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Effect of different tillage in order to introduce an optimum model for the soil aggregate stability in Northa of Khozestan

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ABSTRACT

Tillage intensity causes the soil and aggregates structure stability to change. For the purpose of achieving a better management in soil tillage practices, a reduction of potential damages of agricultural machinery traffic and ultimately an increase in productivity regarding different aspects of soil protection in order to obtain a stable soil aggregates conditions; in this study, an experiment was conducted in potato production farms located in north of Khuzestan province with silt clay loamy soil using a randomized complete block design in spilt-split plot arrangement with three replicates during 2012-2013 growing year. Main plots were soil moisture with three levels (10, 15 and 20%) and subplots were tillage intensities using cyclo-tiller in three vertical rotary speeds of blade (150, 200 and 250 rpm) and the number of agricultural machinery passes after plowing through the target growing year with three levels (including once, three and five times of passes) were considered as sub-sub plots. Modeling of BD, CI, MWD and GMD with potato yield using multiple linear regression model indicated that all three variables in the model as explanatory variables justifying the soil compaction and yield reduction, were successful at explaining more than 80% of the variances, and traffic was detected as the most important factor in soil compaction and potato yields reductions. As a result of employing binary genetic algorithm approach for optimization of potato yield, the optimum soil moisture in time of planting was calculated to be 20%, the optimum vertical rotary speed of blades was 150 rpm and the optimal number of passes was one pass through the total area of farm land. Thus, based on the obtained optimal variable values, the least amount of harvestable potato was estimated to be 27 tons.

Keywords: Soil compaction, Stability of soil aggregates

INTRODUCTION

Soil tillage and seedbed preparation basically aim at a rapid and uniform seed emergence, deep pen-etration of the roots, good soil drainage, and weedcontrol. Aggregate size distribution of plowed layer is an important factor for rapid and uniform seed emergence. A better seed–soil contact can be obtained if seeds and soil aggregates are of similar size [3]Various reports indicated that the finer the aggregate size of the plowed layer thebetter the emergence [13, 30].The breakdown of soil clods to different aggregate sizes is influenced by a number of factors including intrinsic soil properties, climatic conditions, and type of tillage implements. Controlled traffic farming is often seen simply as a system to increase mechanisation efficiency[23]. The effects of controlling field traffic have been studied on at least on four continents, with a variety of crops and in a range of environments[12,17,19]. Unsurprisingly, bulk density of non-trafficked soil has always decreased and porosity has improved, which might be expected to improve yield potential. Crop yields have usually improved under controlled traffic [7, 26], but the relationship between yield and compaction is influenced by many system effects [4]. Despitemajor variability,mean yields have often increased by 5–20% in side-by-side comparisons in grain crops [26], wherefieldtrafficwas the only change. Thiscorrespondswellwiththe literature on soil compaction.[1] studied the effects of deep tillage onphysical properties in silty clay loam and on crop yields. They found that two passes of a tractor re-compacted the soil by the time the first cropwas planted. They advised that controlled traffic is essential to obtain long term benefits from subsoiling. Deep tillage increased soybean and corn yields (3.0–6.9% in 1991 and 1.5–3.0% in 1992) in areas not trafficked.

MATERIALS AND METHODS

The experiment was conducted at Shoushtar region (49º 14′ E and 23º 2′ N), 90 Km located in the north of Khuzestan (iran), at an average altitude of 670 m. The field experiment was conducted on the demonstration field of Islamic Azad University in Shoushtar branch. The experiment field (pervious planting) in a 1 year alternative rotation was wheat and canola in order to be in 2012-2013 was under wheat planting as well average altitude of 50 m. The soil used in this study was of silty clay loam type. With physical properties similar to the parameters of the soil used for the laboratory experiment. The rate of soil moisture content was 20.62%.

Statistical methods

An analysis of variance for a split–split plot design was performed to evaluate the significance of treatment effects on aggregate size distribution using the SAS statistical package for analysis of variance (SAS Institute, 1997). The interactions were investigated using the slice option of LS-means.

RESULTS AND DISCUSSION

Tillage effects on aggregate size distribution in soil at depths of 0 -300mm

According to table (1) Tillage effects on aggregate size distribution in the tables 4 are 0 - 300 mm in depth with a speed of 100 revolutions per minute cyclotiller highest 16.5 percentage of coarse grained soil (greater than 2 mm) and a speed of 300 revolutions per minute, the highest 6 percentage of small dust grains (smaller than 0.25 mm) was found. cyclotiller share away from dust grains with a diameter of 200 rounds per minute and more than 0.5 – 1, 1-2, 0.25 - 0.5 mm had two previous treatments.

