

Comparison of Conservation and Conventional Tillage Systems in Corn Fields and their Effect on Weed Density in West Azarbaijanin Iran

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Abstract – In order to study the influence of tillage method on weed control in corn (single cross 704), an experiment was conducted in Miandoab research station for 3 years from 2006-2009. Design of experiment was split plot based on random block designed. Main factor was two tillage method with chisel and mould board plow in 25 cm depth and weed control methods as sub factor in 4 were: chemical control with using of 1.2 Kg /ha Atrazin (Gezaprin 80 % W.P.) +4 lit/ha E.C), mechanical control with 2 times cultivation between rows in 4 and 8 leaves stage of corn, control treatment without weeds (with 3 –hand weeding) and control treatment with weeds. Analysis of variance results indicated that the effect of tillage methods on corn yield was no significant. Average of corn yield in different tillage methods were 9.422 and 9.148 respectively but the effect of control methods was significant at 1%. Means comparison by Duncans multiple range test showed that chemical weed control and hand weeding respectively with 11.28 and 10.85 were placed in a same group but mechanical weed control and without control treatments respectively with 8.654 and 6.357 were placed in another groups. Analysis variance of results indicated that the effect of tillage methods on density of *Echinochloa crus – galli* and *Portulacaolearaceae* had significant effect at 1 % but on the other weeds, tillage method did not show any effect on their density. Average of density of *Echinochloa crus-galli* during 3 years with mould board plow and chisel were 43.08 and 12.00 respectively and average of density of *Portulacaolearaceae* with mould board plow and chisel were 6.92 and 14.5 respectively and they were placed in separated group by using of Duncans multiple range test.

Keywords – Corn, Tillage, Conservation, Conventional, Weed control.

I. INTRODUCTION

Nowadays discussion about optimize fuel usage are very noticeable and the most of investigated projects are conducted in order to offering some methods and useful techniques, for better consumption of energy resources. Soil tillage are the most important operations of agricultural systems which have generally dedicated more than 50% of whole consumed energy for crop production. So, applying various methods of plowing will be an effective movement in reducing energy consumption in agricultural activities. Applying mould board plow in comparing with chisel, for the primary soil tillage, needs more energy and is the most time consuming step. In these method the soil moisture evaporate much more, and its texture destroys therefore soil is exposed to windy erosion. With continuing applications or mould board plow, the soil surface will be more disturbed and results will be forming the plowing pans which usually forms when tillage occurs

in a constant depth of soil and cause the reducing of plant roots extension and penetration. On the other hand, tillage with chisel produce less control on weeds [7]. Dawiti et al. during 10 years study on Corn and Soybean rotating planting system, has found that plowing system by mould board plow with ignoring the kinds of crop in rotation system, has been resulted in a maximum crop yield. In none of the soil tillage systems neither ordinary nor protective one, in the mentioned period, any reduction has been observed in crop yield. This demonstrates that, the minimum soil tillage systems do not cause any reduction in corn yield. The effect of year on operation in both ordinary and protective soil tillage was not significant. In continues plantings of corn, the applying mould board plow in soil, has the maximum investment retention, while in corn-soybean alternative plantings, applying the chisel, has showed the most investment retention. This study has demonstrated that the protective soil tillage system could perform without any noticeable losses in investment retention and significant increase in chemical pesticides applications [1]. Kitur et Al. (1993) had reported that in comparing the soil tillage methods on silt-loam soils, the yield of corn in no tillage method system was 8.4 tons per hector in the first year, and tillage with mould board plow and chisel resulted in 10.5 and 9.3 tons per hector, respectively. In the second years, the effect of soil tillage method on corn yield was not significant, therefore, protective soil tillage (chisel or none) have been recommended for sloping fields [13]. Yyne and Rimbalt (1993) have declared that application of chisel in a period of 5 years in autumn season, resulted in 5% losses of yield in comparing to mold board plow [20]. Shainer and Nelson (1988), after investigating the six methods of soil tillage, have found that, in duration of 3 years, only no tillage method had less yield than the other systems [19]. According to the reports of Michael (1995), tillage by chisel caused the equal yield as tillage by mould board plow. He found that tillage with chisel need less fuel, energy (40%) and time. [16]. Ruks (1993) according to his economic studies has found that, the application of chisel has better and more direct investment retention than the other methods [18]. Biabani et al (2014) in an experiment with three Tillage treatments included conventional tillage, reduced tillage and no tillage and weed control showed that there was no significant difference on weed density in different tillage methods before herbicide spraying. The highest weed density was observed in no tillage (172 plants m²) and the lowest with 65 plant/m² was observed with reduced tillage [4].

