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Effects of Different Soil Tillage and Seed Rate on Yield and Yield Components of Silage Corn

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ABSTRACT

To investigate the effects of different tillage and seed rate on yield and yield components of corn silage (SC704 cultivar) in 2012-2013 growing season, were evaluated in the Karaj of Iran. In this study, conventional tillage (based on moldboard plow), reduced tillage (based on chisel plow) systems in three seed rate were used. Six treatments using these systems were designed. A randomized complete design with three replications was used. The experiments were conducted on a clay loam soil. The differences between the biological yields were not statistically significant in tillage systems treatments. The differences between the grains yields, dry plant weigh were significant. The results show that conventional tillage and conservation tillage systems produced the highest and lowest grain yield and dry plant weigh, respectively. The highest biological yield in seed rate treatment was in 70 ($Kg.ha^{-1}$) treatments. Results indicated that silage corn production under reduced tillage management in Alborz region is feasible without substantial biological yield reduction. A reduced tillage system appears to be a viable management alternative to conventional practice.

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INTRODUCTION

Corn Silage is a major ingredient in most dairy rations. If, for example, a dairy producer harvests 25 acres for corn silage and the yield is 20 tons per acre, then there should be 500 tons of corn silage available to be incorporated into a ration to be fed to the dairy herd over the next 12 months [9]. Recently, interest in the feeding of processed (rolled) corn silage to lactating dairy cows has increased. Currently, crop processors are available on both self-propelled and pull-type harvesters. Research in North America has shown that processing whole-plant corn silage (WPCS) improves total-tract starch digestion in dairy cows [2] and beef steers [10] and milk production by dairy cows [6]. Satter *et al*. [11] summarized WPCS processing trials for response in milk production, and found 0.5 kg/d higher milk production for processed compared with unprocessed WPCS. In two studies [2], total-tract starch digestion was increased 5 percentage units for processed compared with unprocessed WPCS diets.

Tillage influences crop growth and yields by changing soil structure and moisture removal patterns over the growing season. Soil structure and moisture removal changes are dependent on soil properties, types of tillage and climatic conditions. Moisture removal patterns are of most importance to semi-arid regions of Canada since moisture is usually the limiting crop yield factor [8]. Tillage changes soil properties and the way the environment affects those properties. Soil properties and environment determine the rate of water movement in liquid and gaseous form into and out of soil. To understand how tillage changes soil moisture, soil properties affecting moisture need to be understood. Unfortunately, the relationship between soil moisture and tillage has not been completely defined. Substitution of conventional tillage system by various types of conservation tillage in USA recently reached level of 41% total arable land (45.64 x 106 hectars). Within mentioned land area no-till reached even 23% or 24.96 x106 hectars [1]. During recent years Europe also noticed mentioned trend of non-conventional tillage followers increase. Therefore, nowadays conservation tillage occupies 1.3% of total

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agriculture land in Portugal, very significant amount of 14% in Spain, 17% in France, 20% in Germany till fascinating 30% of total agricultural land in United Kingdom [1].

Conventional tillage is on the one side the most expensive, complicated, organizationally slow system and is significantly great energy and labour consumer, while on the other side it is also ecologically unfavorable way of soil tillage [14]. According to Tebrügge and Düring [12]. ecological disadvantages of conventional soil tillage system are as follows: increasing of soil compaction induced by frequent machinery traffic over the same area, continuous decreasing of soil organic matter as aftermath of intensive and frequent soil tillage, greater erosion susceptibility of conventionally tilled soils and finally significant CO2 emission as a greenhouse gas due to burning of great fossil fuel quantities required for doing that job as well as consequence of stimulation of mineralization of organic matter in soil [4].

The non-conventional tillage systems in Croatian conditions achieved better economic efficiency than conventional tillage system [7]. Different authors [3,5,12] also pointed out to ecological and economic advantages of non-conventional soil tillage systems. Proper planting density corn and the factors affecting them, such as tillage and planting has been one of conflict between farmers, farm managers and experts have been. Therefore, in order to propose a suitable planting density due to the effect of tillage and planting for the subject is justified. Low tillage corn forage, is a new and innovative aspect of this research. The overall objective of this study was to introduce low tillage, planting corn, at an appropriate density in order to reduce the time and costs associated with maintaining a minimum average yield of forage maize production area.

