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EFFECT OF TILLAGE TIMES AND WEED CONTROL ON GROWTH AND YIELD OF MAIZE (*ZEA MAYS* L.) VARIETY DRAKMA

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Abstract

A field experiment was carried out in one of the agricultural fields of the Diyala Governorate, Hibhib District during the autumn season of autumn 2019, to study the effect of tillage times, leveling type and weed control on the growth and yield of maize crop variety Drakma. The study was carried out according to Randomized Complete Block Design (RCBD) using split-plot design arrangement with three replicates, the main plots included the number of tillage times, while the sub-plots included the leveling methods (traditional and precise by laser), whereas the sub-sub-plots included five control treatments (comparison, without weed and chemical, weeding, chemical + weeding). The results showed that the two-time tillage exceeded significantly in the, leaf area by 320.82 cm^2, control percentage of 68.60 cm and total grain yield of 11.32 $ton.ha^{-1}$. The traditional leveling, as it achieved the highest height of 226.76 cm, the best leaf area of 316.02 cm^2, and the total grain yield of 10.65 $ton.ha^{-1}$.

Key words: Tillage, type leveling, Chemical control, Weeding, Maize (*Zea mays* L.).

Introduction

Maize *Zea mays* L is one of the most important crops in the world as it is used directly in human feeding and its grains are used in the production of poultry and livestock diets (Barnes, 2007). The maize crop importance resulted from it contains a good percentage of carbohydrates, proteins, and vitamins (Dhugga, 2007). Despite the importance of this crop, productivity per unit area is still low at a rate of 3.326 $ton.ha^{-1}$ (Central Statistical Organization, 2018) In addition, the local yield rate is very low compared to the global production rate, which was 11.21 $ton.ha^{-1}$ (USDA, 2018). Among the most important reasons for the low productivity is the lack of interest in soil and crop service operations, especially weed control operations that compete with the crop on growth requirements, directly affect the vital activities of the crop, and thus crop degradation and decline (Al-Jubouri *et al.*, 1985). The critical period for weed competition for maize crop between 2-7 weeks after planting and this causes a large loss in the yield amounted to 37% (Shrestha *et al.*, 2019; Barua *et al.*, 2019), and in some cases, the losses reached 18% - 85% (Jagadish *et al.*, 2016). Besides, the weed causes difficulty in harvesting and crop service (Zanin *et al.*, 1986), where one of the most important methods used to control the weed is to follow the method of precise leveling to the field, which achieves the best germination rate per unit area. As well as, it ensures regular and equal irrigation, which is reflected positively on the yield (Al-Wokaa, 2018), and there has been an increase in the yield of up to 40% when applying precise leveling technology using lasers (Hashimi *et al.*, 2017). Chemical control achieved high results in controlling weed and reducing the cost of agriculture due to its ease of use and its positive role in improving the yield and its quality (Mehmeti *et al.*, 2012). aimed the study effect of the tillage times, precise leveling, chemical weed control on the growth and yield of maize variety Drakma.

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Materials and Methods

A field experiment was carried out in one of the agricultural fields of the Diyala Governorate/Hibhib District during the autumn season of 2018-2019, to study the effect of the number of tillage times, leveling type and weed control methods on the growth and yield of maize crop variety Drakma. The study was carried out

according to Randomized Complete Block Design (RCBD) using a split-plot design arrangement with three replicates, with three factors. The first one is two-level tillage (one-time tillage, two-time tillage), the second factor is the two-level leveling method (traditional leveling, precise leveling using a laser) and the third factor is the different control treatments, which are five (comparison, without weed, chemical, weeding, chemical + weeding). The area of one experimental unit was 90 m^2 (3m × 30m), planted with plant density (66666.66) plant.ha^{-1}, the distance between one hole and another was 20 cm and between lines 75 cm. The date of planting was on 20/7/ 2019, while the chemical control process was then carried out using a 400-liter Turkish sprinkler (Kobra) using chlordane herbicides according to the concentration recommended by the manufacturing company, where the (chemical) treatment was sprayed in addition to (chemical treatment + weeding). Then, the field was irrigated immediately after planting and chemical control, where the irrigation continued according to the plant's need. However, the experiment land was fertilized with nitrogen fertilizer and phosphate according to the recommended quantities, as the compound fertilizer (18 N% and P 18%) was added in one batch at a rate of 400 kg.ha^{-1} at planting, while the urea fertilizer (46 N%) was added at an average of 300 kg.ha^{-1} in three batches. The first batch was at planting, the second is when plants reach a height of 30 cm and the third was at the beginning of the flowering stage (Jeyad and Sahuki 2011). The shares (cultivator 6 sweeps) was used in weeding process and was adjusted by leaving 10 cm on each side of plant lines at a speed of 6 km/hour, while the weed was identified as shown in Table 1 and its density was calculated using the squares method as mentioned in (Al-Wagga, 2012). The experiment was harvested on 10/11/2019, and ten plants were taken from the two intermediate lines in the experimental unit randomly to study the following characteristics:

