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Determination of Natural Risk Sources Effective in Wheat Production in Hadim District with the Help of Linear Programming

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ABSTRACT

There are many sources of natural risks affecting wheat cultivation. In this study, it is aimed to estimate the minimum and maximum risk ranges and premium and compensation amounts of the natural risk factors affecting the wheat yield in Hadim district of Konya in terms of farmers and insurance.As natural risk factors, disease and pests, frost, drought, hail, fire and the interactions of other risks and factors were examined.The number of factors dealt with in the study is 6, and the total number of linear models created using all combinations is 63.The 63 linear models established, the minimum and maximum risk ranges in terms of farmers and insurance were determined by using the simplex method of linear programming on the basis of yield and price.In addition, diseases and pests and other risk factors not included in the scope of agricultural insurances were included in the linear models and wheat yield was estimated on district basis.In the model with all risk factors, the expected risk value of the farmer is 64.962 (kg / ha-1) -71.588 (TL / ha-1), while it is estimated as 53.548 (kg / ha-1) -59.009 (TL / ha-1) in terms of insurance. has been. As a result, it was estimated that the farmer paid 20,831 (TL / ha-1) premiums and 122,344 (TL / ha-1), while insurance companies paid 59,009 (TL / ha-1) premium 84,018 (TL / ha-1) compensation.

1. Introduction

Agricultural products are under great risk with the increase of global warming and natural disasters in the world. Although there are many factors that affect yield in agricultural products, the biggest share belongs to natural risk factors. Natural risk factors are common from diseases and pests, frost, drought, hail, fire, earthquake, storm, tornado, landslide, flood and other risks. While it is almost impossible to control climatic-induced natural risk factors, it is partially possible to detect them with the help of early warning systems thanks to developing technology. These events, which occur outside the control of the growers, cause fluctuations in the production of agricultural products. These fluctuations in yield cause the farmers to worry economically (Akçaöz, 2006).

The geographical location of both Turkey and also to take part in many climates although it is quite conducive to a variety of agricultural production, the sector is experiencing a troubled period in terms of economy due to reasons such as the lack of efficient production unions, competition among agricultural product exchanges, low education level, rural to urban migration, climate change, deterioration of ecological balance, disasters and disasters.This situation negatively affects both the income of the producer and the national economy (Karaca et al., 2010; Tsikirayi et al., 2013; Cangi & Oruç, 2017).

The main natural risk factors in wheat production are diseases and pests, frost, drought, hail, fire, etc. It is known that it causes significant loss of yield and low quality as a result of not taking into account the risk factors determined during production (Altay, 2019).

Irregular yields of agricultural products pushed producers to seek assurance to continue their activities (Çukur & Saner, 2008; İkikat Tümer, 2011a; İkikat Tümer, 2011b; Karahan Uysal et al., 2014; Terin & Aksoy, 2015; Tümer, 2019).It has become inevitable that agricultural products produced under risk are covered by insurance and partially compensated for

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the losses incurred.One of the ways to overcome these various and common risks in the agricultural sector is agricultural insurance (Binici et al., 2003; İkikat Tümer, 2004).In this context, after previously functioning of private insurance companies in Turkey rose Law Agricultural Insurance in 2005.Agricultural Insurance Pool and TARSİM started their activities in 2006 (Sümer & Polat, 2016).In this context, the development of agricultural policies within the scope of agricultural insurance in recent years is a beacon of hope for our country's producers.

Turkey continues its activities by state agricultural insurance and negotiated private insurance companies. Both premium and policy support are provided to farmers from the agricultural insurance pool fund. In herbal product insurances, 50% of insurance premiums, 66.67% of frost coverage and 60% of district-based drought have been secured by the state for free (Ertan & Gök, 2012; Kızıloğlu, 2017; Anonymous, 2019).

In this study, it is aimed to estimate the minimum and maximum risk ranges and premium and indemnity amounts in terms of farmers and insurance by making risk analysis of natural risk factors that are effective in wheat production in Hadim district.

2. Materials and Methods

Hadim district, located in the south of Konya, is located on the Taşeli Plateau between 36 ° 59 'north latitude and 32 ° 27' east longitude (Figure 1).The average altitude above sea level is 1510 m, the annual average rainfall is 619 mm and the surface area is 921 km^2.Situated on a valley in the Central Taurus Mountains, Hadim is located in the Mediterranean region and does not fully show the characteristic features of the Mediterranean climate (Anonymous, 2018).In this respect, it shows a transition feature between Terrestrial climate and Mediterranean climate (Anonymous, 2018).It receives more precipitation than the terrestrial climate and is among the districts with the highest day and night temperature difference.Mostly grown field products in Hadim are wheat, barley and chickpeas. Among these products, the product with the most growing area is wheat with 60.82%, and the average wheat yield in the district is 280 kg / da (Anony-mous, 2018; Tuik, 2018; Anonymous, 2018a).

Figure 1

Konya province Hadim district map (Anonim, 2018a).

The probability, frequency and corrected probability values of the natural risk factors and interactions examined in the wheat production of Hadim district were determined by the experts in the light of meteorological data. The probability values of interactions were inspired by the probability of occurring two or more events at the same time and were calculated as P (A) xP (B) x… xP (n).In determining the risk frequencies of interactions, the average of the related main risk factors was taken (Table 1).The effects of natural risk factors and interactions examined in the wheat production of Hadim district were evaluated by local farmers, agricultural engineers and faculty members in the light of various literature and determined by brainstorming (Table 2).

Risk analysis consists of two basic components, risk realization probability and risk effect, and it is calculated as Risk = (RGO x RF) x RGE (Erdoğan, 2017).In wheat production, the period of the plant when the risk occurs will change the severity of the risk effect. Therefore, while calculating the risk in wheat production, without ignoring the effect of time (it takes values between 0-3), the frequency of the risk should also be included in the calculation. Taking the frequencies of the risk as the coefficient of the constraints helped to calculate the weighted average of the risks in terms of time.Finally, risk calculation takes the form of Risk = DRO x RGE (RGO: Probability of Risk Realization, RF: Frequency of Risk, RGE: Effect of Risk on Occurrence, DRO: Probability of Adjusted Risk). The formation stages of linear programming were carried out with the following mathematical expressions (Apaydın, 1996; Sucu, 1996; Yapıcı, 2000).The creation of the objective function has been designed and applied in the logic of a multi-factor linear model that varies according to the number of factors.

