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INFLUENCE OF TILLAGE AND WEED MANAGEMENT METHODS ON CHICKPEA (*Cicer arietinum* L.). I. YIELD AND YIELD COMPONENTS

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ABSTRACT

An experiment was conducted at the Agricultural College farm Duhok University Iraq to study the effect of different methods of weed control on chickpea growth and yield during the growing season of 2009. Ploughs types included disc plow, mould board plow, and cultivator. Weed management practices involved hand hoeing, trifluraline (soil incorporated), Aloxy and paraquat. Results indicated that plough types had no significant effect on any traits of growth or yield of chickpea. Hand hoeing significantly gave highest seed yield and weight of 100 seeds which were 120.4 kg per Donum (1 Donum = 1000m^2) and 30.8 g respectively. Both hand-hoeing and paraquat treatments were superior in number of primary branches (3.5 and 3.4), number of pods per plant (12.3 and 11) and hay yield per donum (363.9 and 318.2 kg), respectively. The interaction of hand hoeing with cultivator and mould board was significant for most of traits under study. In addition, the interaction of paraquat with cultivator was significant in plant height and height of the lowest pod traits which were 41.3 and 23.1 cm, respectively.

Keywords: Yield, growth, chickpea, management, herbicides, tillage.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is considered as one of the most important grain legumes all over the world. It is used widely in public foods, and in various commodities and recipes. Chickpea has great nutritive value as it contains a high percentage of protein. In Iraq, it ranks as a second grain legume after faba bean. Its cultivation is concentrated in the northern governorates including Sulaymania, Duhok, Erbil and Ninevah, covering an area of 14,000 ha with average yield of 0.74 t ha^{-1} (Abbas, 1990), which comprises 6.4% only of the total consumption and the remaining is imported. The limited area cultivated under chickpea and its low productivity per unit area rather than suitable climatic conditions, is due to numerous factors. One of these serious obstacles that have great effect on chickpea quantity and

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quality is weed invasion and competition, in addition to the shortage in mechanization and improved cultivars. Farmers lose a high percentage of their production from chickpea because of weeds. Hand hoeing still widely practiced for controlling which is costly for local farmers. Therefore, searching for other alternative methods of weed control is important. Weeds may be controlled by different methods. Type of ploughs (tillage) affect weed population, soil moisture or soil seed bank dynamics during stirring the soils. Herbicides are also involved; pre-planting herbicide treatment may be effective for weed control before crop is sown. Certain herbicides act on germinated seeds while, others may kill seeds. Pre-emergence herbicides are applied after sowing but before crop emergence. These chemicals may control weeds by killing weed seedlings. Post-emergence herbicides are applied on emerged crop and weed plants which are normally selective chemicals of no or little damage to crop plants.

Barker (2007) mentioned that pre-plant (soil-applied herbicide) such as Isoxaflutole requires rainfall to activate and move it into the soil which converted to its active form through hydrolysis to effectively control weeds, therefore water is required for this chemical reaction to occur. Incorporation would not likely improve control since it could dry the soil and reduce the likelihood of hydrolysis occurrences. Ahmad *et al.,* (1990); Vaishya *et al.,* (1995); Yasin *et al.,* (1995) and Kayan and Adak (2005) demonstrated that the yield and its components chickpea were not increased significantly by herbicides, while hand hoeing led to significant yield increase. On the other hand, Kumar *et al.,* (1989) found that both hand hoeing and fluchloralin (0.5 kg ha^{-1}) in soil applied treatment produced significant yield of chickpea. Varshney and Arya (2004) illustrated that both hand hoeing and pre-emergence herbicides (Isoproturon and pendimethalin) significantly increased chickpea yield, weight of 100 seeds, but both herbicides had no significant effect on number of pods per plant and number of seeds per pod. Similar results were found by Iqbal *et al.,* (1991); Tewari and Tiwari (2004) and Dungarwal *et al.,* (2002) using pendimethalin, while trifluralin herbicide doesn't show any significant effects. Chaudhary *et al.,* (2005) noted significant effect of hand hoeing and pendimethalin herbicide on number of pods per plant, number of seeds per pod and grain yield of chickpea. Singh *et al.,* (2003) reported significant increase in seed and hay yield of chickpea using pre-emergence herbicides, but number of branches, pods per plant and plant height were not significantly changed.

