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<u>Yazışma Adresi / Corresponding Address</u>

Tekirdağ Ziraat Fakültesi Dergisi NKÜ Ziraat Fakültesi 59030 TEKİRDAĞ

E-mail: ziraatdergi@nku.edu.tr
Web adresi: http://jotaf.nku.edu.tr
Tel: +90 282 250 20 07

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İ Ç İ N D E K İ L E R / C O N T E N T S

Determination of Different Tillage Methods In Terms of Technically And Economically in Second Crop Maize For Silage (2nd Year)

M. F. Baran[1] M. R. Durgut[3] İ. E. Kayhan[2] İ. Kurşun[2] B. Aydın[2] Y. Bayhan[3]

[1]University of Adiyaman, Faculty of Technology, Department of Energy Systems Engineering-Adiyaman / Turkey

[2]Atatürk Soil, Water and Agricultural Meteorology Research Station Maneger-Kırklareli / Turkey

[3]University of Namık Kemal, Faculty of Agriculture, Department of Biosystems Engineering-Tekirdağ/ Turkey

The research has been carried out in Central Station of Atatürk Soil and Water Agricultural Meteorology Research station manager in 2011 sowing season. In the research, the effects of different soil tillage systems (T_1: Turn shredder + Heavy tine spring cultivator + Pneumatic precision drill, T_2: Turn shredder + Rotory tiller+ Pneumatic precision drill, T_3: Turn shredder + Chisel + Heavy duty disk harrow + Pneumatic precision drill and T_4: Plough +Heavy duty disk harrow + Pneumatic precision drill) applied in second crop maize for silage have been compared in terms of plant growing, yield and enterprise economy. In the study, fuel consumption and labor success of the machines, average outflow time of the plant, land rattoon outflow degree, straw thickness, plant length and yield values and moisture of the soil have been determined and the methods have been analyzed. As a result of the evaluations, while the highest silage yield has been obtained in traditional method as T_4, the lowest yield has been obtained in T_2: method. Among the methods, the lowest fuel consumption has been determined in T_1 soil tillage system with 25.21 lt/ha and the highest fuel consumption has been determined in T_4 soil tillage system with 46.46 lt/ha. The soil tillage system in which the average labor success is the highest has been T_4 soil tillage system with 5.40 ha/h and the other subjects have been calculated as 5.07 ha/h T_3, 4.23 ha/h T_1, 4.17 ha/h T_2 respectively. In cost analyses which have been done as to gross profits, T_4 soil tillage system has obtained the highest gross profit with 6069.24 TL/ha and T_3 , T_1 and T_2 soil tillage systems have followed it with 5972.50 TL/ha, 5549.40 TL/ha and 5403.37 TL/ha respectively.

Key Words: Economic analysis, fuel consumption, plant growing, second crop maize, soil tillage

II. Ürün Silajlık Mısır Üretiminde Uygulanabilecek Farklı Toprak İşleme Yöntemlerinin Teknik ve Ekonomik Olarak Belirlenmesi (2.Yıl)

Araştırma Kırklareli ilinde; Atatürk Toprak Su Kaynakları ve Tarımsal Meteoroloji Araştırma İstasyonu Müdürlüğü Merkez İstasyonunda 2011 ekim sezonunda yürütülmüştür. Araştırmada, II. ürün silajlık mısırda uygulanan farklı toprak işleme sistemlerinin (T_1: Sap Parçalayıcı +Ağır Yaylı Kültivatör + Ekim Makinesi, T_2: Sap parçalayıcı +Rototiller +Ekim Makinesi, T_3: Sap parçalayıcı Çizel + Gobledisk + Ekim Makinesi ve T_4: Pulluk + Gobledisk + Ekim Makinesi) bitki gelişimine, verime ve işletme ekonomisine etkileri açısından karşılaştırılmıştır. Çalışmada makinaların yakıt tüketimi ve iş başarısı, bitki ile ilgili ortalama çıkış süresi, tarla filiz çıkış derecesi, sap kalınlığı, bitki boyu ve verim, toprak ile ilgili nem değerleri belirlenmiş ve yöntemler ekonomik analize tabi tutulmuştur. Yapılan değerlendirmeler sonucunda en yüksek silajlık verimi geleneksel yöntem olan T_4 yönteminde elde edilirken en düşük verimi ise T_2 yönteminde elde edilmiştir. Yöntemler arasında yakıt tüketimi; en düşük 25.21 lt /ha ile T_1 toprak işleme sistemi, en yüksek 46.46 lt/ha ile T_4 toprak işleme sisteminde tespit edilmiştir. İş başarısının ortalama en yüksek olduğu toprak işleme sistemi 5.40 ha/h ile T_4 olurken, diğer toprak işleme sistemleri sırasıyla; 4.17 ha/h T_2, 4.23 ha/h T_1, 5.07 ha/h T_3 olarak hesaplanmıştır. Brüt karlarına göre yapılan maliyet analizlerinde; 6069.24 TL/ha ile T_4 toprak işleme sistemi en yüksek brüt karı sağlamış ve onu sırasıyla 5972.50 TL/ha T_3, 5549.40 TL/ha T_1 ve 5403.37 TL/ha T_2 takip etmiştir.

