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INFLUENCE OF SOME HERBICIDES ON BARLEY YIELD, YIELD COMPONENTS AND THE COMMON ASSOCIATED WEEDS

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ABSTRACT

This investigation was carried out at the Agricultural Station of the National Research Centre at Shalakan, Kalubia Governorate, Egypt. through two successive seasons (1997/98 and 1998/99) to study the influence of some herbicides on barley yield, yield components and the common associated weeds. The results showed that hand weeding and Isoproturon as well as Bentazon at the high dose were very effective in controlling the most annual weeds up to 80 days after barley sowing in both seasons. Chlorotoluron, Bentazon and Bromofenoxin as well as hand weeding treatment gave the best broad-leaved weed control more than the other treatments. While, Isoproturon and hand weeding treatments showed the best grass weed control in both seasons compared to the other treatments. Foliar application of Isoproturon at 0.650 kg a.i./fed, Bromofenoxin at 0.500 kg a.i./fed and hand weeding treatment improved the growth of barley plants and produced the tallest plants, the highest values of number of spikes/m², spike length, number of spikelets/spike, the heaviest weight of 1000-grain and the highest grain and straw yields/fed compared with the other treatments in both seasons. All weed control treatments achieved an increase in protein, phosphorus, potassium and total carbohydrates percentage of barley grains when compared with unweeded check.

INTRODUCTION

Recently, barley (*Hordeum vulgare, L.*) occupy a prime interest in newly cultivated or reclaimed areas in Egypt, as it has the capability of bearing drought, heat or salt stress. Weeds are considered as a major problem in barley fields. Weeds not only compete with a crop plants for their essential requirements, resulting in crop yield reduction, but also they cause harvesting problems and increasing the cost of this operation. Therefore, weed control especially in the early growth stages are essential for successful yield. Herbicides have been introduced to barley fields for controlling the weeds and increasing the barley yields (Landes, 1990; Diaz *et al*., 1991; Black *et al*., 1994 and Barhoma and Kholosy, 1996). Some workers have been reported that the best weed control and highest grain yield of barley were achieved by application of Isoproturon (Berger and Heitefuss, 1990 and Owino *et al*., 1992), Bromofenoxin (Vouzounis and Americanos, 1995), Bentazon (Young *et al*., 1990 and Jenneus, 1991) and Chlorotoluron (Diaz *et al*., 1991 and Kemmer and Hurle, 1991).

The aim of this work was to study the influence of some herbicides on barley yield, yield components and the common associated weeds.

MATERIALS AND METHODS

Two field trials were carried out in the Agricultural Experimental Station of the National Research Centre at Shalakan, Kalubia Governorate, Egypt, through two successive seasons of 1997/98 and 1998/99 to study the influence of some herbicides on barley yield, yield components and the common associated weeds. The soil texture was clay loam. The experimental unit area was 10.5 m². Grains of barley (*Hordeum vulgare, L.*) cv. Giza 125 were used in both seasons. The sowing dates were Nov. 19 and 17 for the first and second seasons, respectively. The recommended cultural practices for barley plants maintenance were applied properly in both seasons. The trial included 10 treatments (Table1) were arranged in a randomized complete block design with four replicates. Herbicides tested were: Chlorotoluron (Dicuran 80 WP) (3-(3-chloro-p-tolyl)-1,1-dimethyl urea), Bromofenoxin (Faneron 50 WP) [3,5-dibromo-4-hydroxybeni aldehyede-O-(2,4-dinitrphenyl)-oxime.], Bentazon (Basagran 48 % EC) (3-isopropyl-IH-2,1,3-bnzothiodiazin-(4)3H-one-2,2-dioxide), Isoproturon (Arelon 50 % EC) (3-(4-isoproylphenyl)-1,1-dimethyl urea), each alone at two doses. The herbicidal treatments were compared with the hand weeding twice at 30 and 45 days from sowing and the unweeded check. Herbicides were foliarly applied by kanpsack sprayer using a volume rate of 200 litters water/fed, at 3-4 leaf stage (30 days from sowing) of barley plants. Two weed samples from an area of one square meter were randomly taken from each plot after 60 and 80 days from sowing in both seasons. Weeds were identified and classified into annual broad-leaves and annual grasses. Fresh weight of weeds was recorded and the dry weight of weeds was determined after drying in a forced draft oven at 70°C for 48 hours. At harvest time, samples of one squre meter were randomly taken from each plot to measure, plant height, number of spikes/m², spike length (cm), number of spikelets/spike and 1000-grain weight (g). The grain and straw yields were taken from one square meter and calculated in feddan. For determining protein percentage in grains; total nitrogen content was determined according to the method described by Yeun and Follard (1952). N values were multiplied by the factor of 5.83 to obtain the protein percentage. Phosphorus and potassium percentage in grains were determined according to (Cottenie, *et al*., 1982). Total carbohydrate in grains was determined according to (Dubois *et al*., 1956). Combined data for both growing seasons were statistically analyzed according to Little and Hills (1978).

