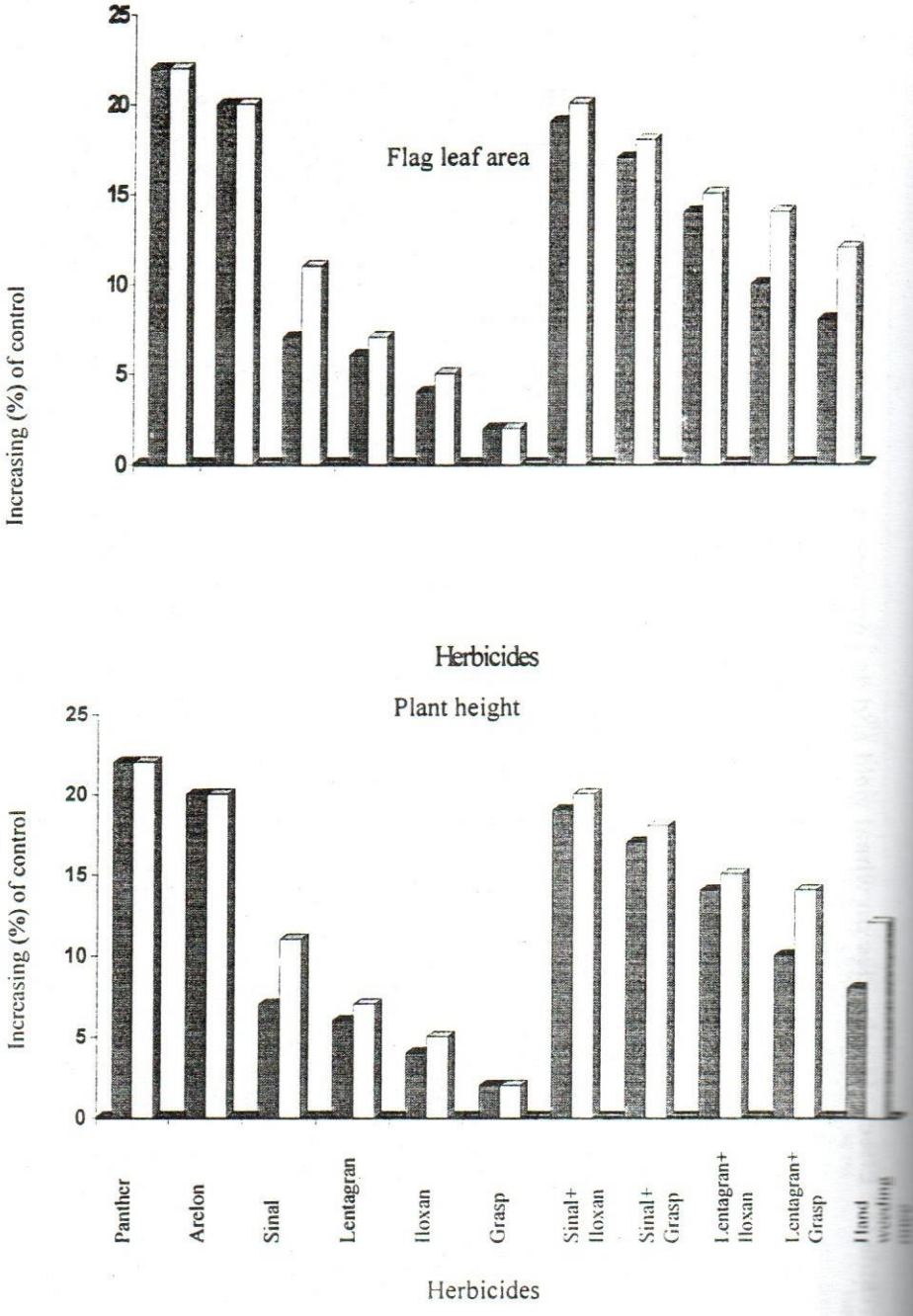


Figure (1): Herbicidal effect on certain vegetative characteristics of heading stage of wheat crop.