Anahtar Kelimeler: Ekonomik analiz , yakıt tüketimi , bitki gelişimi, ikinci ürün mısır, toprak işleme

Introduction

A great part of the energy consumed in plant production is used in soil tillage. The primary purpose in agricultural farms is to obtain the maximum income with the fewest amount of input as in all managements (Karaağaç and Barut, 2009). Soil tillage is one of the important components of plant production. It contains all of the mechanical processes related to the soil which start before planting and continue during the plant development. Therewithal, providing the optimum water-air relationship in the period from planting to harvesting for plants is important. Application differences are in question in these processes as relaxation and ventilating, protection of the water, preparing seedbed, weed control, mixture of the vegetative disposals to the soil which are directed towards to certain purposes inherent in the application periods. It is seen that these applications differ according to climate, soil and plant type and in this respect, protected soil tillage methods regarding to reduced and non-plough applications are used except conventional soil tillage methods. A great deal of studies are carried out in terms of crop yield and soil quality with conventional and protected soil tillage systems.

In Baran et al, 2010 research, , the effects of different soil tillage systems (T_1: Turn shredder+Heavy tine spring cultivator + Pneumatic precision drill, T_2: Turn shredder +Rotory tiller+ Pneumatic precision drill, T_3: Turn shredder + Chisel + Heavy duty disk harrow + Pneumatic precision drill and T_4: Plough +Heavy duty disk harrow + Pneumatic precision drill) applied in second crop sunflower have been compared in terms of plant growing, yield and enterprise economy. As a result of the evaluations, while the highest sunflower yield has been obtained in traditional method as T_2, the lowest yield has been obtained in T_3 method. Among the systems, the lowest fuel consumption has been determined in T_2 soil tillage system with 28.81 lt/ha and the highest fuel consumption has been determined in T_4 soil tillage system with 62.20 lt/ha. The soil tillage system in which the average labor success is the highest has been T_3 soil tillage system with 4.91 ha/h and the other subjects have been calculated as 3,56 ha/h T_1, 3,64 ha/h T_4, 3,70 ha/h T_2 respectively. In cost analyses which have been done as to gross profits, T_2 soil tillage system has obtained the highest gross profit with 1247.53 TL/ha and T_4 ,T_3 and T_1 soil tillage systems have followed it with 1188.34 TL/ha, 925.14 TL/ha and 837.30 TL/ha respectively

Bayhan et al (2006), tried 5 different soil tillage methods and direct planting method in the study which they carried out for five years in connection with reduced soil tillage and direct planting possibilities in second crop maize for silage. They measured soil penetration strength, output day number, exiting offshoot percentages, plant height, stalk diameter and silage yield. They found the highest result for silage yield in soil tillage combination with 96,32 t/ha and the lowest yield in soil tillage system by disc harrow with 58,92 t/ha. They stated that direct sowing would give the best results for the parameters related with fuel consumption, power desire and soil tillage and they suggested reduced soil tillage and direct sowing methods for second crop maize for silage in the region.

In the study carried out by Borin and Sartoni (1995) in which the work success and yield values of different soil tillage systems in corn were examined; the working success was determined as 1.62 ha/h, the yield was determined as 7.8 t/ha in minimum soil tillage method and working success was determined as 0.98 ha/h, the yield was determined as 6.0 t/ha in direct soil tillage method.