RESULTS AND DISCUSSION

A. Weed control :

A.1. Annual broad-leaved weeds :

The most common broad-leaved weeds in barley field through the two experimental seasons were : *Medicago hispida* (Gaerth), *Ammi majus, L.; Melilotus indicus, L.; Beta vulgaris, L.* and *Rumex dentatus, L*. Data in Table (1) revealed that all treatments decreased significantly the dry weight of

annual broad-leaved weeds compared to the unweeded check after 60 and 80 days from sowing in both seasons.

After 60 days from sowing Bentazon, Chlorotoluron and Bromofenoxin at high dose showed the best control of annual broad-leaved weeds (Over 91.18 %) as compared with unweeded check. Whereas, hand weeding achieved 84.69 % control. Except Isoproturon at low dose, the rest herbicidal treatments were in the second rank (73.57 – 88.54 %) Table (2).

After 80 days from sowing, Chlorotoluron at high dose gave the best control, depressing the growth of the annual broad-leaved weeds by 88.98 %. While, hand weeding gave 80.15 % as compared with unweeded check. On the other side, Isoproturon at low dose was less effective than other treatments, giving 63.8% control. The other herbicidal treatments were in between (70.02 – 80.54 %) Table (2).

As previously mentioned, it is clear from the results that the foliar application of Chlorotoluron at 0.400 or 0.600 kg a.i./fed, Bentazon at 0.624 kg a.i./fed and Bromofenoxin at 0.500 kg a.i./fed as well as hand weeding treatment showed superiority in controlling annual broad-Leaved weeds up to 60 and 80 days after barley sowing. These, results are in coincide with those detected by Young *et al*. (1990), Kemmer and Hurle (1991), Vouzounis and Americanos (1995) and Metwally *et al*. (1999).

A.2. Annual grass weeds :

During the two growing seasons of barley crop, the major annual grass weeds were : *Lolium temulentum, L., Avena fatua, L*., and *Phalaris minor* (Retz). Data presented in Table (1) showed that all weed control treatments significantly reduced the dry weight of annual grass weeds compared with unweeded check at 60 and 80 days from sowing in both seasons.

After 60 days from sowing, it is evident that Isoproturon at the two doses and hand weeding treatment as well as Bentazon at high dose showed the best grass weed control, they achieved 89.19, 83.61, 81.88 and 75.52 % respectively, as compared with unweeded check. While, Chlorotoluron and Bromofenoxin at the low doses were significantly lower than the hand weeding treatment. The remaining treatments were statistically similar with the hand weeding treatment and reduced the dry weight of annual grasses by 68.80 – 70.85 % (Table 2).

