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ORIGINAL ARTICLE

ASSESSMENT OF THE EFFICACY AND IMPACT OF CERTAIN HERBICIDES IN THE CONTROL OF BREAD WHEAT NARROW LEAF WEEDS (*TRITICUM AESTIVUM* L.) ON YIELD COMPONENTS

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Abstract: A field trial was conducted to evaluate the efficacy of some selective herbicides on narrow leaf weeds grown in wheat fields. Buhooth 22 was cultivated during the winter season 2017-2018 at the Abu Ghraib Research Station of the Ministry of Agriculture's Department of Agricultural Research. The trial included the use of three herbicides (Reward 10% EC, Traxos 050 EC at two levels and Topik 100 EC) in addition to the weedy controlled treatment with three replications and using a Randomized complete block design (RCBD). The Reward EC 10 % treatment attained the lowest density of weeds, reaching one plant.m^2 with a control rate of 96.96% and a lesser weeds dry weight (2.40 gm.m^{-2}) with either an inhibition rate (95.74%) in comparison with the control treatment, which provided an average of 33 plants.m^{-2} and revealed a positive average weed dry weight (54.43 gm.m^{-2}). The use of the similar herbicide culminated in a rise in grain. Grain with a rate of 37.94% and a weight of 1000 grains by 32.43% and that was reflected in grain yield increment by 82.78% compared to the weedy treatment, which gave the lowest yield rate of 3.328 tons.ha^{-1}. We conclude from the above that both herbicides had a significant effect on all the studied traits and at different rates compared to the weedy treatment, although the Reward 10% EC herbicide treatment significantly outperformed other treatments in the low use rate, the number of weeds, the percentage (%) of control, inhibiting and plant height, while there were no significant differences in the weedy treatment.

***Keywords*:** Weed, Herbicide, Topic, Reward, Traxos.

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1. Introduction

Weed spread in bread wheat (*Triticum aestivum* L.) fields is a major problem in reducing productivity, especially in the early stages of plant development. Weeds have a highly competitive tendency to control plants via the acquisition of growth conditions such as water, light, nutrients and CO_2 and it is also considered a vector for several insect pests and other pathogens, in addition to the secretion of (allelopathic) chemicals that impede crop plants, causing yield reduction and quality degradation. Iraq has over 12 varieties of narrow-leaved weeds, including wild oats. There are more than 12 species of narrow-leafed weeds in Iraq, such as wild oats (*Avena Fatua* L., *Lolium rigidum* L., *Lolium temulentum* L., Abu Damim *Pharais minor* and wild barley *Hordeum glacum* L.) [Ismail (2002)]. Most of the narrow-leafed weeds follow the same family of the wheat crop (Poaceae or Gramineae) and are similar to it, especially in the early stages of crop production. Bread wheat production remains poor in contrast to the global average so in the developing countries producing this crop owing to a lack of scientific techniques for handling and controlling agricultural pests. The most critical of which are narrow-leafed

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weeds, since they are a deciding factor in crop growth and productivity, resulting in a decrease in yield per unit area of up to 30-50% and sometimes up to 70%, depending on the species and density of the weeds if they are not managed in a timely manner [Bari *et al.* (2020)]. As a result, researchers worked on weed control in a variety of ways, including chemical control with herbicides, which is considered one of the most important crop management processes in controlling bush competition for the main crop and thereby increasing yield with high efficiency in reducing the severe damage caused by the weeds and in order to preserve the crop in comparison to other weed control methods. Many people involved in weed control and herbicide-producing industries looked for various varieties of herbicides from different chemical classes that had strong selective efficacy and a low usage rate for the purpose of weed control and environmental protection [Al-Khazali and Shati (2020)]. To successfully combat emerging weeds with seed, we must first understand the type of weed, its mode of reproduction, its life cycle and the degree of harm it causes in order to choose the most effective herbicide and achieve the maximum level of weed control. As a result, the research intends to evaluate the effectiveness of newly applied low-use weed herbicides on narrow-leafed bread wheat weeds, as well as their effects on yield and yield components, as well as growth characteristics.