Hermawan and Cameron (1993), carried out a research on the structural changes which the traditional soil tillage and minimum soil tillage would bring out on the soils. In the research, the stability of soil aggregates, the relationship between the space in the soil and the structure of the soil, the volume density, infiltration case and the resistance of the soils against dispersion were tried to be determined. As a result of the research, it was determined that the traditional soil tillage decreased the aggregate stability of the soils, increased the total and macro porosity of the sowing depth of the soil. It was also determined that minimum soil tillage gave better results directed towards the soil stability, the traditional soil tillage decreased the porosity in the deeper regions of the soil and increased volume density of the soil and the resistance against dispersion. Kayışoğlu et al (1997) applied 6 different soil tillage methods in stubby and no-stubble parcels in order to determine the effects of soil tillage on plant and soil characteristics. They stated that the soil tillage methods applied in the research were significantly effective on soil heat, soil volume weight, soil moisture and plant yield. They also stated that the yield was higher in the no-stubble parcels in the methods in which the plough was used.

The widespread tillage method applied in second crop maize for silage in the region is as irrigation of the stubble field and then the tillage of the soil by ordinary method (plough). In this method, due to all of the processes are have be done in a short period, some problems are observed when the increase in the field traffic and the energy costs are taken into consideration. This research was carried out in order to achieve the soil tillage and sowing process which were considered the most important problem in second crop maize for silage farming by alternative methods and their effects on plant growing and agricultural machinery expenses.

Material And Methods

Material

Definition of Trial Area

The research was carried out in Atatürk Soil, Water and Agricultural Meteorology Research Station which is 4 km away from Kırklareli and on İstanbul-Kırklareli road in Thrace Region. Kırklareli province which is on the north of Thrace region is under the effect of terrestrial climate but the specific effect of rainy Blacksea climate draws the attention. In this sense, the winters are rainy and cold and the summers are hot and arid. The great part of the precipitation is as rainy and certain part is as snowy. The long years precipitation average was determined as 594,7 mm. According to the perennial data, the average temperature is 13 0C. When the highest average air temperatures are observed in July-August months, the lowest average temperatures are observed in January and February months (Çakır et al, 2006).

Soil Characteristics of Trial Area

The soil samples which were taken from 0-30 cm soil layer of the trial area were examined in soil laboratory and the physical and chemical characteristics of the trial area were put forward. The physical and chemical characteristics of the soil of the trial area is in saltless category in terms of salt level. The organic matter content of the soil is too little and the pH value of the soil is slight alkali. The soil structure was determined as sandy-clayey-loamy.

Maize Kind Characteristics

The horse tooth maize king was used as maize for silage in the trial. The seed maturation period is 120-123 days and it is a suitable seed kind for machinery harvesting. The technical characteristics of the agricultural tools and machines used in the trial is given in Table 1. MF-365 tractor, the motor power of which is 60 kW was used as power source. Pneumatic precision drill was used as planting machine in the trial. Sowing systems with disc and burying feet systems were used in planting machine. The water requirement of the maize for silage was given homogeneously to the crop by determining the required water amount with automatically irrigation machine.

Some Tools Used in the Trial

The tape line was used in plant length measurements and the compass was used in plant stalk thickness. Soil auger, moisture holder pots, precision balance and soil dryer (incubator) was used in the determination of the soil moisture in the trial. The weigh out of the plants harvested from each parcel was done with the scales which could make 150 gr weighing. The timekeeper with hour, minute, second split-second was used for time consumption Fuel measurement device was used for the calculation of fuel consumption. It was utilized from KIENZLE fuel measurement system for the determination of the fuel consumptions of the tools and machines. The device was placed between fuel pump and injector and by-pass connection was performed as emitting the excessive fuel which derived from the injector to the system without measuring again.

Method

The trials were carried out in 12 parcels with 3 repetitions according to randomized parcels trial design. Each trial parcel was established in 40 meters length and 6 meter width. The parcels were established as big as possible in order to determine better the labor successes of soil tillage devices aimed at the application.

The effects of the soil tillage devices on the adjacent parcels were tried to be hidden by leaving a blank of 2 meters between the parcels and 3 meters between the blocks. 4 Different soil tillage and sowing systems were compared in the trial. In three methods of these systems, some of the protected soil tillage and planting systems were tackled and in T4 method, the method which is applied by the producers in second crop planting in Thrace Region and named as traditional method was handled.