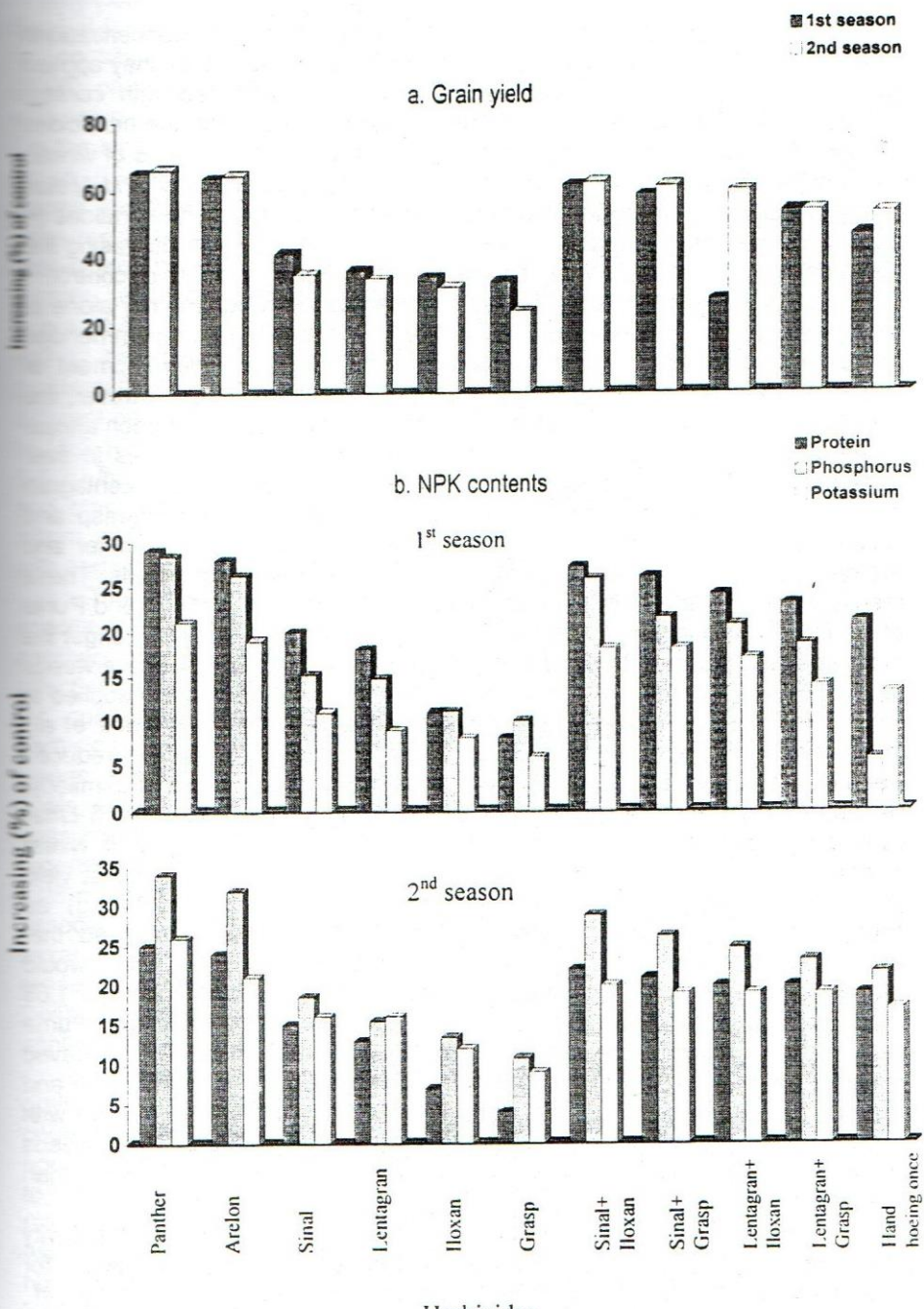


Figure (2): Herbicidal effects on yield (a) and NPK contents (b) of grain of wheat crop.

It was obvious that applying the herbicides at different concentrations satisfactory increased the NPK contents of wheat grains, either they applied alone or more than one time (subsequently) as compared with control. However, it was noted that there is no wide variation between the herbicides themselves and/or hand weeding in raising such contents in grains of wheat, irrespective of the rate and type of application. Applying Panther and Arelon and/or using more than one herbicide in sequences at low concentrations (< recommended dose) remains the most effective treatments in increasing the NPK contents by (up to 29%) as compared with other treatments or control.

