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EFFECT OF DIFFERENT TILLAGE PRACTICES ON WEEDS AND YIELD OF CHICKPEA UNDER SANDY LOAM SOIL CONDITIONS

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ABSTRACT

Field experiments on tillage were conducted under sandy loam soil conditions in District Karak, Pakistan on chickpea fallow rotation during 2002 –05. The effect of tillage practices on number of weeds as well as on yield of chickpea was studied in the experiment. The Tillage treatments used in the experiments were: i) No Till (NT), ii) Chisel plow once and Tine Type Cultivator two times (CPTC2), iii) Mold board plough once and Tine Type Cultivator two times (MBTC2), iv) Disc Harrow once and Tine Type Cultivator two times (DHTC2), and v) Tine Type Cultivator three times (TC3). Tillage treatments were replicated four times under Randomized Complete Block Design (RCBD). Maximum yield of chickpea was obtained from treatment CPTC2 (1968 kg ha^{-1}) i.e 18.98% more than the lowest treatment. The minimum chickpea yield was recorded for NT producing 1695 kg ha^{-1}. This increase might be due to better control of weeds, improved soil moisture and nutrients in CPTC2 tillage treatment that ultimately led to higher chickpea yield. In general, increase in rainfall during the chickpea-growing season increased the weed density m^{-2} under rainfed conditions. It is concluded that if chisel plow is not available, MBTC2 is also a better alternative technique for controlling weeds and conserving moisture under sandy loam soil conditions.

Key words: Chickpea, No- till, deep tillage, chisel plow, cultivator, weed control, yield

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the most important pulse as well as a vegetable crop in Pakistan in general and in the southern region of NWFP in particular. Average chickpea yields are very low as compared to other chickpea producing countries. The major factors responsible for low crop productivity of chickpea in NWFP are; low organic matter in soil, poor soil structure, deficiency of macro and micro nutrients, soil erosion, weeds and improper use of tillage practices. In Pakistan, chickpea was grown during 2003-4 on total area of 0.982 million hectares with total production of 0.611 million tones with an average yield of 622 kg ha^{-1}. In NWFP, chickpea was grown on 0.052 million hectares under rainfed area and the production was 0.020 million tones with an average yield of 377 kg ha^{-1} (Anonymous, 2004)

Weeds are serious negative factor for crop production, which result in great losses in crop yield, despite the use of costly inputs. The reasons for low yields are many, but one of the most serious, but less noticeable cause is the presence of weeds. Weeds compete with crops, resulting into low yield. In the research site, weeds were also one of the serious problem. Tillage is a good method for management of weeds, as it is easier, economical and

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less time dependent as compared to manual method, or use of herbicides. The necessity of adequate weed control cannot be over emphasized and there is a good reason to suppose that it is as important, if not more important, to the crop as the provision of a good seedbed. Tillage is the cheapest method for controlling weeds. Chaudary *et al.*, (1985) studied the effect of deep tillage on the yield of wheat crop. They found grain yield of wheat generally higher in deep tillage (11%) than Zero-tillage in sandy and loamy sand soils. The incorporation of crop residues in tillage plot produced high grain yield than left on surface as much under zero-tillage (Maurya, 1988). In several other studies carried out by the researchers Hobbs *et al*, (1986); Khan *et al*, (1986); Majid *et al.*, (1987); Gill and Aulukh (1990); Khan *et al.*, (1990); Razzaq *et al.*, (1990); Jankee *et al.*, (1991); and Rehman *et al.*, (1995) reported the effect of tillage on plant growth and yield of wheat in sandy loam, silty loam, silty clay, silty clay loam soil. They found highest wheat grain yield (10 - 44%) and straw (20%) more in moldboard plowing than the conventional method of land preparation. In another study, Khokhar and Nizami, (1987) said that chisel and subsoiler plowing gave 8 and 20% more grain yield of wheat than cultivator in a loamy soil in the rainfed area respectively.