Soil tillage systems;

T_1: Turn shredder + Heavy tine spring cultivator + Pneumatic precision drill,

T_2: Turn shredder + Rotory tiller+ Pneumatic precision drill,

T_3: Turn shredder + Chisel + Heavy duty disk harrow + Pneumatic precision drill,

T_4: Plough +Heavy duty disk harrow + Pneumatic precision drill)

Trial blocks were designed for second crop maize for silage and the trial design was prepared according to different soil tillage methods applied in maize for silage farming. 2,5 kg/da seed was used. Chemical analysis in spoiled soil samples taken from 0-20 cm depth of the trial area soils were done and required chemical fertilizers were given according to the analysis results. Struggle with weeds were done and interim hoeing was done twice by tractor. The water was given to the parcels evenly by considering the field capacity during the trial and 5 irrigation was done by automatic irrigation machine. During harvesting, two lines from each parcel edge and 5 meters from the lines were considered as edge effects and all of the two middle lines were harvested from approximately 10-15 cm upper from the soil level (Bayhan et al. 2006). Soil moisture determination was done before sowing and in the time period till irrigation after sowing. Soil samples were taken in three repeated rounds from the parcels of 0-10, 10-20, 20-30 cm depth with soil auger in order to determine the soil moisture and their wet weights were measured by keeping in the moisture boxes. Later, these soil samples were drained in 105^{0}C degree during 24 hours and their dry weights were determined by weighing. The moisture content according to dry base was determined with the following equation (Bahtiyar, 1996).

$$N= \frac{W-W_0}{W_0} * 100 \qquad (1)$$

In this equation,

N: Moisture according to dry base (%)

W: Wet weight total (g)

W_o: Dry soil weight (g)

In the trial parcels, daily outflow plant counting after irrigation with tempering water in three different lines with 5 m length in each parcel was done in order to determine the effects of soil tillage and sowing systems on plant distribution smoothness, germinating and plant outflow in trial parcels. The counting continued during plant outflow immobilization. Average outflow day, percentance of plant emergence were calculated from these counting. Average outflow emergence date is the average outflow time of the plants which outflow until plant outflow immobilization. Field rattoon outflow degree was determined as a percentage with the proportion of outflow plant number to incident plant number. These parameters were calculated with the following equations (Bilbro and Wanjura,1982; Kayişoğlu et al. 2001).

$$O.Ç.G.= \frac{N_1 * D_1 + N_2 * D_2 + ... + N_n * D_n}{N_1 + N_2 + ...N_n} \qquad (2)$$

In this equation;

O.Ç.G: Average emergence date

N: Number of seedling emerging since previous count

D: Number of days after sowing

$$TFÇD = \frac{ÇBS}{ETS} * 100 \qquad (3)$$

In this equation:

TFÇD: Percentage of plant emergence (%)

ÇBS: Number of seedling emerging(5 m)

ETS: Planted seed number (5 m)

Thickness of the sten, height of the plant and yield: harvesting time for the corn has been identified as the period with 65% humidity (Kayişoğlu et al.,2001). 20 plants which were randomly chosen in the middle line of each parcel, excluding the 2.5 meter wide sections at the beginning and end of the parcel and the first two edge lines of each parcel, of an eight-line wide parcel and they are cut at a point close to the ground.

The thickness of the cut sytems were measured by a gauge between the second and third nodes from the bottom. The height of the plant has been measured,by measuring the distance (in cm) between the node where the first side branch of the top tassel grows and the cutting point of the plant. (Kayişoğlu et al.,2001). The plants with determined stem thickness and plant height have been weighed by the scale and the yield of each repetition has been found.

Fuel Consumption

Total fuel consumption of each parcel was calculated as liter/ha by adding the fuel consumptions of the devices and the machines used for soil tillage and planting in soil tillage systems after the pre-plant harvesting in the trial.

Fuel consumption: Fuel amount*Fuel price (Çıkman et al, 2009).

Labor Success

Labor yield of each parcel (ha/h) was calculated by proportioning the total time calculated for soil tillage and sowing in each parcel of the trial to the area amount.

Economical Analysis

Gross profit analysis was performed with the findings.

Gross profit = Gross output value - variable expenses

Variable expenses: seed, fertilizer, herbicide, fuel, water

The values will be calculated by essentially taking the trading and stock exchange prices utilizing from the equation (İnan, 1988).

Evaluation of the Data

The data obtained in order to determine the effects of soil tillage systems on soil, plant growing and agricultural mechanization were subjected to the variance analysis according to randomized blocks trial design.