MATERIAL AND METHOD

The current research was performed in a personal farm of (Karaj) Hashtgerd province in agronomy year of 2013-2014. This farm has placed in latitude 32 to 35.45^0N and longitude 35.45 to 50.55^0 E. The height above sea level was 1300 meters. Average of rainfall was 342 millimeter per year and the maximum and minimum annual average temperature is -16 and +40 respectively.

Field experiments and data analyzing of this study were as factorial experiment in a randomized complete block design with three replication and 6 treatments. Experimental treatments were included:

1. Custom soil preparation: plough with moldboard plow in 30-35 centimeters depth + planting with furrower plow with the application seed amount of 50 kilograms per hectare
2. Custom soil preparation: plough with moldboard plow in 30-35 centimeters depth + planting with furrower plow with the application seed amount of 70 kilograms per hectare
3. Custom soil preparation: plough with moldboard plow in 30-35 centimeters depth + planting with furrower plow with the application seed amount of 90 kilograms per hectare
4. slight(conservative) soil preparation: soil preparation with chisel moldboard plow in 30-35 centimeters depth + planting with furrower plow with the application seed amount of 50 kilograms per hectare
5. slight soil preparation: soil preparation with chisel moldboard plow in 30-35 centimeters depth + planting with furrower plow with the application seed amount of 70 kilograms per hectare
6. slight soil preparation: soil preparation with chisel moldboard plow in 30-35 centimeters depth + planting with furrower plow with the application seed amount of 90 kilograms per hectare

The field of research had been assigned to wheat plantation last year,planting operation was performed for sorghum cultivar of single cross 704, on its residuals after harvesting the wheat. The size of each plot was 80 square meter. 20 rows of maize was planted in each plot. Space between the rows were 75 centimeters and its length was 75 centimeters.

In order to planting with furrower plow application seed amount were 50, 70 and 90 kilogram per hectare with plantation depth of 4 centimeters was regulated.

In order to calculate biological yield, at harvest time, the bushes of three middle rows of each treatment was harvested from ground surface with considering 1 meter distance from beginning and the end of each plot and by specifying 10 square meter of each plot and biological yield of each treatment was determined separately.

For measuring dry weight of bushes, at first, the plant components were separated to steam, leaf, maize, maize husk and maize cob and after weighting and placing them (three sample from each experimental plot) in sampling bag, they were placed in oven for 48 hours with temperature of 75 degree and then dry weight of samples was measured with digital scale

Harvest operation of three middle rows of each treatment with considering 1 meter distance from beginning and the end of each plot and specifying 10 square meter of each plot was performed from the ground surface when the lower part leaves , maize, and maize cover became dry in more than half number of bushes and remained leaves became yellow, and after measuring humidity percentage of seeds with humidity measuring device, weight of maize and its cob, rows number, seed number per rows, seed number per maize, 1000-seed weight, seed percent and maize cob percent of each sample was determined and then final production of seed and harvest index were calculated.

For statistical analyzing, SAS (Statistical Analysis System) software was applied. Means of experimental data were calculated by Dancan's test.

RESULT AND DISCUSSION

Seed and biological yield:

Analyzing of variance results for seed yield and biological yield has indicated in table (1). Main effects of soil preparation method and amount of applying seed on seed yield was significant at the level of 5 percent. In the other word, experimental soil preparation method and also amount of applying seed has significant difference about affecting on the said factors and aren't placed in one statistical group. Main effect of soil preparation on biological yield isn't significant at the level of 5 percent but the amount of applying seed is effective on this factor and treatments of experiments don't place in one group. Table 2 is indicating the main effects of seed amount and soil preparation on seed yield mean and biological mean. Custom soil preparation with the seed mean of 9.65 ton per hectare had more yield in relation to slight soil preparation. About the effect of soil preparation method on yield and its components, it has been offered many reports by researchers that in each of them it has been emphasized on increase , decrease or lake of soil preparation effect on total yield or each of its components, but the results of this study conform with findings of Borin *et al*. [3], Godwin [16] and Vyn [15], so that performing the slight soil preparation because of decreasing density and depth of the soil lead to increasing the specific weight of soil and by negative effect on growth and root system cause to decreasing the yield. Without considering to the applied soil preparation method, applying 50 kilograms seed per hectare, leads to achieve the maximum yield of the seed in sorghum as the amount of 10.39 ton per hectare. Applying more seed is joint with decreasing the seed yield such that application of 70 and 90 kg seed leads to the seed yield of 9.5 and 7.71 ton per hectare.