1- The leaf area (cm^2). The leaf area under the ear was calculated in the flowering stage according to the following equation:

Leaf area cm^2 = leaf length under the main ear× the maximum width of the same leaf 0.75 (Sahuki, 1990).

2- The control percentage for the weed based on the dry matter is calculated by the following equation:

Where:

WCE = weed control efficiency based on dry matter.

DMC = weed dry matter in a comparison treatment (without control).

DMT = weed dry matter in weed control treatments (Al-wagaa *et al.*, 2018).

3- Total grain yield (ton.ha^{-1}): The yield of one plant was calculated in grams, and then the total yield in ton was calculated at the standard humidity 15.5% according to the following equation:

Then the data obtained were analyzed using the program SAS Statistical Analysis System according to the least significant difference at the 5% probability level (Sahuki and Wahib, 1990).

Results and Discussion

The effect of the number of tillage times, leveling type and control methods on the characteristic of leaf area

The leaf area is one of the most important factors associated with the production, as the results in table 2 showed a significant effect of the number of tillage times on the characteristic of the leaf area. The two-time tillage achieved the highest average of leaf area reached 320.82, while the one-time tillage achieved the lowest average leaf area was 274.03 cm^2, this is consistent with (Nicola, 2016). The leveling factor had a significant effect, as the precise leveling gave the highest average leaf area of 316.02 cm^2, while the traditional leveling achieved the lowest average leaf area was 278.83 cm^2, which because of provided a good cradle for germination and growth

Table 1: Types of companion weed to the maize crop for the autumn season 2019-2020.

Common name	English name	Scientific name	Family	Life cycle
Amaranthus	Pigweed amaranth	*Amaranthus retroflexus L.*	Amaranthaceae	Winter annual
Sword-grass	Cogon grass	*Imperata cylindrica L.*	Poaceae	Perennial
Common reed	Common reed	*Phragmites australis*	Poaceae	Perennial
Wild cherry	Ground cherry	*Physalis angulate* L	Solanaceae	Winter annual
Cressa cretica	Salt Cresse	*Cressa ceretica L.*	Convolvulacea	Winter annual
Alhagi maourum	Prickly alhagi	*Alhagi maurorum Medic.*	Papilionaceae	Perennial
Beta vulgaris	Wild beets	*Beta vulgaris L.*	Chenopodiaceae	Winter annual
Wild lettuce	Prickly lettuce	*Lactuca scariola L.*	Compositae	Winter annual
Bind weed	Field Bind Weed	*Convolvolus arvensis L.*	Convolvulacea	perennial

Table 2: The effect of the number of tillage times, leveling type and control methods on the characteristic of leaf area for maize plant variety Drakma.

Tillage systems	Leveling method	Control treatments					Tillage X leveling	Tillage effect	Leveling effect
		Chemical + weeding	Chemical	Without weed	Weeding	Compa -rison			
Two-time tillage	Precise leveling	346.50 b	335.99 c	358.59 a	319.76 e	289.87 i	330.14 a		
	Traditional leveling	324.75 d	318.14 e	337.63 c	309.26 f	267.75 k	311.51 b		
One-time tillage	Precise leveling	316.68 e	308.70 f	325.06 d	299.22 g	259.87 l	301.90 c		
	traditional leveling	288.98 i	283.59 j	294.52 h	188.71 m	175.01 n	246.16 d		
Tillage X control treatments		335.62 b	327.07 c	348.11 a	314.51 d	278.81 h		320.82 a	
		302.83 f	296.14 g	309.79 e	243.96 i	217.44 j		274.03 b	
Leveling X control treatments		331.59 b	322.34 c	341.82 a	309.49 e	274.87 h			316.02
		306.86 f	300.86 g	316.07 d	248.98 i	221.38 j			278.83 b
Control treatments effect		319.23 b	311.60 c	328.95 a	279.24 d	248.12 e			

* The values of averages followed by the same letter for each characteristic are not significantly different at the significance level of 5%.