Research Fındıngs

Results Related to Fuel Consumption and labor force analysis

Fuel consumption values and labor successes of turn shredder, heavy tine spring cultivator, rotory tiller, chisel, plough, heavy duty disk harrow and pneumatic precision drill and enterprise value results of soil tillage devices were given in Table 1.

Table 1. Enterprise value results of soil tillage devices

Soil tillage systems	Equipments	Working speed (km/h)	Labor success (ha/h)	Fuel Consumption (lt/ha)	Labor success (ha/h)	Fuel consumption (lt/ha)
T_1	Turn shredder	10.8	1.08	2.9	4.23	25,21
	Heavy tine spring cultivator	6.9	0.69	15.8		
	Pneumatic precision drill	5.4	0.54	6.5		
T_2	Turn shredder	10.8	1.08	2.9	4.17	28,96
	Rotory tiller	7.2	0.72	19.6		
	Pneumatic precision drill	5.4	0.54	6.5		
T_3	Turn shredder	10.8	1.08	2.9	5.07	37,29
	Chisel	7.6	0.76	16.7		
	Heavy duty disk harrow	10.2	1.02	11.3		
	Pneumatic precision drill	5.4	0.54	6.5		
T_4	Plough	3.9	0.39	28.8	5.40	46,46
	Heavy duty disk harrow	10.2	1.02	11.3		
	Pneumatic precision drill	5.4	0.54	6.5		

As seen in the table, the highest fuel consumption was obtained from T_4 soil tillage system with 46.46 lt/ha. and the lowest fuel consumption was obtained from T_1 soil tillage system with 25.21 lt/ha The soil tillage system in which the average labor success was the highest was T_4 soil tillage system with 5.40 ha/h and the other subjects were calculated as 5.07 ha/h T_3, 4.23 ha/h T_1, 4.17 ha/h T_2 respectively. Fuel consumption and labor success variation of soil tillage systems are given in figure 1.

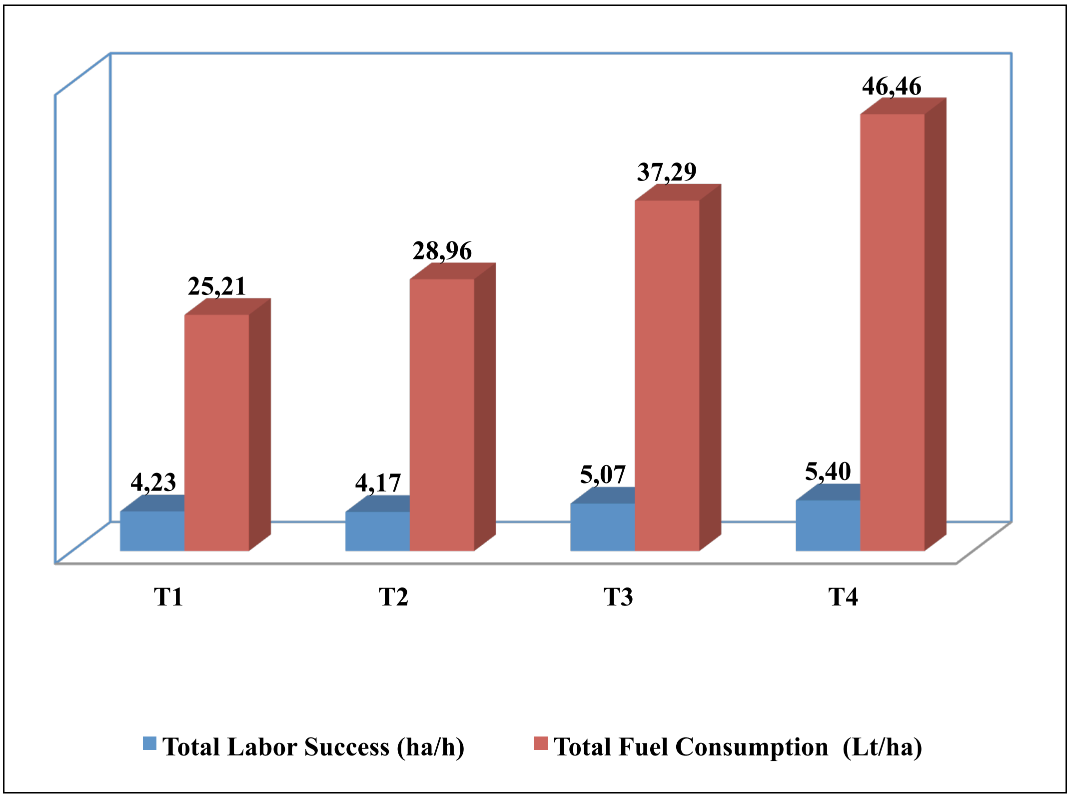

Figure 1.3. Total fuel consumption-total labor success variation of the devices used in soil tillage systems