After 80 days from sowing, the same trend was observed, it could be concluded that a foliar application of Isoproturon at 0.650 kg a.i./fed and hand weeding treatment were more effective for controlling the annual grass weeds than the other treatments, they gave 83.68 and 81.53 % control, respectively. Moreover, Isoproturon at 0.500 kg a.i./fed or Bentazon at 0.624 kg a.i./fed gave satisfactory control for grassy weeds, (78.43 – 71.02 % control) Table (2). Similar results were reported by Rastogi *et al*. (1984), Owino *et al* (1992), Chueca *et al*. (1995) and Metwally *et al*. (1999).

1

A.3. Total annual weeds :

Data recorded in Tables (1 and 2) show that significant differences among the various weed control treatments for the two tested stages in both seasons. All herbicidal treatments and hand weeding treatment significantly caused a reduction in dry weight of total annual weeds more than unweeded control. Generally, the two tested samples (60 and 80 days after sowing), through the two successive seasons showed that treatments of hand weeding, foliar application of Isoproturon at 0.650 kg a.i./fed or Bentazon at 0.624 kg a.i./fed were very effective in controlling the most annual weeds compared to the other treatments. Moreover, Chlorotuluron at 0.600 kg a.i./fed and Bromofenoxin at 0.500 kg a.i./fed gave satisfactory control for total annual weeds up to 80 days after sowing. These results are in harmony with those obtained by Said *et al*. (1989), Berger and Heitefuss (1990), Landes (1990), Kemmer and Hurle (1991), Vouzounis and Americanos (1995) and Metwally *et al*. (1999).

B. Yield and yield components of barley :

B.1. Plant height (cm) :

Results in Table (3) show that all weed control treatments significantly surpassed unweeded check in both seasons. Plant height ranged from 90.5 to 104.1 cm. Hand weeding treatment and Isoproturon at two doses gave the tallest barley plants compared to the other treatments. This, may be due to the excellent control of weeds which minimized weed competition with the crop giving good chance for barley growth. On the other hand, Bromofenoxin at low dose was significantly the lowest weed control treatments. The rest treatments show significantly shorter plants than hand weeding treatment. Similar results were obtained by Berzinya (1989) and Metwally *et al*. (1999).

B.2. Number of spikes/m² :

As shown in Table (3), all weed control treatments significantly surpassed the weedy check in both seasons. The highest number of spikes/m² at harvest was obtained from Isoproturon and Bromofenoxin at high dose as well as hand-weeding treatment. This result could be attributed to the higher weed control efficiency (Tables 1 and 2), which improved the tillering capacity and increased number of spikes/m². Moreover, Bentazon at low dose, Chorotoluron at high dose and Isoproturon at low dose were statistically similar to the hand weeding. On the other side, the lowest number of spikes/m² was obtained from unweeded check. The other weed control treatments were significantly lower than hand weeding treatment. Similar results were reported by Metwally *et al*. (1999) in wheat.

B.3. Spike length (cm) :

Data in Table (3) show significant differences in spike length among various treatments. Generally, all treatments were significantly higher than unweeded check. Spike length ranged from 6.14 to 8.85 cm. The highest spike length was obtained with Isoproturon and Bromofenoxin at high dose as well as hand weeding treatment without any significant differences between them. While, Chlorotoluron and Bromoferoxin at low dose were significantly

lower spike length than other weed control treatments. All other herbicidal treatments were in between. Similar results were reported by Metwally *et al*. (1999).

B.4. Number of spikelets/spike :

Data in Table (3) reveal that all weed control treatments increased number of spikelets/spike over the unweeded control. The highest number of spikelets/spike was obtained by Isoproturon at high dose, Bentazon at low dose and hand weeding treatment compared with unweeded control. This result could be due to better weed control for the above treatments (Table 2). Moreover, Bromofenoxin at two doses gave number of spikelets/spike statistically similar with hand weeding. In contrast, the lowest number of spikelets/spike was recorded with unweeded control. The other herbicidal treatments were significantly lower than hand weeding, but were higher than unweeded control. These results are generally in agreement with those obtained by Metwally *et al*. (1999) in wheat.