Yyne and Rimbalt (1993) declared that soil cone index in chisel was more than mould board plow [20]. Kitur et al.

(1994) have reported that the effect of soil tillage method on resistance of soil to penetrating in silt-loam soil was limited to plowing layer (about 23 cm), and cone index in depths was less than 23 cm for all treatments, and it was less than 2 mega Pascal [13].

Hudak (1989) showed that in sloppy fields, with good drainage and low organic materials, the protective soil tillage methods showed equal crop yield or more, compared to the ordinary soil tillage in corn. In a field with weak drainage and low organic materials and weak soil structures, protective soil tillage with taking time showed improved soil structure, in a way that the organic matters and soil grains increased. The corn yield has improved with time and often was more than the ordinary soil tillage methods [11].

Milader et al (1995) have mentioned that in the reduced tillage systems in comparing to the systems by mould board plow results include in: i) increase in organic matters of soil, which promotes increasing the water holding ability of soil ii) increasing earthworm's populations that allows to promoting the water penetration into soil, and decreasing the erosion and soil washings [16].

Biabani et al (2014) accomplished an experiment in order to investigate the effect of tillage methods on weed control and forage corn in north of Ahwaz in Khuzestan (Iran) on 2013-2014. The experimental design was split plot in a completely randomized block design with three Tillage treatments included conventional tillage, reduced tillage and no tillage and weed control include spraying with five treatments microneer sprayers, Atomizer and hydraulic (with nozzle Teejet) were performed three replications. Results showed that between tillage methods of weed density before spraying, there was no significant difference in the tillage and weed plants per 172 square meters which is the highest density with reduced tillage (131 plants m) was not significant. However, conventional tillage (70 plants per square meter) was significantly different. [4].

John R. Teasdale and Steven B. Mirsky on 2015 reported that Tillage, cover crop management, and crop planting date are factors that influence emergence periodicity and growth potential of important weed species inorganic grain production. They assessed two hairy vetch cover crop management practices, disk-kill and roll-kill, across a range of corn planting dates from early May to late June in three experiments in Beltsville, MD. Patterns of seed dormancy, emergence, and early weed growth were determined for over seeded populations of common ragweed, giant foxtail, and smooth pigweed, three important species in the Mid-Atlantic States that represent early to late emergence. Common ragweed emergence was lowest and dormancy was highest of the three species across all planting dates. Giant foxtail emergence was higher than the other species in roll-killed hairy vetch and included a significant number of seeds that germinated before rolling operations in late June [12].

Larny (1989) has reported that, by lesser intensity of soil disturbance, we would obtain the maximum resistance closer to soil level, and for mould board plow the

maximum depth to cone index was greater than chisel and the maximum resistance to soil tillage via chisel was about 22-25 cm and in soil tillage via mould board plow was limited to 23-40 cm [21]. Choi (1998) has demonstrated that, the external specific bulk of soil is not significantly affected by the kind of soil tillage, but it is affected by depth changing, and the variations of external specific bulk is significant [14]. Kitur et al (1994) have declared that among of the different methods of soil tillage systems, especially in depths of 8-16 cm, show a significant differences ($P < 0.05$) between the both chisel and mould board plow systems [13]. Bosnic et al (1997) has reported that the cone index is affected by the kinds and depths of soil tillage [5]. Leblans et al (1995) have showed that applying herbicides and cultivators between rows, 2-4 weeks after germination of corn increased crop yield and they observed remarkable yield and better weeds control [15].

Weeds control is the most beneficial effect of useful plowing. Different experiments has demonstrated that in the soils without weeds, in plowed fields any significant increase in crop yield has not been showed [1]. Corn is a kind of plants that have more growth in high temperature and light, but have low growth in low temperatures. So, this would be more sensitive in beginning of its growth, whenever the weather in not suitable for this purpose, it would be more sensitive to weeds. The researches which have conducted for estimating the weeds damages had demonstrated that, its damage level in German is 45%, in Russia is 30%, in Indonesia is 50%, and in USA is about 41% up to 86% [2].

Soil seed bank (various seeds which are stored in soil) is the most important origin of weed attacks in most of the plowed fields. Soil tillage by disturbing the soil structure, affected directly the seeds bank. Soil tillage following with herbicides usage, with decreasing indirectly the seed production of plants, would affect the gene bank. This kind of operations, would affected the seed bank characteristics such as seeds number, their growth ability, seeds dormancy, and combination of species. Changes in seed bank characteristics often lead to change in species combinations and varying in flora of weeds [10].