Yield Values

Two lines were considered as 5 meters edge effect from the parcel edges during harvesting. It was weighed by cutting from 10-15 cm outside surface beginning from the soil level from the middle lines. The yield value of the maize for silage was calculated in terms of t/ha by rating the weighing values to unit harvesting area.

Determination of Plant Growing Values

Physical growing characteristics as average plant height, stub height and diameter, straw thickness and straw weight in second crop maize for silage were determined. In the research, the measurements were done from the two lines in left and right side of the parcels in each block (T_1-T_2-T_3-T_4) by not taking the end of the parcel.

Table 2. Some yield parameter values for the trial plant

Soil Tillage systems	Stub diameter (cm)	Stub height (cm)	Plant height (cm)	Stalk thickness (cm)	Stalk weight (gr)
T_1	6.83	22.10	270.83	2.53	322.50
T_2	6.71	21.25	268.96	2.34	267.92
T_3	6.92	22.83	275.54	2.67	338.75
T_4	7.50	23.56	285.63	2.73	348.33

Plant outflow ratios and land rattoon outflow degrees in 10 meters were calculated with three days interval and they were given with the yield values in Table 3. Accordingly, T4 method (plough+ heavy duty disk harrow+ pneumatic precision drill) gave the best result in each three parameter.

Table 3. Some calculations for the trial plant

Soil tillage systems	Average outflow day	Plant outflow ratio(%)	Yield tone/ ha
T_1	5.6	88.0	61.41
T_2	5.6	86.9	60.22
T_3	5.8	90.3	65.51
T_4	5.8	91.1	66.58

Analysis and Evaluation Results

Plant height, stub weight, stub diameter and yield values related with the harvested second crop maize for silage were statistically analyzed in order to determine the yield which is one of the most important factors for the comparison of the systems and yield parameters. The effect of soil tillage systems on the yield was found statistically insignificant and the average values of the systems were given in Table 4.

Table 4. Averages of the yields

Soil tillage systems	Averages
T_4	66.58
T_3	65.51
T_1	61.41
T_2	60.22

Diameter

The effect of soil tillage systems on stub diameter was found statistically significant ($P<0.05$) in variance analysis. As a result of multiple comparison; it was determined that the 15 cm. stub diameter was in the first group. The lowest stub diameter was obtained from T_2 system with 13.42 cm.

Table 5. Stub Diameter LSD average comparison results

Soil tillage systems	Averages
T_4	15.00 a
T_3	13.83 b
T_1	13.67 b
T_2	13.42 b

LSD(0.05)=0.96

Plant Height

The effect of soil tillage systems on plant height was found statistically significant in variance analysis values and plant height average values were given in table 6.

Table 6. Plant height average

Soil tillage systems	Averages
T_4	285.63
T_3	275.55
T_1	270.84
T_2	268.96

Stub Weight

The effect of Soil tillage systems in stub weight values was found statistically significant ($P<0.05$) . Accordingly, the maximum stub weight actualized in T_4. T_3 and T_1subjects.

Table 7. LSD multiple comparison test for stub weight (g)

Soil tillage systems	Averages
T_4	348.33 a
T_3	338.75 a
T_1	322.50 a
T_2	267.92 b

Economic Analysis

Fuel, human labor force values of the tools and machines used in the trials were obtained as a result of the measurements and the calculations and were given in Table 8. Gross profit analysis was done by adding harvesting and transport, tillage-maintenance processes, seed-fertilizer-irrigation prices to these given costs (Table 9). In terms of input usage, the best result was determined in T1 system (Turn shredder+ heavy tine spring cultivator+ pneumatic precision drill) and the highest input usage actualized in T4 system (plough+ heavy duty disk harrow+ pneumatic precision drill).