Table 1: Tillage effects on aggregate size distribution in depth layer 0 – 300 mm

Tillage intensity	Sieve size (mm)			
	0.25 - 0.5	0.5 – 1	1-2	>2
(speed of rotation cyclotiller) (250 rpm)	6 ^{b}	6 ^{b}	4.1 ^{b}	6.3 ^{c}
(speed of rotation cyclotiller) (200 rpm)	13 ^{a}	10 ^{a}	9.8 ^{a}	12.3 ^{a}
(speed of rotation cyclotiller) (150 rpm)	16.5 ^{a}	13 ^{a}	10.8 ^{a}	17.2 ^{a}

Different letters indicate a significant difference for the aggregate size distribution (P<0.05, Duncan's multiple range test).

Soil water content effects on aggregate size distribution in soil at depths of 0 - 300 mm

According to table (2) Effect of soil moisture on soil aggregate size distribution at depths from 0 – 300 mm Soil type, soil moisture at 0.7 most of the coarse grained (greater than 0.25 mm) and the lowest percentage of granular soils (less than 0.25 mm) includes amounts, respectively percent.When soil moisture was increased from0.5 to 0.7 percent to 36.3 percent increase in dust grains larger than 0.25 mm. The results which reported by HU et al (2007) also were the same.

Table 2: Soil water content effects on aggregate size distribution in soil at depths 0 – 300 mm

PL	Sieve size (mm)			
	0.25 - 0.5	0.5 – 1	1-2	>2
0.9	15.6 ^{a}	12.8^{b}	12.1 ^{b}	12.3 ^{b}
0.7	16.7 ^{a}	16.4^{a}	16.8 ^{a}	17.2^{a}
0.5	10.6 ^{b}	7.7^{c}	7.2^{c}	8.5^{c}

Different letters indicate a significant difference for the aggregate size distribution (P<0.05, Duncan's multiple range test).

Correlation coefficients between bulk density, cone index and yield

According to table (3,4 and 5) the results showed a significant correlation between crop yield in different depths of soil bulk density and cone index was negative and significant (P> 0.01), the results show Increased soil bulk density and cone index, potato yields have decreased. So, showed a correlation between bulk density and cone index traits at different depths significant (P> 0.01), there is significant positive correlation. So, the bulk density, the soil cone index increased.

Table 3: Correlation coefficients between traits bulk density, cone index and potato yield in the 0-100 mm depth

	potato yield	bulk density	cone index
potato yield	1		
bulk density	-0.9625**	1	
cone index	-0.9559**	-0.9717**	1

**, ** Significant 0.05. 0.01 Respectively.*

Table 4: Correlation coefficients between traits bulk density, cone index and potato yield in the 100-200 mm depth

	potato yield	bulk density	cone index
potato yield	1		
bulk density	-0.9589**	1	
cone index	-0.96986**	-0.9639**	1

**, ** Significant 0.05. 0.01 Respectively.*

Table 5: Correlation coefficients between traits bulk density, cone index and potato yield in the 200-300 mm depth

	potato yield	bulk density	cone index
potato yield	1		
bulk density	-0.8988**	1	
cone index	-0.9631**	-0.9120**	1

**, ** Significant 0.05. 0.01 Respectively.*

Determine the modeldensity andsoil resistantat various depths and potato yield

The estimation of the compaction and equation of regression for functions related to the bulk density, the cone index of soil and production performance are highly important considering the factors used in the experiment and the relationship between the factors can make it possible to plan better plantation and cultivation accurately and effectively.These connections link differ regarding the soil and production in the area and are essential precision agriculture. In the present method which is based on linear regression model a for variables have been obtained the use of statistics plan of SPSS 10, SAS ver.9.1 by enter is the potato production data on field experiments and the below equations all contained above 0.8up R2 based on F test consequently have statistic validity. The results obtained in the experiment they were selected as useful models for the bulk density mean and cone index in different depth related to potato performance crop. The table 6 shows parameters of the variance of regression equations. The index for explanation for potato yield.

Table 6: Estimate parameters regression model potato yield

variable	d.f	Estimate Parameters	Pr > |t|
Intercept	2	32.18	0.0001
Tillage (speed of rotation cyclotiller) (TI)	2	-3.18	0.0001
Soil water content type (W)	2	1.74	0.0001
Number ofpasses(P)	2	-1.17	0.0004
W × P	4	-0.162	0.0082

Yield = 32/18–3/18 TI+1/74W – 1/17P – 0/162 WP

Yield: potato yield (ton/he)
W: Soil water content type (%)
TI: Tillage (speed of rotation cyclotiller) (rpm)
P: Number of passes

As the regression equations show the number of tractor passes through the season tillage factoring the equation is negative potato yield and soil moisture coefficient in equation yields positive.

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