(Eid *et al.*, 2014). It was also noted from the same Table that there were significant differences between control treatments, as the without weed treatment achieved the highest average leaf area amounted to 328.95 cm^2, while the comparison without control treatment achieved the lowest average leaf area reached 248.12 cm^2, this is consistent with (David *et al.*, 2020). The Table also shows a significant interaction in the number of tillage times with leveling in the two methods, where the two-time tillage treatment with precise leveling achieved the highest leaf area of 330.14 cm^2, while the one-time tillage treatment with traditional leveling gave the lowest leaf area amounted to 246.16 cm^2. Moreover, it was observed that the interaction between the number of tillage times and the control treatments had a significant effect on the characteristic of the leaf area. As the two-time tillage treatment was superior with the without weed treatment and gave the highest leaf area reached 348.11 cm^2, whereas, the one-time tillage treatment with the comparison treatment without control gave the lowest leaf area was 217.44 cm^2. It was also observed that the interaction between the leveling method and the control treatments has a significant effect, as the precise leveling treatment was superior with the without weed treatment and achieved the highest leaf area of 341.82 cm^2, while the traditional leveling treatment with the comparison gave the lowest leaf area reached 221.38 cm^2. The Table also shows that there was a triple significant interaction, as the two-time tillage treatment with the precise leveling and the without weed treatment achieved the highest leaf area of 358.59 cm^2, while the one-time tillage treatment with the traditional leveling and the comparison treatment gave the lowest leaf area of 175.01 cm^2. In general, the increase in leaf area means increasing the efficiency of receiving light, which means increasing the photosynthesis process, which is reflected positively in increasing the yield (Khazali *et al.*, 2019).

Table 3: The effect of the number of tillage times, leveling type and control methods on the characteristic of control percentage of the companion weed the maize crop variety Drakma.

Tillage systems	Leveling method	Control treatments					Tillage X leveling	Tillage effect	Leveling effect
		Chemical + weeding	Chemical	Without weed	Weeding	Compa -rison			
Two-time tillage	Precise leveling	90.88 b	82.37 cd	100.00 a	78.59 e	0.00 h	70.37 a		
	Traditional leveling	84.50 c	79.04 e	100.00 a	70.60 f	0.00 h	66.83 b		
One-time tillage	Precise leveling	90.71 b	82.40 cd	100.00 a	64.47 g	0.00 h	67.51 b		
	traditional leveling	85.11 c	79.90 ed	100.00 a	65.43 g	0.00 h	66.09 c		
Tillage X control treatments		87.69 b	80.70 c	100.00 a	74.59 d	0.00 f		68.60 a	
		87.91 b	81.15 c	100.00 a	64.95 e	0.00 f		66.80 b	
Leveling X control treatments		90.80 b	82.38 d	100.00 a	71.53 f	0.00 h			68.94 a
		84.80 c	79.47 e	100.00 a	68.02 g	0.00 h			66.46 b
Control treatments effect		87.80 b	80.93 c	100.00 a	69.77 d	0.00 e			

* The values of averages followed by the same letter for each characteristic are not significantly different at the significance level of 5%.

The effect of the number of tillage times, leveling type and control methods on the characteristic of control percentage of the companion weed the maize crop:

The results in table 3 showed a significant effect of the number of tillage times on the characteristic of weed control percentage, where the two-time tillage achieved the highest control percentage was 68.60%, while the one-time tillage achieved the lowest control percentage reached 66.80%, this is consistent with (Simic *et al.*, 2020). The leveling factor had a significant effect, as the precise leveling gave the highest control percentage of 68.80%, while the traditional leveling achieved the lowest control percentage, the reason may be attributed to the fact that precise leveling reduces waterlogging and consequently controls moisture content, which in turn reduces weed and this is consistent with (Rickman, 2002). It was also noted from the Table that there were significant differences between control treatments, as the without weed treatment achieved a significant effect by a highest control percentage amounted to 100%, while the comparison without control treatment achieved the lowest control percentage reached 0%, this is consistent with (Khazali *et al.*, 2019). The table also shows a significant interaction in the number of tillage times with leveling in the two methods, where the two-time tillage treatment with precise leveling achieved the highest control percentage of 70.37%, while the one-time tillage treatment with traditional leveling gave the lowest control percentage amounted to 66.09%. The interaction between the number of tillage times and the control treatments had a significant effect on the characteristic of control percentage. As the one-time tillage and the two-time tillage treatments were superior with the without weed treatment and gave the highest control percentage reached 100%, whereas, the one-time tillage treatment with the two-time tillage and the comparison treatment without control gave the lowest control percentage was 0%. Furthermore, it was observed that the interaction between the leveling method and the control treatments has a significant effect. As the precise and traditional leveling treatments were superior with the without weed treatment and achieved the highest control percentage reached 100%, while the precise leveling treatment and the traditional leveling treatment with the comparison gave the lowest control percentage reached 0%.