Table 8. Input costs of the systems

Soil tillage systems	Agricultural Tools and Machines	Fuel consumption (liter/ha)	Fuel consumption cost (TL/ha)	Total Fuel Consumption Cost (TL/ha) (1)	Oil consumption cost (2)	Human power		Total Cost (TL/ha) (1+2+3)
						(h/ha)	(TL/ha) (3)	
	Turn shredder	2,9	8,90					
T_1	Heavy tine spring cultivator	15,8	48,29	76,89	9,06	18	81	166,95
	Pneumatic precision drill	6,5	19,70					
	Turn shredder	2,9	8,90					
T_2	Rotory tiller	19,6	59,73	88,32	10,41	17,2	77,4	176,13
	Pneumatic precision drill	6,5	19,70					
	Turn shredder	2,9	8,90					
	Çhisel	16,7	50,83					
T_3	Heavy duty disk harrow	11,3	34,31	113,74	13,41	19,6	88,2	215,35
	Pneumatic precision drill	6,5	19,70					
	Plough	28,8	87,69					
T_4	Heavy duty disk harrow	11,3	34,31	141,7	16,71	18,5	83,25	241,66
	Pneumatic precision drill	6,5	19,70					

2011 year fuel price: 3.05 TL/L. 2011 year metallic oil price: 2.62 TL/L. 2011 year workmen price: 4.5 TL/h

Table 9. Economic analysis of the yield results

Soil tillage systems	Agriculture tools and machines	Average/ yield (tone/ha)	Crop selling price (TL/tone)	Gross income (TL/ha) (B)	Cost Elements According To The Processes					Total Input Cost (TL/ha) (C)	Gross Profit (TL/ha) A= B-C
					Soil tillage and sowing (TL/ha)	Tractor hoe (TL/ha)	Irrigation- Herbicide- Maintenance (TL/ha)	Seed Fertilizer (TL/ha)	Harvesting- Transport (TL/ha)		
T_1	Turn shredder Heavy tine spring cultivator Pneumatic precision drill	61,41	115,00	7062,15	166,95	50	328,6	727,2	240	1512,8	**5549,40**
T_2	Turn shredder Rotory tiller Pneumatic precision drill	60,22	115,00	6925,30	176,13	50	328,6	727,2	240	1521,9	**5403,37**
T_3	Turn shredder Çhisel Heavy duty disk harrow Pneumatic precision drill	65,51	115,00	7533,65	215,35	50	328,6	727,2	240	1561,2	**5972,50**
T_4	Plough Heavy duty disk harrow Pneumatic precision drill	66,58	115,00	7656,70	241,66	50	328,6	727,2	240	1587,5	**6069,24**

Crop selling price: 115 TL/tone

According to soil tillage systems, gross income, total expense and gross profit were calculated and given in Table 9. T_1 system was the third system with 5549.40 TL/ha in gross profit calculation with the lowest input. T_2 system was in the lowest level with 5403.37 TL/ha in gross profit calculation. T_4 system was in the highest level with 6069.24 TL/ha in gross profit calculation in spite of the highest input.

Results

The second year results of the research is desired to be shared with the scientific world. As the result of the evaluations, the yield amounts were determined as T_1:61.41 t/ha, T_2: 60.22 t/ha, T_3:65.51 t/ha, T_4:66.58 t/ha. The highest yield amounts was obtained from the traditional system, T4 (plough+ heavy duty disk harrow+ pneumatic precision drill) and as the lowest yield amount was obtained from the reduced soil tillage method T2 (turn shredder+ rotory tiller+ pneumatic precision drill). Among the methods, the lowest fuel consumption was determined in T_1 soil tillage system with 25.21 lt/ha and the highest fuel consumption was determined in T_4 soil tillage system with 46.46 lt/ha. The soil tillage device in which the fuel consumption was utmost used was determined as plough with 28.8 lt/ha and the soil tillage devices in which the fuel consumption was a few used were determined as turn shredder, pneumatic precision drill, heavy duty disk harrow, chisel and rotory tiller. The soil tillage system in which the average labor success was the highest was the T_4 soil tillage system with 5.40 ha/h and the other subjects were calculated as T_3: 5.07 ha/h , T_1:4.23 ha/h , T_2:4.17 ha/h respectively. The lowest cost in terms of input usage actualized in T1 system (turn shredder+ heavy tine spring cultivator+ pneumatic precision drill) and the highest cost actualized in T_4 system (plough+ heavy duty disk harrow+ pneumatic precision drill).

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