Khattak and Khan (2005) stated that the type of ploughs had significant effect on seed yield per unit area of chickpea. Chisel plough once and tine cultivator three times surpassed mould board and disc harrow and gave 18.9% yield higher than no tillage treatment and this might be due to better control of weeds. Barzegar *et al.,* (2003)

demonstrated that the mould board has no significant effect on yield of chickpea and gave lower yield (541 kg ha^{-1}) as compared to chisel plow which gave 620 kg ha^{-1}. In contrast, Kayan and Adak (2005) demonstrated that mould board plow surpassed rotary tiller and gave significant yield of chickpea. Hemmat and Iraj (2004) mentioned that ploughs including mould board and chisel plows not significantly affected chickpea yield compared to minimum tillage (sweep plowing). Similarly, Kakarash (2007) reported no significant differences in plant growth due to different plough types including cultivator, mould board and disc harrow. This experiment was conducted to investigate the effect of different methods of weeds control on growth and yield of chickpea under rain fed conditions at Duhok province, Kurdistan Region of Iraq.

MATERIALS AND METHODS

This experiment was carried out at the fields of Agricultural College, Duhok University, Iraqi Kurdistan Region during 2009 growing season (situated between longitudes 43.01º E, latitudes 36.847º N, and altitude 583 meters). The total rainfall for February to June was 158.5 mm and the experiment was planted on silty clay soil. Local chickpea (*Cicer arietinum* L.) seeds (Marakshi) were obtained from Agricultural Research Station and treated with Dithane M45 WP fungicide 2g/kg before sowing. Seeds viability was estimated by standard germination test according to ISTA (1985) and was 100%.

The field was plowed as strips by specific ploughs (Mould board, Disc plow and Cultivator) on 14th January 2009. The field was leveled and the smooth seed bed was prepared manually. The field was divided into plots according to Strip Plot Design with the distances of 2 by 1m; each plot consisted of 4 lines; 20cm apart and 20cm between plants. Each treatment was replicate three times. The experiment included two factors: type of ploughs as a main plot and methods of weed control consisted control (check), hand hoeing, general herbicides paraquat (Gramoxone), soil herbicide trifluralin (Treflan) and, and Aloxy (haloxyfop-p-methyl 10.8% EC) in the sub plot. Trifluralin herbicide was incorporated into the soil on 2 February 2009 at a rate of 600ml/donum; (1 Donum = 1000m^2) 13ml; mixed with 14L water and spread on specified area (1.5L for each unit). Seeds were sown on 15 February 2009 at a depth of 7cm (Siddique and Loss, 1999). Paraquat (Gramoxson) 20% was applied on 10 March 2009 after planting and before emergence of seedlings at a rate of 1 L/donum; 14.5ml mixed with 15L of water and spread on the specified units. Aloxy herbicide for narrow-leaved weeds was added on April 7, 2009 at a rate of 187.5 ml / donum when the weeds were in 5-8 leaves stage; meantime hand hoeing was practiced. At full mature stage, five plants were randomly selected (5 days before harvesting)

from the middle lines of each plot for measurement of plant height, height of lowest pod and number of primary branches and then the average of these plants was calculated for each replicate. Another five plants from the middle lines of plot were taken randomly, air dried and kept in paper bags for further measurements on number of pods per plant, number of seeds per plant, and absolute weight of 100 seeds. All plants in the two middle lines were harvested to determine seed and hay yield per unit area.The most common weeds found in chickpea field were *Polygonum aviculare* L. *Carthamus oxycantha*, *Xanthium strumarium*, *Lathyrus annuus*, *Cichorium intybus*, *Centaurea iberica*, *Hypericum perforatum*, and *Sinapis arvensis*. All data were statistically analyzed according to the strip plot design using the statistical analysis system (SAS. 2001). Duncan's multiple range test was used for means separation at 0.05 probability level (Duncan, 1955).

RESULTS AND DISCUSSION

The results in Tables 1 and 2 indicated no significant effects of ploughs types on plant height and height of lowest pod. Similar results were also reported by Hemmat and Iraj (2004) and Kakarash (2007). While weed management practices significantly influenced both traits. Both trifluraline and Aloxy suppressed plant height and the height of lowest pod, this may be due to the shortage in soil moisture necessary to activate soil-applied herbicides and also reflected on the effectiveness of Aloxy herbicide. These results are in agreement with those reported by Barker (2007). Cultivator with trifluraline significantly impaired both plant height and height of the lowest pod among all other interactions which were 34.1 and 18.8 cm, respectively. It may be due to the surface plowing of cultivator and drought season that exposed the herbicide to the environmental conditions. These results are in harmony with those of different workers (Iqbal *et al.,* 1991; Dungarwal *et al.,* 2002; Varshney and Arya, 2004; Tewari and Tiwari, 2004).

Table-1. Effect of ploughs types and weed management practices and their interactions on chickpea plant height (cm).