The control of weeds without the use of chemical herbicides is an essential component of successful organic farming practices. Tillage alone or in combination with cropping pattern often is the most economical method for weed control. Herbicides are more effective method to kill weeds, however, more expensive due to high cost. Moreover, their application is very cumbersome in the rainfed areas due to the scarce availability of water. Researchers attributed the increase in yield due to loosening of the soil deeper, which encourage root development, better moisture conservation and weed control. Compbell *et al*, (1988) evaluated deep tillage with mould board plow compared to normal shallow tine cultivator. It was observed that mould board plough more loosens the soil, increasing infiltration and recharge during rainfall, and enhancing root penetration and evapo-transpiration. Deep plowing also reduces compaction. It may also increase nutrient availability by bringing nutrients up from the B-horizon and by enhancing oxidation and release of nutrients from soil minerals.

The selection of suitable tillage practices for maintaining good tilth is the objective of this study for chickpea growers. Soil tilth essentially refers to a soil structure with many small soil aggregates and limited compaction. Although to determine the relationship between soil tilth and weed control is the most important critical factor. Tillage plays an important role in the crop production. However, very little is known about the enhancement of chickpea yield by controlling weeds with tillage practices. Therefore, a three year research studies were conducted to compare the effectiveness of various tillage implements combinations on controlling weeds and its effect on yield of chickpea. The specific objectives of the studies were as follows;

1. Effect of different tillage practices on weed control under chickpea-fallow rotation
2. Effect of different tillage practices on yield of chickpea.

MATERIALS AND METHODS

Research studies were conducted in district Karak, NWFP, Pakistan, for three years during 2002 – 03, 2003 – 04, and 2004 - 05 to study the effect of different tillage practices on weed and yield of chickpea under sandy loam soil. The research site was located at latitude of 33° -08, longitude of 71° -06' and altitude of 503 m from the main sea level. The tillage implements used were; moldboard plow, chisel plow, cultivator and disk harrow. The experiment was set up in randomized complete block design (RCBD) with five treatments and four replications. Treatments combinations were;

NT	No-till
CPTC2:	Chisel Plough once and Tine Type Cultivator twice
MBTC2	Mold board plough once and Tine Type Cultivator twice
DHTC2	Disc Harrow once and Tine Type Cultivator twice
TC3	Tine Type Cultivator three times (Farmer's practices)

A total of 20 plots of chickpea were used for the experiments and each treatment measured 40 m x 8 m. Chickpea variety KK1 was used in the experiment. Recommended doses of fertilizers (urea 125 kg ha^{-1} and DAP 125 kg ha^{-1}) were applied during seedbed preparation. The chickpea was seeded @100 kg ha^{-1} in the experiment. Row to row spacing was 30 cm and other inputs were applied uniformly to all the treatments.

Tillage practices wherever applicable were applied two times before sowing of crop. First time, tillage practices were used in the month of June before the start of monsoon rainy season. Second time, tillage practices were applied in the first week of October for preparation of seedbed before sowing of crop.

Data recording

Weed density data were recorded from six randomly selected places at each treatment by using 1 m^{-2} quadrate, at pod filling stage of the crop. Eighteen plants were randomly selected in each treatment, for recording the data on pods $plant^{-1}$ of chickpea and means were calculated. For straw weight and grain yield, six samples of 1 m^{-2} area of chickpea crop were randomly harvested in each treatment and straw and grain yield data were recorded in g m^{-2} after threshing of crop. The grain yield data were subsequently converted to kg ha^{-1}. After threshing, a representative sample of 1000 grains was drawn out from each treatment and weighed with the help of electronic balance.

Rainfall

Rainfall data for the years 2002 - 03, 2003 – 04 and 2004 – 05, are shown in Table – I. The data exhibit a very scanty rainfall during 2003-4, which is even less than half during the other two years of studies during the crop growing season. However, during the Fallow period the rainfall was about 2 times higher during 2003-4 as compared to the other two years of experimentation (Table-1).