The results of several studies have demonstrated that the effects of soil tillage on species combinations are different, and mostly depend on the planting systems and its duration [16]. Ball (1990) has performed an experiment (1985 to 1987) in order to evaluate the effects of primary soil tillage (plowing by chisel and reversible plough), secondary soil tillage (cultivator application) and herbicides application on weed control, altering the population of weeds species, seed bank in soil during the period of three years. In this study the rotation were: continuous planting of corn for 3 years (CN), continuous planting green bean for 3 years (PB), and planting of sugar bean for 2 years and corn in third year (SB). By comparing the chisel with mould board plow, they have demonstrated that the seeds of weeds after plowing by chisel have more dispersed to near of soil level than plowing by reversible plough. Some annual weeds densities after plowing by chisel have showed a high amount of seeds in seed bank

during three years period. The most important species that have showed remarkable increase in PB are mentioned in bellow:

Chenopodium album, *Amaranthusretroflexas*, *Eragrostiscilianensis*, *Solanumsarrachoides*

Reversely, the seeds density of *Kochiascoparia* in plowed plates by chisel in SB plant system has rapidly decreased in. [3].

II. MATERIALS AND METHODS

Present study was conducted in agricultural research center in Miandoab, West Azarbyjan – Iran, with 46 o 9' longitudes and 36 o 58' latitudes and 1371 meter high from sea level during 2006-2009. This station has dry and semi dry regimes and Mesick thermal regime. Average annual raining is about 286- 330 mm, and its soil structure was silt-loam (river sediments) with 8.9 and its electrical conductivity was 1.21 mmos / cm. Experiments were arranged in randomized complete block design with 4 replications in each of three years. Soil tillage treatments and different weeds controlling methods according to the plan are summarized in. Fertilizer applications were done after soil analyses results.

Corn seeds were planted in 4 rows with 75cm distance from each other, and with 20.5 cm distance between plants in each row. The planting area was 9.225 square meter (harvesting was from 2 middle rows). The spaces between blocks were 4 meter and the spaces between plots were one planting line. Single cross 704 corn seed with 65000 seeds density per hector were sowed by corn planting machine in rows. Chemical controlling treatments was done immediately after irrigation by back sprayer with 1.5 bars compact equipped with hand grip and nozzle row sprayer, and water consumption is about 500 liter per hector. 2, 4, D herbicide was then applied in 4 leaves stage of corn plants. First and second cultivator usage in mechanical controlling treatments were done in 4 and 8 leaves stage of corn plants.

In soil tillage treatments by mould board plow, plowing was done in 25cm depth in spring, and then disc and leveler were applied and then planting were done. However, plowing by chisel was done in the same depth and spring plowing were done in 25cm depth by chisel, and then disc and leveler were applied and then planting were done.

III. RESULTS AND DISCUSSION

Effects of soil tillage methods on weeds density

During the first year of experiment main factor of soil tillage methods mould board and chisel level in 25cm depth, none of treatments expect of *Portulacaoleraceae*, has not shown a significant effect on the weeds density.

During the second year of experiment soil tillage did not have any significant effects on weeds density but in third year of experiment the effects were significant ($P < 0.05$). Combine analyses of variance showed that the soil tillage methods have a significant effect on *Echinochloa crus-galli* and *Portulacaoleraceae*'s density ($P < 0.01$) (Table 2). Average of *Echinochloa crus-galli* density in mould board plow and chisel application were 43.083 and 12 plants per square, and the average of *Portulacaoleraceae* density in plowing by mould board plow and chisel were 6.917 and 14.5, respectively. Concerning to *Amaranthusretroflexus* the results were in agreement with Oryokot et al results (1997) that investigated the effects of different plowing methods on germination, phenology and density of *Amaranthusretroflexus* plants. According to their result, although plowing is necessary for germination of most of the weeds, but in the case of *Amaranthusretroflexus* plowing has less importance in prediction of dynamic population and controlling of it [17]. As the results of Oryokot's experiments mentioned before, soil tillage by chisel in comparing with mould board plow causes variation in annual weeds density.

Effects of weed control methods on weeds density

Weed control methods during three years had significant effects on weeds density in corn field ($P < 0.01$) (Tables 1, 2). Comparing the average of weed density during three years tillage demonstrated that mechanical control with control treatment (without any weed control) concerning their effect on *Echinochloa crus-galli*, *Chenopodiumalbum*, *Convolvulusarvensis*, and *Amaranthusretroflexus* were placed in the same statistical group and chemical control and manual weeding both were placed in another group. Concerning to *Portulacaoleraceae*, controlling methods were placed in different groups (Table 4).