2. Materials and Methods

A field study was conducted at Abu Ghraib Research Station during the winter season of 2017-2018, with the aim of determining the benefits of the weed herbicides Reward (10% EC), at an application rate of 600 ml.ha^{-1}, Traxos 050 EC at levels (900 and 1000 ml.ha^{-1}) and Topik 100 EC at an application rate of 600 ml.ha^{-1}, as well as the weedy control treatment Table 1. The experiment was designed as a randomized complete block of three blocks. Plowing, smoothing and leveling were performed until it was divided into experimental units with measurements (2×3) m, a gap of 20 cm between one line and another, 1.5 m between experimental units and 3 m between replications. On 11/15/2017, nitrogen fertilizer (urea fertilizer 46% N) was applied at a rate of 200 kg.ha^{-1} in three equivalent doses (at planting, tillering and in the elongation stage). After smoothing, spread 200 kg.ha^{-1} of triple superphosphate fertilizer (46 % P_2O_5) [Jadoua (1995)]. Irrigation is used when required. Narrow-leaf herbicides were sprayed on wheat plants after germination and at a point of 2-4 natural leaves using a handheld pressure sprayer at a pressure of 2.8 kg.cm^{-2} and a spray level of (30-40 cm) above the plants. It also sprayed both treatments with the broad-leaf herbicide 2, 4 D in accordance with the recommendations. Weeds were allowed to develop throughout the crop and during weedy control procedure.

2.1 Characters studied

Weed types and numbers (plant.m^{-2}): After the weeds reached physiological maturity, they were counted and diagnosed using a square meter area in each plot Table 2.

The percentage of weed control (%): The different treatments were calculated according to the following equation:

Table 1: The commercial name and amount of the active ingredient used in the experiment.

Commercial name	Common name	Active ingredient and Concentration	Application rate	Manufacture
Reward 10% EC		Clodinafop- Propargyl 8% + Cloquintocet- Mexyl 2%	600 ml.ha^{-1}	Turkish Agriculture sciences
Traxos 050 EC		Pinoxaden 25g/ L + Clodinafop -Propargyl 25g/ L	900 ml.ha^{-1} 1000 ml.ha^{-1}	Syngenta
Topik 100 EC	Clodinafop-propargyl	Clodinafop-Propargyl 100 g + Cloquintocet-Mexyl 25 g	600 ml.ha^{-1}	Syngenta

Table 2: The scientific names of the narrow-leafed weeds shown in the experiment.

Name	Narrow leaves weeds/Scientific name	Family	Life cycle
Wild oat	*Avena fatua L.*	Poaceae	Annual
Lesser canary	*Phalaris minor L*	Poaceae	Annual
Johnson grass	*Sorghum halepense L.*	Poaceae	Perineal
Nutgrass	*Cyperus rotundus* L.	Cyperaceae	Perineal

$$\text{Weed control (\%)} = \frac{\text{Weed no. weedy treatment - number of weed in herb treatment}}{\text{Weed no. in weedy treatment}} \times 100$$

Weed dry weight at harvest (gm.m^{-2}) and inhibition percentage (%): The weeds were cut at the soil surface for one m^2 of the experimental unit and put inside perforated bags, which were air-dried with constant stirring for two weeks and until the weight normalized, at which point the percentage (%) of inhibition was measured as follows:

$$\text{Inhibition } (\%) = 100 - \left(\frac{A}{B} \times 100\right)$$

where,

A = Weed dry weight of herbicide applications.

B = Weed dry weight as in management procedure.

Plant height (cm): The plant height was determined as an average of ten plants at the physiological level of maturity from the soil surface to the top of the main stem.

The number of spikes.m^{-2}: It was calculated on the basis of the total spikes and for an area of one square meter of average planting lines for each experimental unit.

The number of grains.Spike^{-1}: After being manually distributed, the total number of grains for ten spikes per experimental device is calculated.

The weight of 1000 grains.gm: For each experimental unit, a random sample was taken from the harvested sample grains. A total of 1000 grains is counted and measured on an electronic scale.

Grain yield (tons.ha^{-1}): The grains were weighed and converted into a ton.ha^{-1} at a humidity level of 14% after manual threshing of the harvested plants for an area of 1 m^2 of each experimental unit.

Table 3: The effect of narrow-leaf weeds herbicides on the number of weeds (m^{-2}) and the control percentage.

Treatment	Application rate	Weed no. (m^{-2})	Weed control%
Reward 10% EC	600 ml.ha^{-1}	1.00	96.96
Traxos 050 EC	900 ml.ha^{-1}	3.00	90.90
Traxos 050 EC	1000 ml.ha^{-1}	3.33	89.94
Topik	600 ml.ha^{-1}	7.67	76.67
Weedy	Weedy treatment	33.00	0.00
L.S.D$\leq$0.05		1.851	3.850

Biological yield (tons.ha^{-1}): Based on all harvested plants for 1 m^2 of each plot, where the entire plants were weighed (grains + straw) and the weight was converted to tons.ha^{-1}.