Objective function;

$$\mathrm{Max(Min)}Z(x) = CX$$

Constraints;$AX\{\leq, =, \geq\}B$

Table 1
Frequencies and Probability of Natural Risks Which are Taken in Wheat Production of Hadim District, Konya

Natural Risks	Symbols	Risk Probability		Risk Frequency		Adjusted Risk Probability	
		Min	Max	Min	Max	Min	Max
Diseases and Pests	x1	0.10	0.20	1.250	2.200	0.125	0.44
Frost	x2	0.15	0.25	1.250	1.950	0.1875	0.4875
Drought	x3	0.05	0.25	1.200	2.050	0.06	0.5125
Hail	x4	0.03	0.08	1.150	1.500	0.0345	0.12
Fire	x5	0.001	0.003	1.030	1.070	0.00103	0.00321
Others	x6	0.15	0.25	1.300	2.350	0.195	0.5875
Diseases and Pests- Frost	x12	0.015	0.05	1.250	2.075	0.01875	0.10375
Diseases and Pests- Drought	x13	0.005	0.05	1.225	2.125	0.006125	0.10625
Diseases and Pests- Hail	x14	0.003	0.016	1.200	1.850	0.0036	0.0296
Diseases and Pests- Fire	x15	0.0001	0.0006	1.140	1.635	0.000114	0.000981
Diseases and Pests- Others	x16	0.015	0.05	1.275	2.275	0.019125	0.11375
Frost- Drought	x23	0.0075	0.0625	1.225	2.000	0.0091875	0.125
Frost- Hail	x24	0.0045	0.02	1.200	1.725	0.0054	0.0345
Frost- Fire	x25	0.00015	0.00075	1.140	1.510	0.000171	0.0011325
Frost- Others	x26	0.0225	0.0625	1.275	2.150	0.0286875	0.134375
Drought- Hail	x34	0.0015	0.02	1.175	1.775	0.0017625	0.0355
Drought- Fire	x35	0.00005	0.00075	1.115	1.560	0.00005575	0.00117
Drought- Others	x36	0.0075	0.0625	1.250	2.200	0.009375	0.1375
Hail- Fire	x45	0.00003	0.00024	1.090	1.285	0.0000327	0.0003084
Hail- Others	x46	0.0045	0.02	1.225	1.925	0.0055125	0.0385
Fire - Others	x56	0.00015	0.00075	1.165	1.710	0.00017475	0.0012825
Diseases and Pests- Frost- Drought	x123	0.00075	0.0125	1.233	2.067	0.000925	0.0258333
Diseases and Pests- Frost- Hail	x124	0.00045	0.004	1.217	1.883	0.0005475	0.0075333
Diseases and Pests- Frost- Fire	x125	0.000015	0.00015	1.177	1.740	0.00001765	0.000261
Diseases and Pests- Frost- Others	x126	0.00225	0.0125	1.267	2.167	0.00285	0.0270833
Diseases and Pests- Drought- Hail	x134	0.00015	0.004	1.200	1.917	0.00018	0.0076667
Diseases and Pests- Drought- Fire	x135	0.000005	0.00015	1.160	1.773	0.0000058	0.000266
Diseases and Pests- Drought- Others	x136	0.00075	0.0125	1.250	2.200	0.0009375	0.0275
Diseases and Pests- Hail- Fire	x145	0.000003	0.00005	1.143	1.590	0.00000343	0.00007950
Diseases and Pests- Hail- Others	x146	0.00045	0.004	1.233	2.017	0.000555	0.0080667
Diseases and Pests- Fire- Others	x156	0.000015	0.00015	1.193	1.873	0.0000179	0.000281
Frost- Drought- Hail	x234	0.000225	0.005	1.200	1.833	0.00027	0.0091667
Frost- Drought- Fire	x235	0.0000075	0.000188	1.160	1.690	0.0000087	0.0003177
Frost- Drought- Others	x236	0.001125	0.015625	1.250	2.117	0.00140625	0.0330729
Frost-- Hail- Fire	x245	0.0000045	0.00006	1.143	1.507	0.000005145	0.0000904
Frost- Hail- Others	x246	0.000675	0.005	1.233	1.933	0.0008325	0.0096667
Frost- Fire- Others	x256	0.0000225	0.000188	1.193	1.790	0.00002685	0.0003365
Drought- Hail- Fire	x345	0.0000015	0.00006	1.127	1.540	0.00000169	0.00009240
Drought- Hail- Others	x346	0.000225	0.005	1.217	1.967	0.00027375	0.0098333
Drought- Fire- Others	x356	0.0000075	0.000188	1.177	1.823	0.000008825	0.0003428
Hail- Fire- Others	x456	0.0000045	0.00006	1.160	1.640	0.00000522	0.00009840
Diseases and Pests- Frost- Drought- Hail	x1234	0.0000225	0.001	1.213	1.925	0.00002728	0.001925
Diseases and Pests- Frost- Drought- Fire	x1235	0.00000075	0.000038	1.183	1.818	0.00000089	0.00006907
Diseases and Pests- Frost- Drought- Others	x1236	0.0001125	0.003125	1.250	2.138	0.000140625	0.0066797
Diseases and Pests- Frost- Hail- Fire	x1245	0.00000045	0.000012	1.170	1.680	0.00000053	0.00002016
Diseases and Pests- Frost- Hail- Others	x1246	0.0000675	0.001	1.238	2.000	0.00008353	0.002
Diseases and Pests- Frost- Fire- Others	x1256	0.000002	0.00004	1.208	1.893	0.000002415	0.00007570
Diseases and Pests- Drought- Hail- Fire	x1345	0.00000015	0.00001	1.158	1.705	0.00000017	0.00001705
Diseases and Pests- Drought- Hail- Others	x1346	0.0000225	0.001	1.633	2.700	0.00003675	0.0027
Diseases and Pests- Drought- Fire- Others	x1356	0.00000075	0.00004	1.195	1.918	0.00000090	0.00007670
Diseases and Pests- Hail- Fire- Others	x1456	0.00000045	0.000012	1.183	1.780	0.00000053	0.00002136
Frost- Drought- Hail- Fire	x2345	0.000000225	0.000015	1.158	1.643	0.00000026	0.00002464
Frost- Drought- Hail- Others	x2346	0.00003375	0.00125	1.225	1.963	0.00004134	0.0024531
Frost- Drought- Fire- Others	x2356	0.0000011	0.000047	1.195	1.855	0.00000131	0.00008719
Frost- Hail- Fire- Others	x2456	0.0000007	0.000015	1.183	1.718	0.00000083	0.00002576
Drought- Hail- Fire- Others	x3456	0.000000225	0.000015	1.170	1.743	0.00000026	0.00002614
Diseases and Pests- Frost- Drought- Hail-Fire	x12345	0.000000023	0.000003	1.176	1.754	0.00000003	0.00000526
Diseases and Pests- Frost- Drought- Hail- Others	x12346	0.000003	0.00025	1.230	2.010	0.00000369	0.0005025
Diseases and Pests- Frost- Drought- Fire- Others	x12356	0.0000001	0.000009	1.206	1.924	0.00000012	0.00001732
Diseases and Pests- Frost- Hail- Fire- Others	x12456	0.00000007	0.0000030	1.196	1.814	0.00000008	0.00000544
Diseases and Pests- Drought- Hail-Fire- Others	x13456	0.000000023	0.000003	1.186	1.834	0.00000003	0.00000550
Frost- Drought- Hail-Fire- Others	x23456	0.000000034	0.000004	1.186	1.784	0.00000004	0.00000714
Diseases and Pests-Frost- Drought-Hail-Fire-Others	x123456	0.0000000034	0.0000008	1.197	1.853	0.000000004	0.00000148