Reviewing the results has demonstrated that the mechanical control treatments were 27.41% effective in weeds control in corn field on Miandoab area, West Azarbayjan province, and this controlling method in comparing with chemical control has resulted in yield loss about 42.01% comparing to chemical control treatment (highest yield). Chemical control had been confirmed as the best and highest weeds control in both soil tillage methods.

Additionally, changing the soil tillage system from traditional (mould board plow) to conservative system (chisel) caused some changes in combination of weed species via germination rate of species seeds in reaction to the different soil tillage. These species are mostly included annual weeds in which soil tillage caused to gathering seeds of these weeds near to the soil surface by chisel plow, while by reversible plough they dispersed in all over the soil layers, almost uniformly.

Table 1: Combined Analyses variance of yield

variance sources	Freedom degree	Square means			
		Weight 100 gram	Interval of crown flower to silk flower appearance	Seed yield	Seeds number in rows
Year	2	17.573	0.042	1.968	0.281
Repetition	9	10.385	0.167	3.572	34.941
Tillage Factor	1	1.260 ns	0.167 ns	1.859 ns	10.010 ns
Year * Tillage	2	2.823 ns	0.042 ns	0.479 ns	11.885
Error	9	2.663	0.278	2.197	22.622
Control Factor	3	148.233 **	0.083 ns	123.342**	45.594*
Year * Control	6	6.587 ns	0.083 ns	1.097 ns	3.906 ns
Error	54	9.002	0.167	3.173	12.392
Coefficient CV%	-	9.52	18.49	19.18	9.60

Table 2: Combined analyzes of variance of weeds density

Square means						
variance sources	Freedom degree	Convolvulus arvensis	Amaranthus retroflexus	Chenopodium album	Portuloca olearacea	Echinochloa Crus-galli
year	2	15.221 **	2.664	0.430	4.726**	25.858**
Year * repetition	9	0.916	0.554	0.390	0.280	2.396
Tillage factor	1	3.123	2.304	0.002	3.741**	23.586**
Year * tillage	2	1.735	2.048	0.011	0.402	6.057
error	9	0.616	1.343	0.369	0.186	1.581
Weeds Control factor	3	15.993**	43.858**	15.151**	28.418**	103.806**
Year * control	6	2.318	2.575**	0.364	1.761**	8.341**
Control factor * tillage factor	3	0.536	1.067	0.039	2.231**	10.324**
Year * control factor *tillage	6	0.206	0.845	0.205	0.256	1.605
error	54	0369	0.409	0.246	0.256	0.935
Variance coefficient CV%	-	37.70	31.99	34.01	27.27	37.54

Table 3: Comparing of corn yield characters means in weeds control methods during three years in p<0.01 (yield and 1000kernel weight) and in p<0.05 (seeds number in rows)

Weeds controlling	Weight of 1000 kernel seeds	Interval of crown flower to silk flower appearance	Seed yield (t/ha)	Seeds number in rows
Chemical control	32.625 AB	2.208 A	11.29 A	37.625 AB
Manual weeding	34.625 AB	2.167 A	10.85 A	38.042 A
Mechanical control	31.342 B	2.167 A	8.654 B	35.667 BC
None control	28.667 C	2.292 A	6.358 C	35.292 C

Table 4: Comparing the weeds density average in weed control methods and tillage methods in three years in p<0.01

weed					
Treatment	Echinochloa Crus-galli	Portulaca olearacea	Chenopodium album	Convolvulus arvensis	Amaranthus retroflexus
Reversible + chemical	0.250 D	1.833 D	0.167 A	0.250 A	0.833 A
Reversible + mechanical	28.583 B	3.917 C	4.417 A	4.500 A	7.333 A
Reversible + weed	43.083 A	6.917 B	5, 292 A	4.750 A	9.917 A
Reversible + none weeds	0 D	0 E	0 A	0.500 A	0 A
Chisel + chemical	0.833 D	1.083 DE	0.417 A	0.475 A	0.583 A
Chisel + mechanical	12.333 C	6.667 B	4.0 A	7.833 A	11.250 A
Chisel + weeds	12.00 C	14.500 A	4.583 A	8.917 A	15.167 A
Chisel + none weeds	0 D	0 E	0 A	0.833 A	0 A

IV. CONCLUSION

Soil tillage are the most important operations of agricultural systems which have generally dedicated most

part of consumed energy for crop production and applying various methods of plowing will be an effective movement in reducing energy consumption in agricultural activities. Results in this study indicated that the effect of tillage methods on corn yield was not significant and

conventional and conservation tillage system effect on some weed density and weed flora in long term. Based on these result farmers can chose different tillage methods according on their farm's history and weed flora.

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