B.5. 1000-grain weight :

Data recorded in Table (3) show significant differences in weight of 1000-grain as affected by various weed control treatments. In general, all treatments gave significantly an increase in weight of 1000-grain more than unweeded check. The heaviest weight of 1000-grain was obtained from Isoproturon at high dose compared to unweeded check. The increase in weight of 1000-grain induced by application of the previous herbicide may be due to the better control of annual weeds at the critical early period (Tables 1 and 2), consequently the competition between barley plants and associated weeds was decreased giving good chance for barley growth and improve the filling of grains resulting in heavier grains. While, Bromofenoxin at high dose, hand weeding, Bentazon at law dose and Chlorotoluron at high dose were in the second rank. On the other hand, the lightest weight of 1000-grain (34.50 g) was obtained from unweeded check. The other treatments were significantly lighter than hand weeding treatment. Confirming results were obtained by Metwally *et al*. (1999), who stated that the post-emergence application of Bromofenoxin, Bentazon and Isoproturon increased the weight of 1000-grain of wheat.

B.6. Grain yield (ardab/fed) :

From Table (3), its apparent that significant differences were detected among various treatments in grain yield/fed. All herbicidal treatments as well as hand weeding treatment significantly produced higher grain yield/fed than the unweeded check. Isoproturon and Bromofenoxin at high dose were the best treatments, they gave the highest grain yield/fed compared to the other weed control treatments. Such superiority is attributed to higher grain yield per unit area, which might have resulted from better weed control. Moreover, Bentazon at low dose and Chlorotoluron at high dose were statistically similar with hand weeding treatment and they ranked secondly. On the contrary, the lowest grain yield/fed (9.96 ardab) was obtained from unweeded check.

3+4

This reduction in gain yield/fed may be due to the higher weed competition in the unweeded check. The rest of herbicidal treatments gave significantly lower grain yield/fed than hand weeding treatment. From the previous results, it could be concluded that the foliar application of Isoproturon at 0.650 kg a.i./fed and Bromofenoxin at 0.500 kg a.i./fed as well as hand weeding treatment gave the highest grain yield/fed compared to the other treatments used. These results are generally in accordance with those obtained by Berzinya (1989), Berger and Heitefuss (1990), Young *et al.* (1990), Kemmer and Hurle (1991) and Metwally *et al*. (1999).

B.7. Straw yield (ton/fed) :

Data in Table (3) indicate that all weed control treatments significantly increased straw yield/fed over the unweeded check in both seasons. The highest straw yield/fed was obtained from Isoproturon at 0.650 kg a.i./fed, Bromofenoxin at 0.500 kg a.i./fed and Bentazon at 0.480 kg a.i./fed as well as hand weeding treatment, respectively as compared with unweeded check. This result might be attributed to the favourable effects exhibited by these treatments on growth characters correlated with its good efficiency in controlling barley weeds. On the other hand, the lowest straw yield/fed was obtained by unweeded check. Whereas, the other weed control treatments were statistically equal. Similar results were obtained by Metwally *et al*. (1999), who reported that the post-emergence application of Isoproturon or Bromofenoxin increased the straw yield/fed in wheat.

C. Chemical composition of grains :

Data in Table (4) show that the protein content of grains ranged from 8.48 – 10.89 %. The highest protein percentage (10.89, 10.58 and 10.26) were obtained with hand weeding, Bromofenoxin at 0.500 kg a.i./fed and Isoprotoruon at 0.650 kg a.i./fed respectively. Generally, all weed control treatments gave an increase in protein content of grains over the unweeded control. Similar trends has been obtained by Nagla Al-Ashkar (1998) and Metwally *et al*. (1999).

Regarding phosphorus and potassium percentage in grains, data in Table (4) show that all herbicidal treatments including hand weeding treatment increased the percentage of both elements compared with unweeded control. Treatments of hand weeding and Bromofenoxin at 0.500 kg a.i./fed gave the highest values of phosphorus and potassium in barley grains than the other treatments. This effect was observed by Metwally *et al*. (1999), who stated that hand weeding and Bromofenoxin increased the phosphorus and potassium content of wheat grains.