Table 2
Effect of Natural Risks Which are Taken in Wheat Production of Hadim District, Konya

Natural Risks	Symbols	Effect of Risks for Farmer (kg/ha^{-1})		Effect of Risks for Insurance (kg/ha^{-1})	
		Min	Max	Min	Max
Diseases and Pests	x1	45	120	0	0
Frost	x2	25	115	40	65
Drought	x3	20	75	40	45
Hail	x4	20	130	30	70
Fire	x5	10	280	20	200
Others	x6	35	145	80	100
Diseases and Pests- Frost	x12	30	155	60	100
Diseases and Pests- Drought	x13	35	135	55	85
Diseases and Pests- Hail	x14	40	180	60	110
Diseases and Pests- Fire	x15	35	280	55	200
Diseases and Pests- Others	x16	60	190	95	120
Frost- Drought	x23	35	130	65	85
Frost- Hail	x24	35	145	55	90
Frost- Fire	x25	30	280	45	200
Frost- Others	x26	55	155	85	95
Drought- Hail	x34	35	140	55	85
Drought- Fire	x35	30	280	45	200
Drought- Others	x36	65	155	95	95
Hail- Fire	x45	25	280	35	200
Hail- Others	x46	50	165	75	105
Fire - Others	x56	55	280	70	200
Diseases and Pests- Frost- Drought	x123	65	195	90	100
Diseases and Pests- Frost- Hail	x124	50	190	70	95
Diseases and Pests- Frost- Fire	x125	50	280	70	200
Diseases and Pests- Frost- Others	x126	60	185	90	100
Diseases and Pests- Drought- Hail	x134	55	180	80	95
Diseases and Pests- Drought- Fire	x135	55	280	85	200
Diseases and Pests- Drought- Others	x136	65	175	90	100
Diseases and Pests- Hail- Fire	x145	45	280	65	200
Diseases and Pests- Hail- Others	x146	50	185	70	105
Diseases and Pests- Fire- Others	x156	55	280	75	200
Frost- Drought- Hail	x234	55	190	85	105
Frost- Drought- Fire	x235	60	280	90	200
Frost- Drought- Others	x236	65	180	95	100
Frost- Hail- Fire	x245	40	280	60	200
Frost- Hail- Others	x246	60	200	85	110
Frost- Fire- Others	x256	55	280	75	200
Drought- Hail- Fire	x345	50	280	70	200
Drought- Hail- Others	x346	65	185	95	100
Drought- Fire- Others	x356	65	280	100	200
Hail- Fire- Others	x456	50	280	75	200
Diseases and Pests- Frost- Drought- Hail	x1234	80	200	110	120
Diseases and Pests- Frost- Drought- Fire	x1235	90	280	115	200
Diseases and Pests- Frost- Drought- Others	x1236	85	210	110	120
Diseases and Pests- Frost- Hail- Fire	x1245	85	280	115	200
Diseases and Pests- Frost- Hail- Others	x1246	95	225	120	125
Diseases and Pests- Frost- Fire- Others	x1256	90	280	125	200
Diseases and Pests- Drought- Hail- Fire	x1345	85	280	115	200
Diseases and Pests- Drought- Hail- Others	x1346	85	190	110	110
Diseases and Pests- Drought- Fire- Others	x1356	85	280	115	200
Diseases and Pests- Hail- Fire- Others	x1456	90	280	120	200
Frost- Drought- Hail- Fire	x2345	95	280	130	200
Frost- Drought- Hail- Others	x2346	100	225	135	120
Frost- Drought- Fire- Others	x2356	100	280	140	200
Frost- Hail- Fire- Others	x2456	105	280	145	200
Drought- Hail- Fire- Others	x3456	85	280	110	200
Diseases and Pests- Frost- Drought- Hail-Fire	x12345	100	280	140	200
Diseases and Pests- Frost- Drought- Hail- Others	x12346	110	230	150	125
Diseases and Pests- Frost- Drought- Fire- Others	x12356	110	280	145	200
Diseases and Pests- Frost- Hail- Fire- Others	x12456	110	280	155	200
Diseases and Pests- Drought- Hail-Fire- Others	x13456	100	280	135	200
Frost- Drought- Hail-Fire- Others	x23456	115	280	160	200
Diseases and Pests-Frost- Drought-Hail-Fire-Others	x123456	120	280	165	200

Positivity requirement;

$X \geq 0$ this is expressed in the form. In this place;

$C = [c_1, c_2, \dots, c_n]$,

$$X = \begin{bmatrix} x_1 \\ x_2 \\ . \\ . \\ . \\ x_n \end{bmatrix},$$

$$A = \begin{bmatrix} a_{11} a_{12} \dots a_{1n} \\ a_{21} a_{22} \dots a_{2n} \\ . \quad . \quad . \\ . \quad . \quad . \\ . \quad . \quad \dots \quad . \\ a_{m1} a_{m1} \dots a_{mn} \end{bmatrix},$$

$$B = [b_1, b_2, \dots, b_m]^T = \begin{bmatrix} b_1 \\ b_2 \\ . \\ . \\ . \\ b_m \end{bmatrix},$$

C: (1 x n) dimensional objective function coefficients vector (Adjusted Probability of Risk),

X: (n x 1) dimensional decision variables vector (Risk Factors and Interactions),

A: (m x n) dimensional constraint coefficients matrix (Frequency of Risk),

B: (m x 1) is the vector of the values of the dimensional constraints (Effect of Risk).