Table-1. Rainfall at Research site for the years 2002 – 05

	2002 -03	2003 - 04	2004-05
		(mm)	
Fallow rainfall (June – September)	202	455	260
Crop growing season (October – April)	205	98	257

Source. Manual rain gauge as installed at the research site.

RESULTS AND DISCUSSION

Weed density m^{-2}

During the growing seasons of chickpea 2002 – 03, average weed density after tillage practices are shown in Table -2. The number of weeds ranged from 6 – 10 m^{-2}. There was no significant difference among various tillage practices. During the year 2003 – 04.

mean weed density ranged from 3 – 6 m^{-2} (Table –1). There was significant affect of tillage on weeds. The higher weed density of 6 m^{-2} was observed in tillage treatments NT and the lower weed density of 3 m^{-2} in tillage treatments CPTC2 and DHTC2, followed by MBTC2 and TC3 having a density of 4 plants m^{-2}. During the last year 2004 – 05, average weed density ranged from 5 – 12 m^{-2} as shown in Table – 2l. The highest (12 m^{-2}) weed density was recorded in tillage treatments NT and the least 5 m^{-2} weed density was noted for MBTC2 tillage treatment. Mean of three years growing seasons of chickpea 2002 – 05, show average density after tillage practices and it ranged from 5 – 9 m^{-2}. The highest weed density of 9 m^{-2} was observed in tillage treatments NT and the lowest weed density of 5 m^{-2} for tillage treatments CPTC2 and MBTC2, followed by DHTC2 having 6 plants m^{-2}. The predominant weeds infesting the experiments were; *Asphodelus tenuifolius* (wild onion), *Carthamus oxycantha* (woolly distaff thistle), *Convolvulus arvensis* (field bindweed), *Cynodon dactylon* (bermuda grass) and *Euphorbia helioscopia* (leafy spurge).

No. of pods plant^{-1}

During the growing season 2002-03, pods plant^{-1} ranged from 24 to 36 (Table-3). The maximum (36 pods plant^{-1}) were recorded for DHTC2, while minimum 24 and 25 pods plant^{-1} were noted for NT followed by CPTC2. During the year 2003 –04, pods plant^{-1} ranged from 33 – 41 as given in Table-3. The highest (41 pods plant^{-1}) were observed for CPTC2 and the lowest 33 pods plant^{-1} were recorded for NT. The differences were statistically significant among various tillage treatments. In year 2004 –05, pods plant^{-1} varied from 38 – 63 as given in Table-3. There was significantly variation among different tillage treatments. The maximum 63 pods plant^{-1} were counted for CPTC2, while the minimum 38 pods plant^{-1} were found in DHTC2 tillage treatment. Overall during the growing season 2002-05, mean pods plant^{-1} data ranged from 34 to 43 (Table-3). A maximum pods plant^{-1} of 43 were recorded for CPTC2 followed by MBTC2 and TC3 (39) each, while the minimum of 34 pods plant^{-1} were recorded for NT. There were statistically significant differences in number of pods plant^{-1} among various tillage treatments as indicated by means of the years. These result show that different tillage practices can affect the yield components of chickpea.

1000 grain weight (g)

The 1000-grain weight recorded ranged from 195 to 200 g during 2002-2003 as shown in Table-4. Maximum 1000 grain weight of 200 g was obtained from MBTC2 closely followed by DHTC2 (199 g), while minimum (195 g) weight was recorded for TC3, followed by CPTC2 (196 g). There was significant variation in all the tillage treatments. During 2003 – 2004, 1000 grain weight values ranged from 184 to 191 g as shown in Table-4, however there was no significant difference in all the tillage treatments. During the year 2004 –05, 1000 grain weight ranged between 180 and 190 g. Maximum 1000-grain weight 190 g for chickpea seed was obtained from MBTC2, while minimum was obtained from CPTC2 weighing 180 g. There were statistical differences in all the tillage treatments. Based on the three year mean data, the mean maximum 1000-grains weight of 192 g each was obtained from DHTC2 and MBTC2, followed by TC3 (191 g), while the minimum was obtained for CPTC2 and NT of 188 g each. There was significant difference among the tillage treatments. Thus, we can conclude from the findings that tillage practices affect the growth and development of the crop and hence the yield and other yield components. Tillage not only affects the weed establishment but also the root penetration and moisture availability for the plants.