It was evident that applying the six selective herbicides either alone at recommended dose or subsequently at low concentrations (< recommended dose) gave promising results in suppressing growth and development of weeds as well as increasing wheat yield and its components. However, the fluctuation between the herbicides in controlling a wide range of such annual broad and narrow leave weeds may be related to the differences in their selectivity toward the target weeds. For instance, Sinal and Lentagran herbicides were the best for controlling broad- leaved weeds, Grasp and Iloxan were the most efficient for grassy weeds, meanwhile, Panther and Arelon had a special advantage for controlling both types of weeds. These results were coincide with those obtained by Ahmed *et al.*, (1993) and Punia *et al.*, (1993) who indicated that Arelon (1 kg or 1.85 L/ha) were amongst the most effective treatments used in controlling broad and narrow leave weeds (e.g. *Chenopodium* sp. and *Avena* sp.) in wheat, particularly when applied at the 2-3 leave stage of weed growth (Hallgren *et al.*, 1991a). Akhatar *et al.*, (1991) found that applying Arelon 75 WP at (2 kg/ha) substantially reduced weed biomass from untreated control values of 114.9 g/m to 5.51g. Similarly, Hassan *et al.*, (1994) illustrated that Arelon at the higher rates (1.75 L/ha) completely eradicated broad- narrow leave weeds associated with winter wheat about one month after foliar application, however, the greatest yield (3.75 T/ha) was recorded with the lower concentration (0.87 kg) as compared with untreated control. In contrast, Ravn (1984) claimed that Arelon herbicide was effective only against grasses, suggesting that it would be better to use Arelon in combination with Stomp at a concentration of 1.85 kg/ha or even with others such as Diflufenican, Assert, Grasp and Puma herbicides to obtain wider efficiency covering grasses and broad-leaved weeds as well (Hallgren *et al.*, 1991b; Salembier, 1990). Adamezewski and Paradowski (1988) reported that using Arelon (2 kg/ha) in tank mixture with X-Pand (0.6 L) gave promising results for controlling broad-leaved weeds (87.8-89.9%) and increasing yield from 4.33 T/ha to 5.48-5.66 T than applying it alone.

Sinal (Metasulam) and Lentagran (Pyridate) are, in terms of selectivity and weed control, highly sophisticated herbicides designed preliminary for controlling broad- leaved weeds in cereal crops (Swed, 1991; Sultan *et al.*, 1999). In this regards, Drazic *et al.*, (1987) demonstrated that Lentagran WP provided good control for broad leave weeds e.g. *Sinapis arvensis* and *Chenopodium album* that aggressively attack wheat field, but the negative effect on the vegetative growth of wheat as well as yield and its constituents were discouraging. El-Metwally (2002) assumed that Lentagran WP and

Sinal at 0.7 and 0.04 L/fed., respectively are the most preferable herbicides for controlling broad leave weeds in winter wheat. Recently, Saad *et al.*, (2003) provided evidence that Sinal at 0.04 L/fed. was more than 90% efficient in reducing broad leave weeds when compared with grasses (25%). On the other hand, several workers revealed that Grasp (Tralkoxydim) and Illoxan (Diclofop-methyl) were the most reliable herbicides for controlling grassy weeds in wheat (Tzamir *et al.*, 1988; Tag-El-Din, 1989). Grasp has been registered in different countries e.g. France and Egypt as a selective post-emergence herbicides for controlling narrow leave weeds troublesome cereals i.e. wheat and barley (Eschenbrenner, 1990; Fayed *et al.*, 1998). Rola *et al.*, (1993) reported that applying Grasp and Illoxan at 0.25 and 1 kg/ha, respectively potentially suppressed the growth of the most problematic grassy weeds *Avena ludoviciana* that strongly hits wheat field in different parts of the world from untreated control value of 192.8-394.5 g $m^{-2}$ to 15.2-166.5 g. Nowicka and Rola (1994) described that spraying Grasp at 1-1.2 L/ha resulted in satisfactory control of *Avena fatua* weed populations and other troublesome weeds such as *Galinsoga parviflora*, *Cenopodium album* and *Polygonum convolvulus*, particularly when used in combination with certain adjuvant (e.g. Atplus and Olbras) or herbicides such as Optica.

The results seem to indicate that applying more than one of the specific herbicides e.g. one selective for broad- leaved weeds followed by another one for grassy weeds at sub-recommended dose were equally effective to substitute those herbicides applied alone at high concentrations for controlling weeds infested wheat particularly Panther and Arelon herbicides, the most recommendable for controlling broad and narrow leave weeds in cereals. This, hopefully, reflected on achieving two main valuable goals, effective weed control and saving our health and media from the over consumption of synthetic herbicides. In this context, Faris *et al.*, (1988) reported that spraying Illoxan at 750 ml/donam followed by 2,4-D amine at 1.25 ml provided excellent control for grasses as well as broad leave weeds associated with wheat, meanwhile, the individual application of the herbicide Illoxan (750 ml/donam) or Grasp (425 ml/donam) was effective only against grasses. Ahmed *et al.*, (1991) revealed that Arelon in combination with Dosanex was more efficient in controlling weeds infested wheat than applying either herbicide alone, even they used at higher concentrations.

