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## Agricultural Mechanization of Field Crops in Thrace Region of Turkey

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**Abstract** Objective of this research is to determine mechanization chain for field crops in Thrace Region of Turkey. Agricultural machinery type, size, specifications application time of agricultural practices and amount of agricultural inputs were determined for wheat, sunflower, canola, maize, sugar beet and rice. Fuel consumption of each procedure and time requirements of field operations were determined from survey, research studies and articles. In addition, production costs were calculated. As an example: fuel consumption and time requirement of machinery operations were 107.5 l/ha and 3 h/ha for sunflower. In addition, human labour and requirements were determined 3.2 h/ha for field operations of sunflower production. From tillage to harvest of the sunflower, there are 13 field operations. These are plough, cultivator, harrow, centrifugal fertiliser spreader, planting, roller, fertilisation with centrifugal fertiliser spreader, hoeing, 2 times herbicide application, and harvesting. The results can be used to manage next year growing strategies such as field traffic, agricultural input requirements.

**Keywords** Mechanization, field crops, Thrace Region, Turkey

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### Introduction

European part of Turkey is gradually well developed region in Turkey (Figure 1). Instead of one of the well-developed industrialised area of Turkey, Thrace Region has important agricultural production. A large portion of Thrace Region has been used as cultivation land. The most important means of livelihood in Edirne and Kırklareli provinces are agriculture and the agriculture industry. A great part of the people living especially in the inland and western parts deal with work based on agriculture in Tekirdag province, which has an intense industrial production [1].



Figure 1: Thrace Region of Turkey [2]

Agriculture is the one of the important income sources in Edirne, Kırklareli and Tekirdag Cities in Thrace Region. Agricultural production value of the Region was obtained from plant production in 79.13% and animal

production 20.87%. Wheat, sunflower and rice are the most important crops in this Region. In addition, canola, sugar beet, grape, apple have been growing. Mean size of farm area is approximately 7 ha. Instead of the mean size is higher than Turkey's average farm size 5 ha, 37% of farms are lower than 5 ha. in Thrace Region. Economic income of the farmers is small because of small scale farms and non irrigated agricultural crop production [3].

Mechanization chain is important for machinery selection and determination of the problems in field crop production. Objective of this research was to determine mechanization chain for field crops in Thrace Region of Turkey. Field operations, agricultural machinery type, size, specifications application time of agricultural practices and amount of agricultural inputs were determined for wheat, sunflower, canola, maize, sugar beet and rice. Fuel consumption of each procedure and time requirements of field operations were determined from survey, research studies and articles. In addition, production costs were calculated.

### Materials and Methods

Wheat, sunflower, rice, canola, maize for silage, and sugar beet widely produced in Thrace Region were selected for determining of agricultural mechanization. Agricultural machinery type, size, application time of agricultural practices and amount of agricultural inputs were determined for wheat, sunflower [4], canola, maize, sugar beet and rice from farmers and literature. . Field operations, machine type, time, speed, effective machine capacity, fuel consumption and human labour requirement were determined by using question with farmers in Thrace Region. .Fuel consumption of each procedure and time requirements of field operations were determined from research studies, articles and surveys. Machine size and type, field size, soil type and working conditions etc. affect fuels consumption, effective machine capacity and labour requirement. In this research a sample data were given for an average size farm in Thrace Region. Daily working hour accepted as 10 hour per day. Field efficiency data of the agricultural machines were taken from [5-7].

Collected data were used to calculate effective field capacity (h/ha), efficiency of effective field capacity field capacity (%), total fuel consumption (l/ha), fuel consumption percentage in total fuel consumption(%) for each operations, total man labour requirement (h/ha) and percentage of man labour requirement in total man labour requirement (%) for each field operations[8].

### Results and Discussions

Field operations of the crops investigated in this article have been made by agricultural machineries. Results of the study were given in Table 1 for wheat, in Table 2 for sunflower, in table 3 for paddy, in Table 4 for maize, in Table 5 for canola and in Table 6 for sugarbeet.