The risk analysis of this study was obtained with thehelp of the version 24.1.3.CPLEX algorithm version 2.5.1.0 of the GAMS package program of the generated linear 63 different risk models.

3. Results and Discussion

The results of the risk models created for the wheat yield of the Konya province Hadim district are given in Table 3 in terms of farmer and insurance based minimum and maximum risk ranges in terms of yield (kg / ha^{-1}) and wage (TL / ha^{-1}). There are huge differences in terms of some risk factors in terms of farmers and insurance. Some of these differences are closing due to premium support. In terms of natural risks, 50% of the premium, 66.67% of the frost coverage and 60% of the drought are covered by the state (Çiftçi, 2014). However, it is thought that the district-based natural risk factors are slightly below the expectations of the farmers because they only cover the drought risk and the disease pests and other risk factors are excluded from the coverage.

Thanks to 63 different models created with linear programming logic, farmers are able to choose the natural risks they want. In this context, the farmer can provide the opportunity to pay less premiums by insuring the natural risk factors he sees as risky for his own region. Similar situations apply to health, vehicle and home insurances. For example, in a place where there is no landslide and hose risk, home and workplace owners can pay lower premiums by excluding these risks from insurance coverage.

Confidence intervals of natural risk factors in terms of farmer and insurance are given in Table 3.The amount of risk expected by the district farmer for diseases and pests is estimated to be between 5.625-52.800 (kg / ha^{-1}).In frost risk, the amount of risk that the farmer expects is between 7,500-56,063 (kg / ha^{-1}), while insurance is 4,688-31,688 (kg / ha^{-1}).While the risk range of the farmer in drought risk is 2,400-38,438 (kg / ha^{-1}), insurance is estimated to be 1,200-23,063 (kg / ha^{-1}).In addition, farmers cannot benefit from the drought risk individually, as the insurance applies a district-based drought insurance. When the hail risk is taken into account, it has been determined that the farmer is 1,035-15,600 (kg / ha^{-1}), while there may be a loss in the range of 0.690-8,400 (kg / ha^{-1}) of insurance.In fire risk, farmer loss is estimated to be between 0.021-0.899 (kg / ha^{-1}), while insurance will be in the range of 0.010-0.642 (kg / ha^{-1}).In case of other risks that cannot be handled individually, the farmer was found to be between 15,600-85,188 (kg / ha^{-1}), while insurance was between 6,825-41,125 (kg / ha^{-1}).

Considering all natural risk factors in wheat production of Hadim district, it was 18.903-111.020 (kg / ha^{-1}) and 20.831-122.344 (TL / ha^{-1}) for the farmer, while in terms of insurance, the risk is expected between 30.854-76.241 (kg / ha^{-1}) and 34.001-84.018 (TL / ha^{-1}). (Table 3).When an evaluation is made in terms of long years, the risk expected by the district farmers in wheat production is 64.962 (kg / ha^{-1}) -71.588 (TL / ha^{-1}), while the risk amount expected by insurance companies is 53.548 (kg / ha^{-1}) -59.009 (TL / ha^{-1}) (Table 4)

Table 3
Results of Farmer and Insurance Risk Analysis in Wheat Production of Hadim District, Konya

Natural Risks (Models)	Symbols	Farmer Risk (kg/ha^{-1})		Insurance Risk (kg/ha^{-1})		Farmer Risk (*TL/ha^{-1})		Insurance Risk (*TL/ha^{-1})	
		Min	Max	Min	Max	Min	Max	Min	Max
Diseases and Pests	x1	5.625	52.800	0.000	0.000	6.199	58.186	0.000	0.000
Frost	x2	7.500	56.063	4.688	31.688	8.265	61.781	5.166	34.920
Drought	x3	2.400	38.438	1.200	23.063	2.645	42.359	1.322	25.415
Hail	x4	1.035	15.600	0.690	8.400	1.141	17.191	0.760	9.257
Fire	x5	0.021	0.899	0.010	0.642	0.023	0.991	0.011	0.707

Table 3
Results of Farmer and Insurance Risk Analysis in Wheat Production of Hadim District, Konya