Harvest index (HI): HI was determined in the following way:

HI = (Grain yield/ Biological yield) × 100

Statistical analysis

The data for all studied traits is collected and classified before being analyzed using the GenStat V.12.1 program. The arithmetic means of the various treatments were compared using Least Significant Differences (LSD) at the 5% level.

3. Results and Discussion

3.1 Weed control % and Weed density (plant.m^{-2})

Table 3 shows that narrow-leaf weed herbicides outperform in decreasing weed density when compared to the control treatment, the Reward 10% EC treatment has the lowest average for this trait, with 1 plant.m^{-2} and a control ratio of 96.96% (33 plants.m^{-2}). There were also significant variations between both herbicide treatments and the weedy treatment. The effectiveness of the herbicide Reward 10% EC in controlling narrow-leaf weeds by the mechanism of its effect in inhibiting (ACCase) acetyl CoA carboxylase, which is an important molecule in metabolism and is used in many biochemical reactions, is that the herbicide reduces weed density, that could be attributed to stunted growth of the narrow-leaf weeds. This was expressed favorably in the reduction of their number and at a rapid pace as compared to the control treatment. This observation is consistent with the findings of Georgiev *et al*. (2020) who recorded improved weed control rates and substantial weed density reductions as a result of weed herbicide application.

3.2 Dry weight of the weeds (gm^{-2}) and inhibition rate (%)

Table 4 shows that the herbicides had a significant effect on the dry weight of the weeds in gm.m^{-2} and the inhibition rate, when the herbicides Reward 10% EC and Traxos 050 EC were significantly higher in reducing the dry weight of the weeds in gm.m^{-2} and the inhibition rate was 2.4 and 3.80 gm.m^{-2} and 95.74 and 92.96%, respectively, as compared to the decrease

Table 4: The effect of narrow-leaf weed herbicides on weed dry weight in gm.m^{-2} and inhibition levels.

Treatment	Application rate	Weed dry weight (gm.m^{-2})	Inhibition rate (%)
Reward 10% EC	600 ml.ha^{-1}	2.40	95.74
Traxos 050 EC	900 ml.ha^{-1}	3.80	92.96
Traxos 050 EC	1000 ml.ha^{-1}	7.57	85.99
Topik	600 ml.ha^{-1}	9.44	82.67
Weedy	Weedy treatment	54.43	0.0
L.S.D$\leq$0.05		3.588	4.476

Table 5: Effect of narrow-leaf weed herbicides on plant height, biological yield and harvest index.

Treatments	Application rate	Plant height (cm)	Biological yield (ton.ha^{-1})	Harvest index (%)
Reward 10% EC	600 ml.ha^{-1}	104.40	15.70	38.91
Traxos 050 EC	900 ml.ha^{-1}	100.20	17.63	34.81
Traxos 050 EC	1000 ml.ha^{-1}	102.20	17.40	34.65
Topik	600 ml.ha^{-1}	98.60	15.40	38.93
Weedy	Weedy treatment	94.60	12.44	30.75
L.S.D$\leq$0.05		3.455	1.554	3.00

in the number of weeds.m^{-2} gives a clear indication of the effectiveness of these herbicides by their effect on the vital activities of the weeds. The photosynthesis process was overshadowed by the respiration process and the crop's biological yield. Table 5 resulted in a loss of light reaching the weed plants, resulting in a decrease in weed dry weight. The extent of inhibition (%). This observation agreed with Al-Khazali and Shati (2016), Ahmad *et al.* (2021) and Arya *et al.* (2018) who reported that weed herbicides caused a decrease in dry weight and a rise in inhibition rate.

3.3 Herbicide impact on growth traits and harvest index

The findings showed substantial variations in the plant height of wheat crops by using narrow-leaf weed herbicides (Table 5), with the herbicide award 10% EC inducing a 10.35% rise in plant height relative to the weedy unit, which offered the lowest average plant height of 94.60 cm, owing to herbicides efficacy in minimizing the number of weeds. Table 3 and 4, which provided a favorable environment for the crop to grow in without competition for light, water, nutrients and CO_2. As a result, the productivity of the photosynthesis process improved, as did the crop's biological activities, which culminated in an improvement in plant height by extending the internodes.