**Table 1:** Wheat mechanization

Field operations / Machine Type	Working Time	Machine Width (m)	Working Speed (km/h)	Efficiency (%)	Effective Field Capacity (ha/h)	Fuel consumption (l/ha)	Man labour (h/ha)
Plough	August- September	1.4	6	0.80	0.67	30.0	1.190
Disc harrow	September	3.0	10	0.85	2.55	12.0	0.333
Cultivator	September October	4.0	13	0.80	4.16	7.0	0.192
Centrifugal fertiliser spreader	October	16.0	14	0.70	15.68	3.5	0.045
Toothed roller	October	4.0	17	0.80	5.44	4.5	0.147
Sowing machine	October	4.0	12	0.70	2.24	12.0	0.208
Roller	October	5.0	13	0.85	5.53	4.5	0.308
Fertiliser spreader	January-February	16.0	14	0.70	15.68	3.5	0.045
Sprayer	February	16.0	14	0.65	14.56	3.5	0.045
Sprayer	March	16.0	14	0.65	14.56	3.5	0.089
Fertiliser spreader	March-April	16.0	14	0.70	15.68	3.5	0.089
Sprayer	April	16.0	14	0.65	14.56	3.5	0.089
Sprayer	May	16.0	14	0.65	14.56	3.5	0.089
Sprayer	May-June	16.0	14	0.65	14.56	3.5	0.089
Combine	June-July	5.2	4	0.70	1.46	20.0	0.962
<b>TOTAL</b>						<b>118.0</b>	<b>3.920</b>



**Table 2:** Sunflower mechanization

Field operations / Machine Type	Working Time	Machine Width (m)	Working Speed (km/h)	Efficiency (%)	Effective Capacity (ha/h)	Fuel Consumption (l/ha)	Man labour requirement (h/ha)
Plough	September-November	1.40	6	0.8	0.67	30.00	1.190
Cultivator	March	3.40	9	0.85	2.60	10.00	0.327
Cultivator	April	3.50	10	0.8	2.80	8.00	0.286
Toothed harrow	April	4.00	15	0.8	4.80	4.00	0.167
Fertiliser spreader	April	16.00	14	0.7	15.68	3.50	0.089
Sprayer	April	16.00	14	0.65	14.56	3.50	0.089
Sowing machine	April-May	4.20	7	0.7	2.06	8.00	0.340
Roller	April-May	5.00	12	0.85	5.10	4.50	0.167
Fertiliser spreader	June	16.00	14	0.7	15.68	3.50	0.089
Hoeing	June	4.20	7	0.8	2.35	9.00	0.340
Sprayer	June	16.00	14	0.65	14.56	3.50	0.089
Combine	September	5.20	7	0.7	2.55	20.00	0.549
<b>TOTAL</b>						<b>107.50</b>	<b>3.723</b>

**Table 3:** Paddy mechanization

Field operations / Machine Type	Working Time	Machine Width (m)	Working Speed (km/h)	Efficiency (%)	Effective Capacity (ha/h)	Fuel Consumption (l/ha)	Man labour requirement (h/ha)
Plough	September-October	1.4	6	0.80	0.672	30,0	1.190
Goble disc harrow	March-April	3.0	10	0.85	2.550	12,0	0.333
Levelling	March-April	4.0	7	0.70	1.960	12,0	0.714
Combine harrow	April	4.0	13	0.80	4.160	8,0	0.192
Spring tooth harrow	April	4.0	15	0.80	4.800	4,0	0.167
Centrifugal fertiliser spreader	May (before sowing)	16.0	14	0.70	15.680	3,5	0.089
Centrifugal fertiliser spreader for sowing	May	3.0	7	0.70	1.470	10,0	0.952
Fertiliser application	July	16.0	10	0.70	11.200	3,5	0.125
Spraying-1	May-June	16.0	10	0.65	10.400	3,5	0.125
Spraying-2	July	16.0	10	0.65	10.400	3,5	0.125
Combine	September	5.2	5	0.70	1.820	20,0	0.769
<b>TOTAL</b>						<b>110,0</b>	<b>4.783</b>