Concerning to the percentage of total carbohydrate in barley grains, data in the same Table revealed that all weed control treatments increased total carbohydrates when compared with unweeded control. The highest values (71.05, 70.56 and 70.24), were obtained by treatments of hand weeding, Isoproturon at 0.650 kg a.i./fed and Bromofenoxin at 0.500 kg a.i./fed respectively. The lowest carbohydrate content was obtained from unweeded check. Similar results were reported by Nagla Al-Ashkar (1998).

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دراسة تأثير بعض مبيدات الحشائش على محصول الشعير ومكوناته والحشائش الشائعة المصاحبة

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اجريت تجربتان حقليتان بمزرعة المركز القومى للبحوث بشلقان بمحافظة القليوبية خلال موسمى ٩٨/١٩٩٧ ، ٩٩/١٩٩٨ لدراسة تأثير بعض مبيدات الحشائش على محصول الشعير ومكوناته والحشائش الشائعة المصاحبة له حيث اوضحت نتائج البحث مايلى :

- اظهرت معاملات المقاومة اليدوية واستخدام مبيدات ايزوبروتورون ، البنتازون عند الجرعة العالية تأثير فعال فى مقاومة معظم الحشائش الحولية خلال ٨٠ يوم بعد زراعة الشعير .
- اعطت معاملات الكلوروتلورون ، البنتازون والبروموفينوكسين وكذلك معاملة المقاومة اليدوية احسن مقاومة للحشائش الحولية عريضة الاوراق مقارنة بالمعاملات الاخرى .
- اظهرت معاملات ايزوبروتورون والمقاومة اليدوية احسن مقاومة للحشائش النجيلية مقارنة بالمعاملات الاخرى .
- ادت معاملات ايزوبروتورون بمعدل ٠,٦٥٠ كجم مادة فعالة /فدان ، البروموفينوكسين بمعدل ٠,٥٠٠ كجم مادة فعالة /فدان وكذلك معاملة المقاومة اليدوية الى تحسين نمو نباتات الشعير حيث اعطت اطول نباتات واطول سنابل واكبر عدد من السنيبلات فى السنبلة واكبر عدد من السنابل فى المتر المربع واعلى وزن للالف حبة واعلى محصول حبوب وقش للفدان مقارنة بمعاملات مقاومة الحشائش الاخرى .
- اعطت كل معاملات مقاومة الحشائش زيادة فى نسبة البروتين والفوسفور والبوتاسيوم والكربوهيدرات الكلية فى حبوب الشعير مقارنة بمعاملة بدون مقاومة .

Table 1 : Effect of weed control treatments on the dry weight of annual weeds (gm/m²) at 60 and 80 days after sowing. (Combined analysis for 1997/98 and 1998/99 seasons).

Treatments	Rates kg a.i./ fed	Days from sowing					
		60 days			80 days		
		Broad- leaved	Grasses	Total ann. weeds	Broad- leaved	Grasses	Total ann. weeds
Chlorotoluron	0.400	10.27cd	36.80b	47.07b	18.45bc	48.07b	66.52bcd
Chlorotoluron	0.600	4.87d	30.45bc	35.32bc	10.45c	38.64bcd	49.09cde
Bromofenoxin	0.250	13.65bcd	36.65b	50.30b	26.52bc	48.18b	74.70b
Bromofenoxin	0.500	6.19cd	28.45bc	34.64bc	18.78bc	35.87bcd	54.65b-e
Bentazon	0.480	8.04cd	29.72bc	37.76bc	28.42b	41.42bc	69.84bc
Bentazon	0.624	3.45d	23.89bcd	27.34c	20.17bc	32.64cde	52.81b-e
Isoproturon	0.500	25.27b	16.00cd	41.27bc	34.32b	24.29de	58.61b-e
Isoproturon	0.650	18.54bc	10.55d	29.09c	25.75bc	18.38e	44.13de
Hand weeded	-	10.74cd	17.69cd	28.43c	18.82bc	20.80e	39.62e
Unweeded check	-	70.15a	97.60a	167.75a	94.80a	112.62a	207.42a

Table 2 : Efficiency (%) of weed control treatments for annual weeds at 60 and 80 days after sowing. (Combined analysis for 1997/98 and 1998/99 seasons) .