Others	x6	15.600	85.188	6.825	41.125	17.191	93.877	7.521	45.320
Diseases and Pests- Frost	x12	8.700	44.500	8.900	21.250	9.587	49.039	9.808	23.418
Diseases and Pests- Drought	x13	5.675	37.500	3.025	15.500	6.254	41.325	3.334	17.081
Diseases and Pests- Hail	x14	5.220	31.680	1.980	7.360	5.752	34.911	2.182	8.111
Diseases and Pests- Fire	x15	4.513	24.661	0.060	0.737	4.973	27.176	0.066	0.812
Diseases and Pests- Others	x16	10.650	54.750	14.925	31.000	11.736	60.335	16.447	34.162
Frost- Drought	x23	5.012	40.625	8.488	26.562	5.523	44.769	9.354	29.271
Frost- Hail	x24	4.508	34.050	7.148	20.050	4.968	37.523	7.877	22.095
Frost- Fire	x25	3.765	29.469	6.027	16.816	4.149	32.475	6.642	18.531
Frost- Others	x26	10.238	48.438	19.913	29.687	11.282	53.379	21.944	32.715
Drought- Hail	x34	1.653	26.750	2.983	16.150	1.822	29.479	3.287	17.797
Drought- Fire	x35	1.012	19.592	2.022	11.878	1.115	21.590	2.228	13.090
Drought- Others	x36	7.237	48.438	14.713	29.687	7.975	53.379	16.214	32.715
Hail- Fire	x45	0.611	10.930	0.921	6.049	0.673	12.045	1.015	6.666
Hail- Others	x46	6.075	41.150	13.238	27.500	6.695	45.347	14.588	30.305
Fire - Others	x56	5.278	36.865	12.031	25.450	5.816	40.625	13.258	28.046
Diseases and Pests- Frost- Drought	x123	10.186	70.445	11.730	37.062	11.225	77.630	12.926	40.842
Diseases and Pests- Frost- Hail	x124	9.609	53.509	10.572	27.190	10.589	58.967	11.650	29.963
Diseases and Pests- Frost- Fire	x125	8.719	45.223	8.948	21.955	9.608	49.836	9.861	24.194
Diseases and Pests- Frost- Others	x126	16.222	73.946	24.440	41.937	17.877	81.488	26.933	46.215
Diseases and Pests- Drought- Hail	x134	6.464	47.392	5.112	22.540	7.123	52.226	5.633	24.839
Diseases and Pests- Drought- Fire	x135	5.690	38.247	3.088	16.265	6.270	42.148	3.403	17.924
Diseases and Pests- Drought- Others	x136	12.861	70.839	17.980	42.438	14.173	78.065	19.814	46.767
Diseases and Pests- Hail- Fire	x145	5.243	32.013	2.055	7.928	5.778	35.278	2.265	8.737
Diseases and Pests- Hail- Others	x146	11.626	60.598	16.837	35.680	12.812	66.779	18.554	39.319
Diseases and Pests- Fire- Others	x156	10.683	55.359	14.982	31.600	11.773	61.006	16.510	34.823
Frost- Drought- Hail	x234	5.835	52.075	9.737	32.188	6.430	57.387	10.730	35.471
Frost- Drought- Fire	x235	5.034	41.548	8.517	27.245	5.547	45.786	9.386	30.024
Frost- Drought- Others	x236	11.323	75.312	21.307	43.750	12.478	82.994	23.480	48.213
Frost- Hail- Fire	x245	4.523	34.749	7.176	20.590	4.984	38.293	7.908	22.690
Frost- Hail- Others	x246	11.261	59.238	21.455	35.338	12.410	65.280	23.643	38.942
Frost- Fire- Others	x256	10.266	49.285	19.951	30.340	11.313	54.312	21.986	33.435
Drought- Hail- Fire	x345	1.665	27.464	3.006	16.705	1.835	30.265	3.313	18.409
Drought- Hail- Others	x346	8.130	57.862	16.054	34.387	8.959	63.764	17.692	37.894
Drought- Fire- Others	x356	7.268	49.285	14.746	30.340	8.009	54.312	16.250	33.435
Hail- Fire- Others	x456	6.104	41.789	13.269	27.995	6.727	46.051	14.622	30.850
Diseases and Pests- Frost- Drought- Hail	x1234	10.824	82.422	12.557	45.327	11.928	90.829	13.838	49.950
Diseases and Pests- Frost- Drought- Fire	x1235	9.538	71.552	10.974	37.932	10.511	78.850	12.093	41.801
Diseases and Pests- Frost- Drought- Others	x1236	17.018	112.905	25.290	63.062	18.754	124.421	27.870	69.494
Diseases and Pests- Frost- Hail- Fire	x1245	9.204	54.381	10.304	27.892	10.143	59.928	11.355	30.737
Diseases and Pests- Frost- Hail- Others	x1246	16.072	95.982	24.274	50.149	17.711	105.772	26.750	55.264
Diseases and Pests- Frost- Fire- Others	x1256	15.015	75.020	22.413	42.778	16.547	82.672	24.699	47.141
Diseases and Pests- Drought- Hail- Fire	x1345	5.791	48.321	4.254	23.257	6.382	53.250	4.688	25.629
Diseases and Pests- Drought- Hail- Others	x1346	12.173	95.804	15.633	48.895	13.415	105.576	17.228	53.882
Diseases and Pests- Drought- Fire- Others	x1356	11.260	71.926	14.527	41.966	12.409	79.262	16.009	46.247
Diseases and Pests- Hail- Fire- Others	x1456	10.438	59.760	12.811	36.337	11.503	65.856	14.118	40.043
Frost- Drought- Hail- Fire	x2345	5.520	52.923	9.100	32.885	6.083	58.321	10.028	36.239
Frost- Drought- Hail- Others	x2346	12.263	96.668	21.390	52.675	13.514	106.528	23.572	58.048
Frost- Drought- Fire- Others	x2356	11.498	77.866	20.230	45.659	12.671	85.808	22.293	50.316
Frost- Hail- Fire- Others	x2456	10.427	66.990	18.739	38.570	11.491	73.823	20.650	42.504
Drought- Hail- Fire- Others	x3456	6.906	58.725	13.722	35.100	7.610	64.715	15.122	38.680
Diseases and Pests- Frost- Drought- Hail-Fire	x12345	11.032	83.274	13.936	46.228	12.157	91.768	15.357	50.943
Diseases and Pests- Frost- Drought- Hail-Others	x12346	18.270	132.332	30.408	75.320	20.134	145.830	33.510	83.003
Diseases and Pests- Frost- Drought- Fire-Others	x12356	17.701	114.144	28.625	64.177	19.507	125.787	31.545	70.723
Diseases and Pests- Frost- Hail- Fire- Others	x12456	13.545	89.930	26.599	51.103	14.927	99.103	29.312	56.316
Diseases and Pests- Drought- Hail-Fire-Others	x13456	14.688	84.761	20.436	49.473	16.186	93.407	22.520	54.519
Frost- Drought- Hail-Fire- Others	x23456	12.815	92.166	25.312	53.581	14.122	101.567	27.894	59.046
Diseases and Pests-Frost- Drought-Hail-Fire-Others	x123456	18.903	111.020	30.854	76.241	20.831	122.344	34.001	84.018

*The unit price of wheat kilogram is taken as 1.102 TL

Table 4
Expected Results of Farmer and Insurance Risk Analysis in Wheat Production of Hadim District, Konya