**Table 4:** Maize mechanization

Field operations / Machine Type	Working Time	Machine Width (m)	Working Speed (km/h)	Efficiency (%)	Effective Capacity (ha/h)	Fuel Consumption (l/ha)	Man labour requirement (h/ha)
Plough	September-October	1.4	6	0.80	0.672	30.0	1.190
Cultivator	Maarch-April	3.5	10	0.85	2.975	10.0	0.286
Fertiliser Spreader	April-May	16.0	14	0.70	15.680	3.5	0.089
Sowing	April-May	4.2	7	0.70	2.058	8.0	0.340
Sprayer	May	16.0	14	0.65	14.560	3.5	0.089
Fertiliser Spreader	June	16.0	14	0.70	15.680	3.5	0.089
Hoeing	June	4.2	7	0.80	2.352	9.0	0.340
Sprayer	June	16.0	14	0.65	14.560	3.5	0.089
Lister	June-July	4.2	7	0.80	2.352	7.0	0.340
Combine	September-October	5.2	7	0.70	2.450	66.0	0.286
<b>TOTAL</b>						<b>144.0</b>	<b>3.139</b>



Table 5: Canola mechanization

Field operations / Machine Type	Working Time	Machine Width (m)	Working Speed (km/h)	Efficiency (%)	Effective Capacity (ha/h)	Fuel Consumption (l/ha)	Man labour requirement (h/ha)
Plough	July	1.40	6	0.80	0.67	30.00	1.190
Disc Harrow	August	3.00	9	0.85	2.30	12.00	0.370
Sprayer	August-Sept.	16.00	14	0.65	14.56	3.50	0.045
Disc Harrow	September	3.00	9	0.85	2.30	12.00	0.370
Rotary tiller	September	3.00	5	0.85	1.28	25.00	0.667
Fertiliser spreader	September	16.00	14	0.70	15.68	3.50	0.045
Harrow	September	4.00	15	0.85	5.10	4.50	0.167
Roller-packer	September	5.00	12	0.85	5.10	4.50	0.167
Sowing machine	October	3.00	7	0.65	1.37	12.00	0.476
Roller-packer	October	5.00	12	0.85	5.10	4.50	0.167
Fertiliser spreader	December	16.00	14	0.70	15.68	3.50	0.045
Sprayer	February	16.00	14	0.65	14.56	3.50	0.045
Fertiliser spreader	March	16.00	14	0.70	15.68	3.50	0.045
Sprayer	March	16.00	14	0.65	14.56	3.50	0.045
Harvesting	May-June	5.20	8	0.70	2.91	20.00	0.240
<b>TOTAL</b>						<b>145.50</b>	<b>4.082</b>

Table 6: Sugarbeet mechanization

Field operations /	Working Time	Machine Width (m)	Working Speed (km/h)	Efficiency (%)	Effective Capacity (ha/h)	Fuel Consumption (l/ha)	Man labour requirement (h/ha)
Fertiliser spreader	September	16.0	14.0	0.70	15.68	3.50	0.0893
Plough	Sept.-Oct.-Nov.	1.4	6.0	0.80	0.67	30.00	1.1905
Chisel	March	3.4	9.0	0.85	2.45	10.00	0.3268
Combined harrow	April	3.5	10.0	0.85	2.98	8.00	0.2857
Harrow	April	4.0	15.0	0.85	5.10	4.00	0.1667
Pesticide application	March	16.0	14.0	0.65	19.04	3.50	0.0893
Fertiliser spreader	March	16.0	14.0	0.70	14.56	3.50	0.0893
Pneumatic	March	4.2	5.0	0.70	1.47	8.00	0.4762
Fertiliser spreader	May	16.0	14.0	0.70	15.68	3.50	0.0893
Hoeing	May	4.2	7.0	0.85	2.06	9.00	0.3401
Pesticide application	May/June	16.0	14.0	0.65	19.04	3.50	0.0893
Sugar beet harvester	Sept./Oct.	2.0	2.5	0.70	0.33	30.00	4.2105
<b>TOTAL</b>						<b>116.50</b>	<b>7.4429</b>