Bush dry weight:

Measuring the bush dry weight was performed in the stages of before, coincident and after appearance of crown flower and at the harvest time. Analyzing of variance results of data about total bush dry weight in the stages of before, coincident and after appearance of crown flower is indicated in table (3). Main effects of data about dry weight of total plant in the stages of before, coincident and after appearance of crown flower and in dough stage of seeds became significant at 5 percent level. Effect of applying seed amount on dry weight of total bush, was significant, before coincident and after appearance of crown flower and in dough stage at 5 percent level. In the other word, applying seed amounts, has no significantly difference about effect on dry weight of total bush and don't place in one statistical group. Table (4) indicates the main effects of seed amount and soil preparation method on mean of total bush dry weight. Custom soil preparation with the mean of 100.65, 250.8, 321.32 and 358.24 gram, always has more mean of dry weight in all physiological growth stages in relation to slight soil preparation. Although helmholtz and carter (1987), found that soil temperature state in conservative soil preparation, confronted with decreasing germination percent, growth and root activity, delay in germination and therefore decreasing photosynthesis and maize tasseling increasing the humidity at harvest time in comparison with custom soil preparation. Therefore less dry weight in slight soil preparation, is due to less activity and root weakness in absorption of nutrition in relation to the custom soil preparation, but other researchers such as Benjamin and Jared, reported that remaining the plants remnants in soil surface leads to keep cool the soil surface and expressed that being cooler of the soil surface, results in delay of plant primary growth and has been known as one of incompatibility factors of slight soil preparation method.

Table 1: Analysis of variance on some agronomic traits affected by different tillage and seed rate in silage corn

S.O.V	Df	MS	
		Grain yield	Biological yield
Method of tillage	1	4.68^{*}	113.1^{ns}
Seed rate	2	14.91^{*}	297.2^{*}
Method of tillage* Seed rate	2	0.241^{ns}	1.13^{ns}
Error	12	0.241	23.19
C.V (%)	-	3.5	4.32

ns, * and ** : Non significant at the 5 and 1% levels probability respectively.

Table 2: The main effects of seed rate and tillage on grain yield and biological yield

Treatment	Grain yield ($Kg.ha^{-1}$)	Biological yield ($Kg.ha^{-1}$)
Seed rate		
50 ($Kg.ha^{-1}$)	10.39a	75.00b
70 ($Kg.ha^{-1}$)	9.50b	76.70a
90 ($Kg.ha^{-1}$)	7.71c	71.31c
Method of tillage		
Conventional tillage	9.65a	78.8a
Reduced tillage	8.75b	77.6a

Means with similar letter were not significant at the 5% probability level.

Table 3: Analysis of variance on Plant dry weight affected by different tillage and seed rate in silage corn

S.O.V	Df	MS			
		2 weeks prior to tassel emergence	Concurrent with the rise tassel	2 weeks after tassel emergence	Dough stage
Method of tillage	1	3989.45^{*}	11474.7^{*}	6504.33^{*}	4779.9^{*}
Seed rate	2	111.49^{ns}	239762.1^{*}	59963.1^{*}	10343.14^{*}
Method of tillage* Seed rate	2	735.68^{*}	2316.32^{*}	5673.66^{*}	3811.99^{*}
Error	12	73.67	352.51	67.18	65.55
C.V (%)	-	7.53	6.86	5.25	3.14

ns, * and ** : Non significant at the 5 and 1% levels probability respectively.

Table 4: The main effects of seed rate and tillage on dry weight of the plant

Traitment	2 weeks prior to tassel emergence	Concurrent with the rise tassel	2 weeks after tassel emergence	Dough stage
Seed rate				
50 ($Kg.ha^{-1}$)	82.39a	241.1b	356.42b	341.85b
70 ($Kg.ha^{-1}$)	96.5a	265.70a	322.51a	372.5a
90 ($Kg.ha^{-1}$)	95.71a	196.31c	301.47c	331.12c
Method of tillage				
Conventional tillage	100.65a	250.8a	321.32a	358.24a
Reduced tillage	80.75b	220.6b	332.12b	345.13b

Means with similar letter were not significant at the 5% probability level.