Natural Risks (Models)	Symbols	Farmer Risk (kg/ha^{-1})	Insurance Risk (kg/ha^{-1})	Farmer Risk (kg/ha^{-1})	Insurance Risk (kg/ha^{-1})
		Minimum Expected	Minimum Expected	Maximum Expected	Maximum Expected
Diseases and Pests	x1	29.213	0.000	32.192	0.000
Frost	x2	31.782	18.188	35.023	20.043
Drought	x3	20.419	12.132	22.502	13.369
Hail	x4	8.318	4.545	9.166	5.009
Fire	x5	0.460	0.326	0.507	0.359
Others	x6	50.394	23.975	55.534	26.420
Diseases and Pests- Frost	x12	26.600	15.075	29.313	16.613
Diseases and Pests- Drought	x13	21.588	9.263	23.789	10.207
Diseases and Pests- Hail	x14	18.450	4.670	20.332	5.146
Diseases and Pests- Fire	x15	14.587	0.399	16.075	0.439
Diseases and Pests- Others	x16	32.700	22.963	36.035	25.305
Frost- Drought	x23	22.819	17.525	25.146	19.313
Frost- Hail	x24	19.279	13.599	21.245	14.986
Frost- Fire	x25	16.617	11.422	18.312	12.586
Frost- Others	x26	29.338	24.800	32.330	27.330
Drought- Hail	x34	14.202	9.567	15.650	10.542
Drought- Fire	x35	10.302	6.950	11.353	7.659
Drought- Others	x36	27.838	22.200	30.677	24.464
Hail- Fire	x45	5.771	3.485	6.359	3.840
Hail- Others	x46	23.613	20.369	26.021	22.447
Fire - Others	x56	21.072	18.741	23.221	20.652
Diseases and Pests- Frost- Drought	x123	40.316	24.396	44.428	26.884
Diseases and Pests- Frost- Hail	x124	31.559	18.881	34.778	20.807
Diseases and Pests- Frost- Fire	x125	26.971	15.452	29.722	17.028
Diseases and Pests- Frost- Others	x126	45.084	33.189	49.683	36.574
Diseases and Pests- Drought- Hail	x134	26.928	13.826	29.675	15.236
Diseases and Pests- Drought- Fire	x135	21.969	9.677	24.209	10.664
Diseases and Pests- Drought- Others	x136	41.850	30.209	46.119	33.290
Diseases and Pests- Hail- Fire	x145	18.628	4.992	20.528	5.501
Diseases and Pests- Hail- Others	x146	36.112	26.259	39.795	28.937
Diseases and Pests- Fire- Others	x156	33.021	23.291	36.389	25.667
Frost- Drought- Hail	x234	28.955	20.963	31.908	23.101
Frost- Drought- Fire	x235	23.291	17.881	25.667	19.705
Frost- Drought- Others	x236	43.318	32.529	47.736	35.846
Frost- Hail- Fire	x245	19.636	13.883	21.639	15.299
Frost- Hail- Others	x246	35.250	28.397	38.845	31.293
Frost- Fire- Others	x256	29.776	25.146	32.813	27.710
Drought- Hail- Fire	x345	14.565	9.856	16.050	10.861
Drought- Hail- Others	x346	32.996	25.221	36.362	27.793
Drought- Fire- Others	x356	28.277	22.543	31.161	24.842
Hail- Fire- Others	x456	23.947	20.632	26.389	22.736
Diseases and Pests- Frost- Drought- Hail	x1234	46.623	28.942	51.379	31.894
Diseases and Pests- Frost- Drought- Fire	x1235	40.545	24.453	44.681	26.947
Diseases and Pests- Frost- Drought- Others	x1236	64.962	44.176	71.588	48.682
Diseases and Pests- Frost- Hail- Fire	x1245	31.793	19.098	35.036	21.046
Diseases and Pests- Frost- Hail- Others	x1246	56.027	37.212	61.742	41.007
Diseases and Pests- Frost- Fire- Others	x1256	45.018	32.596	49.610	35.920
Diseases and Pests- Drought- Hail- Fire	x1345	27.056	13.756	29.816	15.159
Diseases and Pests- Drought- Hail- Others	x1346	53.989	32.264	59.496	35.555
Diseases and Pests- Drought- Fire- Others	x1356	41.593	28.247	45.836	31.128
Diseases and Pests- Hail- Fire- Others	x1456	35.099	24.574	38.680	27.081
Frost- Drought- Hail- Fire	x2345	29.222	20.993	32.202	23.134
Frost- Drought- Hail- Others	x2346	54.466	37.033	60.021	40.810
Frost- Drought- Fire- Others	x2356	44.682	32.945	49.240	36.305
Frost- Hail- Fire- Others	x2456	38.709	28.655	42.657	31.577
Drought- Hail- Fire- Others	x3456	32.816	24.411	36.163	26.901
Diseases and Pests- Frost- Drought- Hail-Fire	x12345	47.153	30.082	51.963	33.150
Diseases and Pests- Frost- Drought- Hail- Others	x12346	75.301	52.864	82.982	58.256
Diseases and Pests- Frost- Drought- Fire- Others	x12356	65.923	46.401	72.647	51.134
Diseases and Pests- Frost- Hail- Fire- Others	x12456	51.738	38.851	57.015	42.814
Diseases and Pests- Drought- Hail-Fire- Others	x13456	49.725	34.955	54.796	38.520
Frost- Drought- Hail-Fire- Others	x23456	52.491	39.447	57.845	43.470
Diseases and Pests-Frost- Drought-Hail-Fire-Others	x123456	64.962	53.548	71.588	59.009

Table 5
Premiums and Compensation Results in terms of Farmers and Insurance in Wheat Production of Hadim District, Konya