Increasing the yield and its components as well as NPK contents in grain of wheat in response to the herbicidal application or hand weeding could be explained in term of reducing the growth and density of weed populations associated with wheat plants which giving them the opportunity to grown more vigoursly. Similar results were obtained by Rastogi *et al.*, (1984) who attributed the increasing occurred in grain yield (up to 33%) of wheat as a results of applying Isoproturon (Arelon & Tolkan formula) herbicides to the greatest reduction in the growth and development of surrounding weeds which was estimated by 51-62%. Additionally, applying Illoxan at 3-4 leaf stage yielded more than 3.4 T/ha against 2 T in untreated plot for the same reason (Anonymous, 1983). Ahmed *et al.*, (1993) reported that using Isoproturon herbicide in controlling wheat's weed was promising for increasing the yield components (e.g. weight of 100 grains), which

subsequently reflected in increasing the total grain yield to 4.86 T/ha against 4 T for control. Dabec-Gad and Bujak (2002a, b) explained that the increasing in grain yield in response to Arelon and other related herbicides was just about a consequence of increasing ear density per $m^2$, number and weight of grains per ear and 100 grain weight. Supporting view was recorded by Akhatar *et al.*, (1991) and Khalil *et al.*, (2000) who confirmed that Arelon produced more fertile tiller density coupled with more grains per spike at all level of concentrations than the untreated control, however, the maximum values of such parameters were obtained, in particular, at the highest rate (2.47 L/ha) of herbicide application. Punia *et al.*, (1993) found that Arelon (Isoproturon), Grasp and Iloxan herbicides substantially increased the total grain yield of wheat treated field by more than 5 T/ha. Recently, El-Metwally (2002) found good results with applying Metosulam, Lentagarn, Grasp and Isoproturon herbicides in increasing the grain yield of wheat and its components, either they applied alone or in tank mixture, suggesting that the significant reduction in growth and intensity of associated weeds were the real reason behind increasing the tellering capacity, number of spikes $m^{-2}$ and hence the total grain yield.

From the obvious results it can be suggested that using more than one herbicide in subsequent application at low concentrations (< recommended dose) would be more efficient for controlling wide range of mono and dicotyledonous weeds infested wheat crop than being used alone at higher concentrations.

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# فاعلية بعض مبيدات الحشائش الاختيارية في مكافحة الحشائش ورفع إنتاجية محصول القمح (*Triticum aestivum* L.)

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أجريت تجربتان حقليتان بمزرعة المركز القومي للبحوث بشلقان- محافظة القليوبية لدراسة تأثير ٦ أنواع من المبيدات الاختيارية في مكافحة الحشائش الحولية ورفع إنتاجية محصول القمح. استخدم في ذلك اثنين (Sinal 10 SC ; Lentegran 600 EC) من المبيدات المتخصصة لمكافحة الحشائش عريضة الأوراق ، و أل Grasp 10 SC; Iloxan EC للحشائش العشبية ، في حين استخدم أل Panther SC; Arelon FL لمكافحة كلا النوعين من الحشائش. استخدمت المبيدات رشا علي المجموع الخضري كمعاملات ما بعد الإنبات سواء في صورة منفردة أو علي التوالي يعقب بعضها بعضا وذلك عند تركيزات مختلفة منها. أظهرت غالبية المبيدات المستخدمة تأثيرا جوهريا واضحا في خفض نمو وتطور مدي واسع من الحشائش عريضة وضيقة الأوراق المصاحبة لنمو القمح. كان للمعاملة الورقية بمبيدات أل Arelon ; Panther عند تركيزات 0.6; 1.25 L/fed. علي التوالي افضل الأثر في قمع نمو وتطور الحشائش عريضة (up to 98%) وضيقة (up to 86%) الأوراق وكذلك رفع إنتاجية محصول القمح بما يقدر ب 71% وذلك إذا ما قورنت بغيرها من معاملات مبيدات الحشائش الأخرى أو الكنترول. كما أن استخدام أل Sinal أو Lentagran في تتابع علي التوالي مع Grasp و Iloxan عند تركيزات اقل من الموصي بها أعطى نتائج مماثلة إلى حد بعيد لتلك المبيدات التي استخدمت علي حدة وعند تركيزات مرتفعة منها في مكافحة الحشائش وزيادة محصولية حبوب القمح بما يقدر ب (53-62%) مقارنة بالكنترول. أدت معاملة النقاوة اليدوية لمرة واحدة أيضا إلى نتائج جيدة (45-93%) في الحد من نمو الحشائش عريضة وضيقة الأوراق بالقمح وكذلك رفع إنتاجية المحصول بمقدار 47-53%. كما تسببت المعاملة بمبيدات الحشائش إلى حد سواء في رفع محتوي حبوب القمح من عناصر أل NPK ، بصرف النظر عن معدل ونوع المعاملة سواء عند المقارنة بمعاملة ازالة الحشائش باليد أو الكنترول. ويستنتج من ذلك أن استخدام اكثر من مبيد من المبيدات الاختيارية عند تركيزات اقل من الموصى بها قد يكون اكثر فاعلية في مكافحة مدي واسع من الحشائش المداهمة لمحصول القمح عنة إذا ما استخدمت بصورة منفردة وحتى عند التركيزات العالية منها.