Ploughs	Weeds Management Practices					Mean of ploughs
	Control	Hand hoeing	Gramoxone	Trifluraline	Aloxy	
Disc plow	36.34ab	35.20ab	40.27ab	35.94ab	36.3ab	36.82
Mould board	36.94ab	39.14ab	38.54ab	35.20ab	36.14ab	37.19
Cultivator	37.07ab	41.20a	41.33a	34.14b	35.74ab	37.90
Mean of weed management	36.78ab	38.52ab	40.09a	35.09b	36.07b	

For main factor or their interaction, the values that shared the same letter are not significantly different according to Duncan's multiple range test at 0.05 probability.

Table-2. Effect of ploughs types and weed management practices and their interactions on height of lowest pod (cm).

Ploughs	Weeds Management Practices					Mean of ploughs
	Control	Hand hoeing	Gramoxone	Trifluraline	Aloxy	
Disc plow	20.40ab	21.54ab	22.07ab	19.88ab	19.8ab	20.75
Mould board	20.34ab	20.34ab	22.07ab	19.67ab	21.54ab	20.79
Cultivator	22.14ab	22.60a	23.14a	18.80b	21.14ab	21.56
Mean of weed management	20.96ab	21.49ab	22.43a	19.45b	20.85ab	

For main factor or their interaction, the values that shared the same letter are not significantly different according to Duncan's multiple range test at 0.05 probability.

Ploughs types had no significant effect on the number of primary branches (Table-3). However, weed management practices have significant effects on number of primary branches per plant. Triluraline resemble the check plot in this trait, while hand hoeing and Gramoxone or Aloxy significantly enhanced the number of primary branches which gave 3.49, 3.40 and 3.12, respectively. The interaction of cultivator with trifluraline had the worst effect on number of branches (2.73); while the interaction of cultivator with hand hoeing gave the highest number of primary branches per plant (3.7).

Table-3. Effect of ploughs types and weed management practices and their interactions on the number of primary branches per plant.

Ploughs	Weeds Management Practices					Mean of ploughs
	Control	Hand hoeing	Gramoxone	Trifluraline	Aloxy	
Disc plow	2.80b	3.33ab	3.20ab	2.86ab	3.20ab	3.08
Mould board	2.86ab	3.46ab	3.46ab	3.00ab	3.06ab	3.18
Cultivator	2.86ab	3.66a	3.53ab	2.73b	3.06ab	3.18
Mean of weed management	2.85b	3.49a	3.40a	2.87b	3.12ab	

For main factor or their interaction, the values that shared the same letter are not significantly different according to Duncan's multiple range test at 0.05 probability.

Table-4 also showed no significant effect of ploughs on the number of pods per plant. Hand hoeing was the best among weed management practices and gave highest number of pods (12.67) per plant. The interaction of ploughs and weeds management practice was significant. The interaction of mould board plough with hand hoeing gave the highest number of pods per plant (13.67). These results are in agreement with those of other researchers (Ahmad *et al.,* 1990; Vaishya *et al.,* 1995; Yasin *et al.,* 1995) but in conflict with those of Kayan and Adak (2005).

Table-4. Effect of ploughs types and weed management practices and their interactions on the number of pods per plant.

Ploughs	Weeds Management Practices					Mean of ploughs
	Control	Hand hoeing	Gramoxone	Trifluraline	Aloxy	
Disc plow	9.87bc	11.60a-c	11.60a-c	11.47a-c	11.57a-c	11.22
Mould board	9.80bc	13.67a	10.47a-c	10.07a-c	9.87bc	10.78
Cultivator	10.57a-c	12.74ab	10.74a-c	9.74bc	8.47c	10.45
Mean of weed management	10.08b	12.67a	10.94ab	10.43b	9.97b	

For main factor or their interaction, the values that shared the same letter are not significantly different according to Duncan's multiple range test at 0.05 probability.

Results in Table-5 revealed no significant effects of ploughs types and weed management or their interaction on number of seeds per plant.

Table-5. Effect of ploughs types and weed management practices and their interactions on the number of seeds per plant.

Ploughs	Weeds Management Practices					Mean of ploughs
	Control	Hand hoeing	Gramoxone	Trifluraline	Aloxy	
Disc plow	8.67	11.14	10.14	10.47	11.74	10.43
Mould board	9.07	11.67	9.34	9.20	9.34	9.72
Cultivator	10.47	10.07	9.94	8.72	8.00	9.44
Mean of weed management	9.40	10.96	9.80	9.46	9.69	

Table-6 showed no significant effects of ploughs types on the weight of 100 seeds. Hand hoeing surpassed all other methods and gave 30.8g; while other treatments were not significantly different from the control. The interaction between ploughs types and weeds control methods was significant. The interaction of hand hoeing with both cultivator and disc plow gave the highest values which were 31.59 and 31.42g, respectively. This may be because of low competition of weeds (low weeds density) which led to more nutrients absorption from the soil that positively influenced seed weight. These results are confirmed by Varshney and Arya (2004); Iqbal *et al.,* (1991); Tewari and Tiwari (2004) and Dungarwal *et al.,* (2002).