Treatments	Rates kg a.i./ fed	Days from sowing					
		60 days			80 days		
		Broad- leaved	Grasses	Total ann. weeds	Broad- leaved	Grasses	Total ann. Weeds
Chlorotoluron	0.400	85.36	62.30	71.94	80.54	57.32	67.93
Chlorotoluron	0.600	93.06	68.80	78.94	88.98	65.69	76.33
Bromofenoxin	0.250	80.54	62.45	70.01	72.03	57.22	63.99
Bromofenoxin	0.500	91.18	70.85	79.35	80.19	68.15	73.65
Bentazon	0.480	88.54	69.55	77.49	70.02	63.22	66.33
Bentazon	0.624	95.08	75.52	83.70	78.72	71.02	74.54
Isoproturon	0.500	63.98	83.61	75.40	63.80	78.43	71.74
Isoproturon	0.650	73.57	89.19	82.66	72.84	83.68	78.72
Hand weeded	-	84.69	81.88	83.05	80.15	81.53	80.90
Unweeded check	-	00.00	00.00	00.00	00.00	00.00	00.00

Table 3 : Effect of weed control treatments on barley yield and its components at harvest. (Combined analysis for 1997/98 and 1998/99 seasons).

Treatments	Rates kg a.i./ fed	Plant height (cm)	No. of spikes/m²	Spike length (cm)	No. of spikelets /spike	1000-grain weight	Grain yield (ardab/fed.)	Straw yield (ton/fed)
Chlorotoluron	0.400	99.2bc	354e	7.10d	18.24de	37.80f	13.98d	1.678c
Chlorotoluron	0.600	100.1b	386cde	8.42abc	18.92cde	42.90cd	16.58b	1.927bc
Bromofenoxin	0.250	96.0d	366de	7.44d	19.85bcd	39.80ef	14.09cd	1.691c
Bromofenoxin	0.500	98.4c	423ab	8.77a	20.05bc	47.50ab	19.43a	2.332a
Bentazon	0.480	99.8bc	388cd	8.68ab	21.14ab	43.50cd	17.31b	2.130ab
Bentazon	0.624	98.5c	369de	7.95c	17.84e	39.90ef	14.88cd	1.786bc
Isoproturon	0.500	103.1a	378cde	8.19bc	18.67cde	40.70de	15.20cd	1.824bc
Isoproturon	0.650	103.9a	442a	8.85a	21.83a	48.85a	19.49a	2.339a
Hand weeded	-	104.1a	405bc	8.75a	20.70ab	45.0bc	17.75b	2.077abc
Unweeded check	-	90.5e	311f	6.14e	15.87f	34.50g	9.96e	1.195e

Table 4 : Effect of weed control treatments on the chemical composition of barely grains. (Average of 1997/98 and 1998/99 seasons).

Treatments	Rates kg a.i./fed	Protein %	Phosphorus %	Potassium %	Carbohydrates %
Chlorotoluron	0.400	9.27	0.224	0.319	67.89
Chlorotoluron	0.600	9.04	0.186	0.297	65.63
Bromofenoxin	0.250	9.18	0.289	0.392	69.52
Bromofenoxin	0.500	10.58	0.315	0.452	70.24
Bentazon	0.480	9.93	0.199	0.307	66.07
Bentazon	0.624	9.47	0.228	0.340	69.29
Isoproturon	0.500	9.14	0.276	0.389	68.28
Isoproturon	0.650	10.26	0.299	0.396	70.56
Hand weeded	-	10.89	0.318	0.456	71.05
Unweeded check	-	8.48	0.140	0.278	63.48

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