General evaluations for fuel consumption and man labour requirement were given in Table 7.

Table 7: General evaluations for fuel consumption and man labour requirement for field crops

		Tillage	Spraying	Sowing	Fertilising	Harvesting	Total
<b>Wheat</b>	Fuel (l/ha)	58.00	17.50	12.00	10.50	20.00	118.00
	Fuel (%)	49.15	14.83	10.17	8.90	16.95	100.00
	Man labour (h/ha)	2.17	0.40	0.21	0.18	0.96	3.92
	Man labour (%)	55.36	10.23	5.31	4.57	24.54	100.00
<b>Canola</b>	Fuel (l/ha)	92.50	10.50	12.00	10.50	20.00	145.50
	Fuel (%)	63.57	7.22	8.25	7.22	13.75	100.00
	Man labour (h/ha)	3.10	0.14	0.48	0.14	0.24	4.08
	Man labour (%)	75.86	3.31	11.66	3.31	5.88	100.00



<b>Paddy</b>	Fuel (l/ha)	66.00	7.00	10.00	7.00	20.00	110.00
	Fuel (%)	60.00	6.36	9.09	6.36	18.18	100.00
	Man labour (h/ha)	2.60	0.25	0.95	0.21	0.77	4.78
	Man labour (%)	54.30	5.23	19.91	4.48	16.08	100.00
<b>Sunflower</b>	Fuel (l/ha)	65.50	7.00	8.00	7.00	20.00	107.50
	Fuel (%)	60.93	6.51	7.44	6.51	18.60	100.00
	Man labour (h/ha)	2.48	0.18	0.34	0.18	0.55	3.72
	Man labour (%)	66.55	4.78	9.13	4.78	14.75	100.00
<b>Maize</b>	Fuel (l/ha)	56.00	7.00	8.00	7.00	66.00	144.00
	Fuel (%)	38.89	4.86	5.56	4.86	45.83	100.00
<b>Silage</b>	Man labour (h/ha)	2.16	0.18	0.34	0.18	0.29	3.14
	Man labour (%)	68.71	5.67	10.83	5.67	9.11	100.00

Total fuel consumption was determined as 118 l/ha for wheat, 107.5 l/ha for sunflower, 110 l/ha for paddy, 144l/ha for maize, 145.5 l/ha for canola and 116.50 for sugar beet.

Total man labour requirement 3.93 h/ha for wheat, 3.72 h/ha for sunflower, 4.78 h/ha for paddy, 3.13 h/ha for maize, 4.08 h/ha for canola, 7.44 h/ha for sugarbeet.

Fuel consumptions and man labour requirement of tillage operations are generally more than 50% of the total fuel consumption and total man labour requirement for all field crops investigated in this research. When make a farm management plan these data should be taken into account. Results are also useful for researchers to see what the mechanization problem of the field crops is.

### Conclusions

According to the results there are a few field operations such as hoeing; cutting of sugar beet top etc. has been done by workers. Turkish government support agricultural mechanization. Last 10 years farmers get 50% support for selected agricultural machineries. This support caused good agricultural mechanization for all farmers in this region. The problems are small scale farm, small field plots and young people don't want to carry out agricultural production (Ministry of Food, Agriculture and Livestock, 2016). Mean age of farmers is 56. In the future, these also will be reason of new stage of agricultural production.

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