Table-6. Effect of ploughs types and weed management practices and their interactions on weight of 100 seeds (gm).

Ploughs	Weeds Management Practices					Mean of ploughs
	Control	Hand hoeing	Gramoxone	Trifluraline	Aloxy	
Disc plow	25.13b-d	31.42a	25.16b-d	25.15b-d	25.16b-d	26.41
Mould board	22.07cd	29.38ab	27.70a-c	23.86b-d	24.59b-d	25.52
Cultivator	26.52a-c	31.59a	25.88ab-d	25.50a-d	20.07d	25.91
Mean of weed management	24.57b	30.80a	26.25b	24.84b	23.28b	

For main factor or their interaction, the values that shared the same letter are not significantly different according to Duncan's multiple range test at 0.05 probability.

Table-7 clearly showed that ploughs types have no significant effect on the hay yield per donum. Weed management methods significantly affected hay yield. Both hand hoeing and paraquat significantly increased hay yield which were 363.9 and 318.2 kg; respectively. The interaction of ploughs types and weed management was significant. Mould board and hand hoeing interaction significantly gave the highest hay yield per unit area. While trifluraline with mould board gave the lowest value (173.85). These results agree with those of Singh *et al.,* (2003). Hand hoeing and paraquat were effective in controlling weeds, which gave more vigorous chickpea plants.

Table-7. Effect of ploughs types and weed management practices and their interactions on hay yield (kg) per donum.

Ploughs	Weeds Management Practices					Mean of ploughs
	Control	Hand hoeing	Gramoxone	Trifluraline	Aloxy	
Disc plow	198.40ed	340.98a-c	362.08ab	175.23e	248.38a-e	252.53
Mould board	228.38b-e	384.70a	262.98a-e	173.85e	198.25ed	249.62
Cultivator	212.23c-e	365.93ab	329.58a-d	193.68ed	206.35c-e	261.55
Mean of weed management	213.00b	363.88a	318.20a	180.93b	217.68b	

For main factor or their interaction, the values that shared the same letter are not significantly different according to Duncan's multiple range test at 0.05 probability.

Table-8 demonstrated no significant effects of ploughs types on yield of chickpea per donum. Hand hoeing was the only operation that significantly increased seed yield, and most effective weed control measure increased crop growth and yield. Seed yield showed similar trend to that of hay yield. Low crop yield was mainly due to drought conditions since total rainfall from March to June was only 158.5 mm. Hand hoeing gave the highest yield (120.4 kg) followed by paraquat which gave only 78.4 kg. The interaction of hand hoeing with both cultivator and mould board gave the highest yield per donum which were 127.5 and 126.6 kg, respectively. These results agree with those of different workers (Ahmad *et al.,* 1990; Vaishya *et al.,* 1995; Yasin *et al.,* 1995; Kayan and Adak 2005; Varshney and Arya 2004; Iqbal *et al.,* 1991; Tewari and Tiwari, 2004; Dungarwal *et al.,* 2002; Singh *et al.,* 2003).

Based on the obtained results, hand hoeing is recommended for controlling weeds when possible in small areas. Herbicides such as paraquat can be used efficiently for weed control, while more research is still needed on possible use of other herbicides in large areas when hand hoeing is not practiced. It has to be supported by economic feasibility estimation to compare the cost of labor with the cost of herbicides. It must be taken in consideration that plowing may expose soil to more loss of moisture and may negatively affect growth of crop plants.

Table-8. Effect of ploughs types and weed management practices and their interactions on seed yield (kg) per donum.

Ploughs	Weeds Management Practices					Mean of ploughs
	Control	Hand hoeing	Gramoxone	Trifluraline	Aloxy	
Disc plow	47.41c	107.00ab	83.92a-c	51.25bc	68.5bc	71.62
Mould board	46.50c	126.58a	65.08bc	51.58bc	54.00bc	68.75
Cultivator	55.75bc	127.50a	86.17a-c	48.92c	35.92c	70.85
Mean of weed management	49.89b	120.36a	78.39b	50.58b	52.81b	

For main factor or their interaction, the values that shared the same letter are not significantly different according to Duncan's multiple range test at 0.05 probability.