The effect of a number of tillage times, leveling type and control methods on the characteristic of grain yield (ton.ha^{-1})

The results in table 4 showed a significant effect of the number of tillage times on the characteristic of grain yield, where the two-time tillage achieved the highest grain yield amounted to 11.32 ton.ha^{-1}, while the one-time tillage achieved the lowest grain yield reached 8.91 ton.ha^{-1}, this is agreed with (Abdul Amir *et al.*, 2010) results. The leveling factor had a significant effect, as the precise leveling gave the highest grain yield reached 10.65 ton.ha^{-1}, while the traditional leveling achieved the lowest grain yield was 9.58 ton.ha^{-1}, this is consistent with (Hashimi *et al.*, 2017). It was also noted from the same Table that there were a significant differences between control treatments. As the chemical control + weeding treatment achieved the highest grain yield amounted to 11.55 ton.ha^{-1}, followed by without weed treatment of 11.23 ton.ha^{-1}, while the comparison without control treatment achieved the lowest grain yield reached 7.83 ton.ha^{-1}. This gives a clear indication that the weed works to continuously absorb nutrients throughout the growing season, which in turn reduces the simplest

Table 4: The effect of the number of tillage times, leveling type and control methods on the characteristic of grain yield for maize plant variety Drakma.

Tillage systems	Leveling method	Control treatments					Tillage X leveling	Tillage effect	Leveling effect
		Chemical + weeding	Chemical	Without weed	Weeding	Compa -rison			
Two-time tillage	Precise leveling	14.04 a	12.80 c	13.73 b	10.98 g	9.19 k	12.15 a		
	Traditional leveling	12.08 d	11.35 f	11.78 e	9.29 k	7.93 o	10.49 b		
One-time tillage	Precise leveling	10.36 h	9.29 k	9.84 i	8.71 m	7.51 p	9.14 c		
	traditional leveling	9.72 ij	9.08 l	9.59 j	8.29 n	6.70 q	8.68 d		
Tillage X		13.06 a	12.07 c	12.75 b	10.14 d	8.56 g		11.32 a	
control treatments		10.04 d	9.19 f	9.72 e	8.50 g	7.10 h		8.91 b	
Leveling X		12.20 a	11.05 c	11.78 b	9.85 g	8.35 i			10.65 a
control treatments		10.90 d	10.21 f	10.69	8.79 h	7.31 j			9.58 b
Control treatments effect		11.55 a	10.63 c	11.23 b	9.32 d	7.83 e			

* The values of averages followed by the same letter for each characteristic are not significantly different at the significance level of 5%.

growth ingredients needed for the maize and this is embodied in the comparison treatment (Ramesh, 2019). The Table also shows a significant interaction in the number of tillage times with leveling in the two methods, where the two-time tillage treatment with precise leveling achieved the highest grain yield of 12.15 ton.ha^{-1}, while the one-time tillage treatment with traditional leveling gave the lowest grain yield amounted to 8.68 ton.ha^{-1}. Moreover, it was observed that the interaction between the number of tillage times and the control treatments had a significant effect on the average yield, as the two-time tillage treatment was superior with the chemical control + weeding treatment and gave the highest grain yield reached 13.06 ton.ha^{-1}. Whereas, the one-time tillage treatment with the comparison treatment without control gave the lowest grain yield was 7.10 ton.ha^{-1}. It was also observed that the interaction between the leveling method and the control treatments has a significant effect, as the precise leveling treatment was superior with the chemical control + weeding treatment and achieved the highest grain yield reached 12.20 ton.ha^{-1}, while the traditional leveling treatment with the comparison gave the lowest grain yield reached 7.31 ton.ha^{-1}. The Table also shows that there was a triple significant interaction, as the two-time tillage treatment with traditional leveling in the control + weeding treatment achieved the highest grain yield amounted to 14.04 ton.ha^{-1}, while the one-time tillage treatment with traditional leveling with comparison treatment gave the lowest grain yield was 6.70 ton.ha^{-1}.

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