Natural Risks (Models)	Symbols	Farmer Risk (kg/ha^{-1})		Insurance Risk (kg/ha^{-1})		Farmer Risk (*TL/ha^{-1})		Insurance Risk (*TL/ha^{-1})	
		Prem	Comp	Prem	Comp	Prem	Comp	Prem	Comp
Diseases and Pests	x1	5.625	52.800	0.000	0.000	6.199	58.186	0.000	0.000
Frost	x2	7.500	56.063	4.688	31.688	8.265	61.781	5.166	34.920
Drought	x3	2.400	38.438	1.200	23.063	2.645	42.359	1.322	25.415
Hail	x4	1.035	15.600	0.690	8.400	1.141	17.191	0.760	9.257
Fire	x5	0.021	0.899	0.010	0.642	0.023	0.991	0.011	0.707
Others	x6	15.600	85.188	6.825	41.125	17.191	93.877	7.521	45.320
Diseases and Pests- Frost	x12	8.700	44.500	8.900	21.250	9.587	49.039	9.808	23.418
Diseases and Pests- Drought	x13	5.675	37.500	3.025	15.500	6.254	41.325	3.334	17.081
Diseases and Pests- Hail	x14	5.220	31.680	1.980	7.360	5.752	34.911	2.182	8.111
Diseases and Pests- Fire	x15	4.513	24.661	0.060	0.737	4.973	27.176	0.066	0.812
Diseases and Pests- Others	x16	10.650	54.750	14.925	31.000	11.736	60.335	16.447	34.162
Frost- Drought	x23	5.012	40.625	8.488	26.562	5.523	44.769	9.354	29.271
Frost- Hail	x24	4.508	34.050	7.148	20.050	4.968	37.523	7.877	22.095
Frost- Fire	x25	3.765	29.469	6.027	16.816	4.149	32.475	6.642	18.531
Frost- Others	x26	10.238	48.438	19.913	29.687	11.282	53.379	21.944	32.715
Drought- Hail	x34	1.653	26.750	2.983	16.150	1.822	29.479	3.287	17.797
Drought- Fire	x35	1.012	19.592	2.022	11.878	1.115	21.590	2.228	13.090
Drought- Others	x36	7.237	48.438	14.713	29.687	7.975	53.379	16.214	32.715
Hail- Fire	x45	0.611	10.930	0.921	6.049	0.673	12.045	1.015	6.666
Hail- Others	x46	6.075	41.150	13.238	27.500	6.695	45.347	14.588	30.305
Fire - Others	x56	5.278	36.865	12.031	25.450	5.816	40.625	13.258	28.046
Diseases and Pests- Frost- Drought	x123	10.186	70.445	11.730	37.062	11.225	77.630	12.926	40.842
Diseases and Pests- Frost- Hail	x124	9.609	53.509	10.572	27.190	10.589	58.967	11.650	29.963
Diseases and Pests- Frost- Fire	x125	8.719	45.223	8.948	21.955	9.608	49.836	9.861	24.194
Diseases and Pests- Frost- Others	x126	16.222	73.946	24.440	41.937	17.877	81.488	26.933	46.215
Diseases and Pests- Drought- Hail	x134	6.464	47.392	5.112	22.540	7.123	52.226	5.633	24.839
Diseases and Pests- Drought- Fire	x135	5.690	38.247	3.088	16.265	6.270	42.148	3.403	17.924
Diseases and Pests- Drought- Others	x136	12.861	70.839	17.980	42.438	14.173	78.065	19.814	46.767
Diseases and Pests- Hail- Fire	x145	5.243	32.013	2.055	7.928	5.778	35.278	2.265	8.737
Diseases and Pests- Hail- Others	x146	11.626	60.598	16.837	35.680	12.812	66.779	18.554	39.319
Diseases and Pests- Fire- Others	x156	10.683	55.359	14.982	31.600	11.773	61.006	16.510	34.823
Frost- Drought- Hail	x234	5.835	52.075	9.737	32.188	6.430	57.387	10.730	35.471
Frost- Drought- Fire	x235	5.034	41.548	8.517	27.245	5.547	45.786	9.386	30.024
Frost- Drought- Others	x236	11.323	75.312	21.307	43.750	12.478	82.994	23.480	48.213
Frost- Hail- Fire	x245	4.523	34.749	7.176	20.590	4.984	38.293	7.908	22.690
Frost- Hail- Others	x246	11.261	59.238	21.455	35.338	12.410	65.280	23.643	38.942
Frost- Fire- Others	x256	10.266	49.285	19.951	30.340	11.313	54.312	21.986	33.435
Drought- Hail- Fire	x345	1.665	27.464	3.006	16.705	1.835	30.265	3.313	18.409
Drought- Hail- Others	x346	8.130	57.862	16.054	34.387	8.959	63.764	17.692	37.894
Drought- Fire- Others	x356	7.268	49.285	14.746	30.340	8.009	54.312	16.250	33.435
Hail- Fire- Others	x456	6.104	41.789	13.269	27.995	6.727	46.051	14.622	30.850
Diseases and Pests- Frost- Drought- Hail	x1234	10.824	82.422	12.557	45.327	11.928	90.829	13.838	49.950
Diseases and Pests- Frost- Drought- Fire	x1235	9.538	71.552	10.974	37.932	10.511	78.850	12.093	41.801
Diseases and Pests- Frost- Drought- Others	x1236	17.018	112.905	25.290	63.062	18.754	124.421	27.870	69.494
Diseases and Pests- Frost- Hail- Fire	x1245	9.204	54.381	10.304	27.892	10.143	59.928	11.355	30.737
Diseases and Pests- Frost- Hail- Others	x1246	16.072	95.982	24.274	50.149	17.711	105.772	26.750	55.264
Diseases and Pests- Frost- Fire- Others	x1256	15.015	75.020	22.413	42.778	16.547	82.672	24.699	47.141
Diseases and Pests- Drought- Hail- Fire	x1345	5.791	48.321	4.254	23.257	6.382	53.250	4.688	25.629
Diseases and Pests- Drought- Hail- Others	x1346	12.173	95.804	15.633	48.895	13.415	105.576	17.228	53.882
Diseases and Pests- Drought- Fire- Others	x1356	11.260	71.926	14.527	41.966	12.409	79.262	16.009	46.247
Diseases and Pests- Hail- Fire- Others	x1456	10.438	59.760	12.811	36.337	11.503	65.856	14.118	40.043
Frost- Drought- Hail- Fire	x2345	5.520	52.923	9.100	32.885	6.083	58.321	10.028	36.239
Frost- Drought- Hail- Others	x2346	12.263	96.668	21.390	52.675	13.514	106.528	23.572	58.048
Frost- Drought- Fire- Others	x2356	11.498	77.866	20.230	45.659	12.671	85.808	22.293	50.316
Frost- Hail- Fire- Others	x2456	10.427	66.990	18.739	38.570	11.491	73.823	20.650	42.504
Drought- Hail- Fire- Others	x3456	6.906	58.725	13.722	35.100	7.610	64.715	15.122	38.680
Diseases and Pests- Frost- Drought- Hail-Fire	x12345	11.032	83.274	13.936	46.228	12.157	91.768	15.357	50.943
Diseases and Pests- Frost- Drought- Hail- Others	x12346	18.270	132.332	30.408	75.320	20.134	145.830	33.510	83.003
Diseases and Pests- Frost- Drought- Fire- Others	x12356	17.701	114.144	28.625	64.177	19.507	125.787	31.545	70.723
Diseases and Pests- Frost- Hail- Fire- Others	x12456	13.545	89.930	26.599	51.103	14.927	99.103	29.312	56.316
Diseases and Pests- Drought- Hail-Fire- Others	x13456	14.688	84.761	20.436	49.473	16.186	93.407	22.520	54.519
Frost- Drought- Hail-Fire- Others	x23456	12.815	92.166	25.312	53.581	14.122	101.567	27.894	59.046
Diseases and Pests-Frost- Drought-Hail-Fire-Others	x123456	18.903	111.020	30.854	76.241	20.831	122.344	34.001	84.018