Straw weight (g m^{-2})

Statistical analysis of the data showed that straw weight during the year 2002 – 03, varied from 183 to 206 g m^{-2}. Maximum straw weight was recorded for MBTC2 (206 g

m^{-2}), while minimum was observed for NT of 183 g m^{-2} as shown in Table-5. Significant differences were found in the straw weight of chickpea among various tillage treatments. During 2003 – 04, straw weight ranged from 188 to 211 g m^{-2} (Table-5). The highest 211 g m^{-2} straw weight was recorded for MBTC2 and the lowest 188 g m^{-2} straw weight was noted for NT. Thus there was a significant difference in the straw weight of chickpea among the tillage treatments. In year 2004 – 05, straw weight varied from 300 to 419 g m^{-2} as given in Table-5. The maximum straw weight of 419 g m^{-2} was noted for MBTC2, while minimum straw weight of 300 g m^{-2} was recorded for TC3. Overall mean of the three years (2002 – 05) straw weight ranged between 228 to 279 g m^{-2}. The maximum straw weight was recorded for MBTC2 (279 g m^{-2}), while the minimum was recorded for NT and TC3 of 228 g m^{-2} as shown in Table-5. The data indicates that there is a big difference in the three years. It may be attributed to the fact that total rainfall was comparatively higher in 2004 – 05 as compared to the 2002 – 03 and 2003 – 04. Hence higher rainfall (Table –I) enabled chickpea to achieve bigger vegetative growth and thus accumulated more biomass.

Grain yield (kg ha^{-1})

ANOVA showed that during 2002 –03, grain yield of chickpea was recorded in the range of 1549 to 1678 kg ha^{-1} as shown in Table-6. The highest 1678 kg ha^{-1} grain yield was recorded in the tillage treatment DHTC2, while the lowest 1549 kg ha^{-1} grain yield was found in NT tillage treatment. There was a significant difference in grain yield of chickpea in all the tillage treatments. During 2003 – 04, grain yield ranged from 1277 to 2093 kg ha^{-1} (Table-6) Maximum grain and statistically significant yield of 2093 kg ha^{-1} was produced by CPTC2 and the minimum grain yield of 1277 kg ha^{-1} was found in DHTC2 tillage treatment In year 2004 – 05, grain yield was recorded in the range of 1593 to 2177 kg ha^{-1} (Table 6) The highest 2177 kg ha^{-1} grain yield of chickpea was obtained in the tillage treatment CPTC2, while the lowest yield of 1593 kg ha^{-1} was recorded in NT tillage treatment. There was a significant variation in grain yield of chickpea in all the tillage treatments.

Overall mean of the three years 2002 – 05 exhibited that grain yield of chickpea ranged from 1653 to 1968 kg ha^{-1}. Mean highest grain yield of chickpea was recorded in the tillage treatment CPTC2 of 1968 kg ha^{-1}, while the lowest 1695 kg ha^{-1} was found in NT There was a statistically significant variation in grain yield of chickpea in all the tillage treatments. Tillage treatment CPTC2 produced 18.98% and 16.12% higher grain yield as compared to TC3 (farmer's practices) and NT, respectively, While the tillage treatments NT and TC3 almost produced the same chickpea grain yield. These results are in close agreement with the findings of Ahmad *et al.*, (1990) they reported that the average grain yield of chisel plow was significantly higher as compared to moldboard plough and cultivator The increase in grain yield by chisel plough occurred due to deep root system, increased root spreading due to breaking sub-soil layer, weed control, increased infiltration rate, decreased run-off and soil erosion, increased water efficiency and increased soil water storage Zentner *et al.*, (2002) reported that relatively poor economic performance of conservation tillage practices reflects 13% higher cost for controlling weeds by using herbicides than the conventional tillage practices on silt loam and clay soils. It is concluded that CPTC3 is the best tillage practices for controlling weeds as well as for increasing yield in sandy loam soil, however MBTC2 is also suitable for sandy loam type of soil. The findings of the instant project lead us to the conclusion, that deep tillage not only conserves soil moisture but, also reduces weed density in rainfed conditions. As there is a scarcity of water in southern districts of NWFP, hence in chickpea-fallow system, deep tillage in the summer months may be employed for moisture conservation during the fallow period