Conclusion:

According to the analysis comparing the experimental data, we conclude that, by changing tillage than conventional tillage to conservation tillage practices a Although the biological function change is not statistically significant, and even corn yield is reduced however, with the goal of planting fodder production is that this change can be a practical way to increase the economic benefit generated by reducing production costs and time taken machining operations.

REFERENCES

[1] Anonymous: European Conservation Agriculture Federation, http://www.ecaf.org , 2004.
[2] Bal, M.A., J.G. Coors and R.D. Shaver, 1997. Impact of the maturity of corn for use as silage in the diets of dairy cows on intake, digestion, and milk production. J. Dairy Sci., 80: 2497-2503.
[3] Borin M., L. Sartori, 1995. Barley, soybean and maize production using ridge tillage, no-tillage and conventional tillage in north-east Italy, Journal of Agricultural Engineering Research, 62: 229-236.
[4] Dimitrov, I., T. Mitova, M. Borisova, D. Ivanov, Y. Karamanov, 2000. Energy analysis of different tillage systems applied in crop rotation, 15th ISTRO Conference, Fort Worth, USA.
[5] Hussain, I., K.R. Olson, S.A. Ebelhar, 1999. Impacts of tillage and no-till on production of maize and soybean on an eroded Illinois silt loam soil, Soil & Tillage Research, 52: 37-49.
[6] Johnson, L., J. H. Harrison, C. Hunt, K. Shinners, C.G. Doggett and D. Sapienza, 1999. Nutritive value of corn silage as affected by maturity and mechanical processing: A contemporary review. J. Dairy Sci., 82: 2813-2825.
[7] Kelava, I., B. Stipesevic, M. Josipovic, I. Zugec, 2000. Investigation of reduced siol tillage for some arable crops in eastern Croatia, Possibilities of rational soil tillage for Winter wheat (*Triticum aestivum*) in Baranja region, 15th ISTRO Conference, Fort Worth, USA.
[8] Lindwall, C.W., 1984. Minimizing Tillage Operations. Soil Conservation - Providing for the Future. Christian Farmers Federation. Lethbridge
[9] Littell, R.C., G.A. Milliken, W.W. Stroup and R.D. Wolfinger, 1996. SAS System for Mixed Models. SAS Inst., Inc., Cary, NC.

[10] Rojas-Bourrillon, A., J.R. Russell, A. Trenkle and A.D. McGilliard, 1987. Effects of rolling on the composition and utilization by growing steers of whole-plant corn silage. J. Anim. Sci., 64: 303-311.
[11] Satter, L.D., Z. Wu, V.R. Moreira, M.A. Bal and R.D. Shaver, 1999. Processing corn silage. Page 49–58 in Proc. of the 24th Annual Minnesota Forage Conf., American. Forage and Grassland Council, Rochester, MN.
[12] Tebrügge, F., R.A. Düring, 1999. Reducing tillage intensity - a review of results from a long-term study in Germany, Soil & Tillage Research, 53: 15-28.
[13] Tebrügge, F.J., R.A. Düring, A. Böhrnsen, U. Gross, W. Gruber, A. Wagner, 1998. Interactions between different soil tillage intensity on soil properties with consideration of environmental and economical benefits, Proc. of the Int'l Agr. Eng. Conf., Bangkok, Thailand.
[14] Zugec, I., B. Stipesevic, I. Kelava, 2000. Rational soil tillage for cereals (Winter wheat - Triticum aestivum L. and Spring barley - *Hordeum vulgare* L.) in eastern Croatia, 15th ISTRO Conference, Fort Worth, USA.
[15] Vyn, Y.J. and B.A. 1993. Raimbault. Long term effect of five tillage systems on corn response and soil structure. Agronomy journal., 850: 1074-1079.
[16] Godwin, R.J., 2202. Tillage for crop production in areas of of low rainfall. FAO agricultural service bulletin., 83: 161.