The treatment of the herbicide Traxos, at an application rate of 900 ml.ha^{-1}, gave the highest increase in the biological yield rate, reaching 41.72%, followed by the treatment of Traxos with an application rate of 1000 ml.ha^{-1}, which achieved an increase in the biological yield by 39.87% compared to the weedy treatment, which gave the lowest biological yield reached 12.44 tons.ha^{-1}. The decrease in the biological yield in the herbicide treatment may be due to the presence of the competition factor of the weeds, which clearly affected the growth and development of the crop and then the effect on the accumulation of dry matter in the different parts of the plant. This result is consistent with Alvi *et al.* (2004), who observed that using weed herbicides resulted in a substantial increase in biological yield as compared to the weedy unit whereas the herbicide Topik treatment greatly outperformed, yielding the highest average harvest index of 38.93%, the weedy treatment yielded the lowest average harvest index ratio of 30.75%. The impact of herbicides reduces weed competitiveness for the crop for various growth conditions, as weed density and dry weights decrease (Table 3 and 4). As a result, sufficient environmental conditions for the growth and development of plant organs were established, allowing it to achieve a grain yield increase greater than the % increase in total dry matter yield relative to weedy treatment. This finding was supported by Ismail (2002) and Muhammad *et al.* (2020), who observed that using weed control herbicides had a major impact on improving vegetative characteristics, which was expressed in an improvement in yield and its components (Table 6) and the explanation for raising the harvest index compared to the weedy unit.

Table 6: The effect of narrow-leaf weed herbicides on yield components and grain yield.

Treatments	Application rate	Spike no.m^{-2}	Grain per spike	1000 grain weight	Grain yield ton.ha^{-1}
Reward 10% EC	600 ml.ha^{-1}	368.3	52.93	39.30	6.083
Traxos 050 EC	900 ml.ha^{-1}	348.3	52.73	39.77	6.100
Traxos 050 EC	1000 ml.ha^{-1}	358.3	51.63	39.33	6.003
Topik	600 ml.ha^{-1}	334.7	51.57	37.90	5.980
Weedy treatment	213.0	38.37	29.80	3.823	
L.S.D ≤ 0.05		10.27	2415.0	1.806	0.2145

3.4 The effect of weed herbicides on grain yield and its components

The results showed a significant effect of weed herbicides on the characteristics of the yield components (number of spikes.m^{-2}, number of grains spike^{-1} and weight of 100 grains.gm), as the treatment of the herbicide Reward 10% EC gave the highest averages for these traits (368.3, 52.93 and 39.30) compared to the weedy treatment which gave the lowest mean for these traits which were (213.3, 38.37 and 29.80), respectively (Table 5). In terms of number of grains spike^{-1} and weight of 1000 grains, there were no major variations between the two treatments of Reward 10% EC and Traxos 050 EC. This finding can be due to the herbicides' efficacy in reducing the number of weeds and their dry weights (Table 3 & 4), which allowed the crop plants to grow without environmental stress, especially competition over the growth requirements between the crop and the weed and thus the efficiency of the photosynthesis process increased, which in turn led to the improvement of the crop performance. Because of its vital activities, the number of spikes, the number of grains and the weight of 1000 grains increased. This result is in agreement with Knezevic *et al.* (2010) who stated that the highest number of spikes is obtained in the absence of a competition factor between the crop and the associated weeds and they stated that the presence of the competition factor has a significant effect on the growth and development of the crop and that the survival of the weeds and failure to control it during the tillering stage is a determining factor in the growth and productivity of the crop.

The researches have confirmed the superiority of the Traxos herbicide at a rate of 900 ml.ha^{-1} and the herbicide Reward 10% EC treatment greatly improved the total grain yield (59.56 and 59.41%) relative to the weedy treatment.

This finding is due to the difference between these two treatments in the yield components (number of seeds spike^{-1}, number of grains per spike and weight of 1000 grains), which resulted in an increase in yield. This result may be due to the crop's availability of a suitable environment, which resulted in its growth production, which improved the efficiency of the photosynthesis process, which was reflected in the vital activities and utilization of the growth requirements and the amount of what enables it to utilize the majority of the nutrients available in the formation of grains [Al-Chalabi and Al-Agidi (2010)]. This finding is consistent with the findings of Said and Jaff (2020), who found that weed herbicide use increases yield components and crop yield.

4. Conclusion

We conclude that both herbicides had a significant effect on all of the studied traits and at different rates compared to the weedy treatment, though the Reward 10 percent EC herbicide treatment significantly outperformed other treatments in the low use rate, the number of weeds, the percent percentage of control, inhibiting and plant height, although there were no significant differences in the other treatments.

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