Table-2. Effect of various tillage practices on weed density during chickpea growing seasons 2002 - 2005

Treatments	Weed density (m^{-2})			
	2002 – 03	2003 – 04	2004 - 05	Means
NT	10	6 a	12 a	9 a
CPTC2	7	3 b	6 bc	5 c
DHTC2	9	3 b	6 bc	6 bc
MBTC2	6	4 b	5 c	5 c
TC3	9	4 b	7 b	7 b
$LSD_{0.05}$	NS	1.71	1.99	1.41

Means in the respective column, bearing the same letter are not statistically different from one another at $LSD_{0.05}$.

Table-3. Effect of various tillage treatments on No. of pods plant^{-1} during chickpea growing seasons 2002 - 2005.

Treatments	No. of Pods plant^{-1}			
	2002 – 03	2003 – 04	2004 - 05	Means
NT	24 d	33 e	45 c	34 d
CPTC2	25 d	41 a	63 a	43 a
DHTC2	36 a	35 d	38 d	36 c
MBTC2	31 b	36 c	50 b	39 b
TC3	28 c	38 b	51 b	39 b
$LSD_{0.05}$	2.67	0.85	3.25	1.99

Means in the respective column, bearing the same letter are not statistically different from one another at $LSD_{0.05}$.

Table-4. Effect of various tillage treatments on 1000-grains weight during chickpea growing seasons 2002 - 2005.

Treatments	1000 grains weight (g)			
	2002 – 03	2003 – 04	2004 - 05	Means
NT	198 ab	184	182 bc	188 b
CPTC2	196 b	187	180 c	187 b
DHTC2	199 ab	190	186 abc	192 a
MBTC2	200 a	186	190 a	192 a
TC3	195 b	191	188 ab	192 a
$LSD_{0.05}$	3.17	NS	6.57	3.47

Means in the respective column, bearing the same letter are not statistically different from one another at $LSD_{0.05}$.

Table-5. Effect of various tillage treatments on straw weight during chickpea growing seasons 2002 - 2005.

Treatments	Straw weight ($g\ m^{-2}$)			
	2002 - 03	2003 – 04	2004 - 05	Means
NT	183 c	188 d	313 c	228 d
CPTC2	186 bc	206 b	378 b	257 b
DHTC2	186 bc	195 c	374 b	252 c
MBTC2	206 a	211 a	419 a	279 a
TC3	187 b	196 c	300 d	228 d
$LSD_{0.05}$	3.06	5.04	9.60	4.33

Means in the respective column, bearing the same letter are not statistically different from one another at $LSD_{0.05}$.

Table-6. Effect of various tillage treatments on grain yield during chickpea growing seasons 2002 - 2005.

Treatments	Grain yield ($kg\ ha^{-1}$)			
	2002 - 03	2003 – 04	2004 - 05	Means
NT	1549 e	1740 c	1797 c	1695 c
CPTC2	1634 b	2093 a	2177 a	1968 a
DHTC2	1678 a	1277 e	2003 b	1653 d
MBTC2	1594 c	1559 d	2054 b	1736 b
TC3	1571 d	1798 b	1593 d	1654 d
$LSD_{0.05}$	16.57	57.18	55.79	31.39

Means in the respective column, bearing the same letter are not statistically different from one another at $LSD_{0.05}$.

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