REFERENCES CITED

Abbas, A.I. 1990. Status of chickpea production in Iraq. *In:* Chickpea in the nineties: proceedings of the Second International Workshop on Chickpea Improvement, 4-8 Dec, 1989, ICRISAT Center, India. pp. 293-294.

Ahmad, M., S. Khalid, and S. U. Siddiqui. 1990. Efficacy of pre and post emergence herbicides and their application methods on the growth, yield and nodulation of chickpea (*Cicer arietinum* L.). Pak. J. Weed Sci. Res. 3(2):89-97.

Barker B. 2007. Broadleaf weed control in chickpeas shows potential http://www.topcropmanager.com/content/view/1010/67/

Barzegar, A.R., M.A. Asoodar, A. Khadish, A.M. Hashemi and S.J. Herbert. 2003. Soil physical characteristic and chickpea yield responses to tillage treatments. Soil and Tillage Res. 71(1): 49-57.

Chaudhary, B.M., J.J. Patel and D.R. Delvadia. 2005. Effect of weed management practices and seed rates on weeds and yield of chickpea. Indian J. Weed Sci. 37(3/4): 271-272.

Duncan, D. E. 1955. Multiple range and multiple F-tests Biometrics 11: 1-42.

Dungarwal, H.S., P.C. Chaplot and B.L. Nagda. 2002. Chemical weed control in chickpea (*Cicer arietinum* L.). Indian J. Weed Sci. 34(3/4): 208-212.

Hemmat, A. and E. Iraj. 2004. Tillage system effect upon productivity of a dryland winter wheat- chickpea rotation in the northwest region of Iran. Soil and Till. Res. 78(1): 69-81.

International Seed Testing Association ISTA, 1985. International Seed Testing Association (ISTA), International Rules for Seed Testing. Rules 1985. Seed Sci. Technol. 13: 299–355

Iqbal, J., M. Tariq, A.C. Iftikhar and A.C. Zahid. 1991. Effect of herbicides on the growth and yield of chickpea (*Cicer arietinum*). J. Agric. Res. 29(4): 501-505.

Kakarash, S.A. 2007. Ecophysiological study of soil seed bank for different arable systems at Erbil Governorate. M.Sc. Thesis. College of Agriculture, Salah-Alddin University, Erbil, Iraq.

Kayan, N. and M.S. Adak. 2005. Effects of different soil tillage methods, weed control and phosphorus fertilizer doses on yield components in chickpea under Central Anatolian conditions. Pak. J. Biol. Sci. 8(11): 1503-1506.

Khattak, M.K. and M.J. Khan. 2005. Effect of different tillage practices on weeds and yield of chickpea under sandy loam soil condition. Pak. J. Weed Sci. 11(3/4): 157-164.

Kumar, Y., O.P. Gupta and O.P. Gill. 1989. Weed control studies in irrigated chickpea in Rajasthan, India. Sukhadia University, ICN 21 p. 28-30.

SAS. 2001. SAS/STAT\User's Guide for personal computers. Release 6.12. SAS Institute Inc., Cary, NC, USA.

Siddique, K.H.M. and S.P. Loss. 1999. Studies on sowing depth for chickpea (*Cicer arietinum* L.), faba bean (*Vicia faba* L.) and lentil (*Lens culinaris* Medik) in a Mediterranean-type environment of south-western Australia. J. Agron. and Crop Sci. 182:105–112.

Singh, A., K.K. Vashist and J.S. Kang. 2003. Chemical weed control in irrigated desi gram (*Cicer arietinum* L.) Indian J. Weed Sci. 35 (1/2): 136-138.

Tewari, A.N. and S.N. Tiwari. 2004. Chemical control of *Asphodelus tenuifolius* infesting gram (*Cicer arietinum*) under rainfed condition. Indian J. Agric. Sci. 74(8): 436-437.

Vaishya, R.D., M. Fayaz, S. Singh and A.L. Rajput. 1995. Effect of seed rate and weed-management practice on nodulation and yield of chickpea (*Cicer arietinum*). Indian J. Agron. 40(2): 312-313.

Varshney, J.G. and R.L. Arya. 2004. Effect of integrated nutrients use and weed-control methods on sole gram (*Cicer arietinum*) and gram+Indian mustard (*Brassica juncea*) intercropping system. Indian J. Agri. Sci. 74(3):121-125.

Yasin, J.Z., S.Al-Thahabi, B.E. Abu-Irmaileh, M.C. Saxena, and N.I. Haddad. 1995. Chemical weed control in chickpea and lentil. Intern. J. Pest Manage. 41(1): 60-65.