(Pre: Premium, Comp: Compensation)

Considering the natural risks individually for Hadim district, the farmer pays 6.199 (TL / ha-1) premiums and expects a compensation of 58.186 (TL / ha-1), although diseases and pests are not covered by insurance. In the event of frost risk, the farmer pays 8.265 (TL / ha-1) premium and waits for 61.781 (TL /

ha-1) compensation, while insurance companies pay 20.043 (TL / ha^{-1}) premium 34.920 (TL / ha-1) It has been estimated. The formation of the drought situation, farmers 2,645 (TL / ha^{-1}), premium pay, 42.359 (TL / ha^{-1}) while waiting for compensation, the insurance companies 13.369 (£ / ha-1) premium 25.415 (TL / ha^{-1}) estimated that paying compensation. For hail risk, the premium prices of the farmer and insurance were estimated to be 1.141 (TL / ha^{-1}) -5.009 (TL / ha-1), while the compensation amount was estimated to be 17.191 (TL / ha^{-1}) -9.257 (TL / ha^{-1}).In case of occurrence of the risk of fire, farmer 0023 (TL / ha^{-1}) premium pay 0.991 (TL / ha^{-1}), while compensation expectations, while insurance companies in 0359 (TL / ha^{-1}) premium 0707 (TL / ha^{-1}) to pay compensation. Natural risk factors that could not be addressed in the statistical model were collected under the name of other risks and included in the analysis.In case of other natural risks, the premium prices of the farmer and the insurance are 17.191 (TL / ha^{-1}) -26.420 (TL / ha^{-1}), while the compensation amount is 93.877 (TL / ha^{-1}) - 45.320 (TL / ha^{-1})(Table 5).

In case of occurrence of all natural risks, the farmer pays 20.831 (TL / ha-1) premium and waits for 122.344 (TL / ha-1) compensation, while insurance companies compensate 59.009 (TL / ha-1) premium 84.018 (TL / ha-1). It was estimated that they paid (Table 5).Since half of the premium amount of insurance companies is supported by the state, the premium amount paid by the farmer is 29.505 (TL / ha-1).It has been determined that the premium amount determined by the insurance companies is 29.40% more than the premium amount requested by the farmers. In compensation amounts, it was determined that there is a less than 45.62% of the compensation amount requested by the farmers.

In general, the risk analysis practices of agricultural products are in the form of farmers' attitudes towards risk, determining the risk sources, measuring the risk encountered and creating risk management strategies that can be applied (Hazneci and Ceyhan 2011; Çetin 2012; Bayramoğlu & Kaya 2015; Mancı &Eren 2017).Risk analysis applications in existing studies are economically based, and yield-based and region-based risk analysis studies are quite limited.In this study, an economic-based, yield-based and region-based risk analysis application is discussed in terms of both manufacturers and insurance companies.

It is understood that the study conducted by Altay & Keskin (2018) and the results of our study are partially in agreement.There may be parts of this study that are not compatible with the literature, the main reason for this may be the different levels of climate factors, natural risks and the different wheat yield of the district due to the different district.

4. Conclusions

In this study conducted to determine the natural risks in wheat cultivation in the Hadim district of Konya, a new risk analysis method has been introduced, and the minimum and maximum risk ranges and premiums and compensation amounts have been determined in terms of farmers and insurance.

The most difficult part in risk analysis applications is the stage of determining the impact of risks. The newly established agricultural risk database in our country creates a huge disadvantage for farmers and insurance companies.Achieving overcoming this disadvantage with qualitative (subjective) methods is a very risky situation.Therefore, quantitative methods should be preferred in solving the problem.With the help of satellite image processing methods (NDVI), which has been developing in recent years, the risk (s) effects can be estimated by processing the images of the risk (s) when they occur, and correlating them with efficiency.In this way, a risk database can be created by accessing satellite images and efficiency information in the past.

Also, Agroshell, Apes, Cropsyst, Daisy, Dssat, Fasset, Hermes, Stics, Wofost etc. In addition to modules, making yield estimates by using satellite images will support healthier and more accurate evaluations in terms of farmers and insurance (Palosuo, 2011; Altay& Keskin 2018).

These problems are eliminated by both the creation of a database and the widespread use of agricultural technologies in developed countries (Uysal, 2005).In addition, considering the advances in geographic information systems and meteorology, it is expected to reduce the yield loss by developing early warning systems suitable for the characteristics of each region.In this context, it is necessary to provide a more qualified risk assessment opportunity by revealing a new risk analysis method.

Although the agricultural insurance pool provides both premium support and policy support to farmers, it sometimes thinks that the producers cannot cover the risks as they expect, as a result of the private insurance companies' desire to keep their profit rates high.

Farmers want to insure all possible risks by paying the least insurance premium. When considered in terms of farmers, it is clear that there are differences in terms of both climatic conditions and the attitudes of farmers engaged in wheat growing against risk.For this reason, the farmer minimum risk amount of the linear models formed was evaluated as the premium and the maximum amount as the amount of compensation.

Determining the minimum and maximum points within the framework of the linear programming logic did not provide a confidence interval for farmers and insurance companies. It may be a better approach that both stakeholders meet at the midpoint and not burden each other economically.

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The Elemental Compositionin Aboveground and Underground Organs of Some *Agropyron* Species Grown in Different Salt Concentrations

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ABSTRACT

Salinity, which is more common in semi-arid and arid areas, is increasing every day with climate change, poor quality irrigation water, and soil structure. High salt concentration restricts plant production and causes productivity loss in agriculture. To sustain agriculture in saline soils, the determination of plant species resistant to salinity comes into prominence in areas with salinity problems. For this reason, the research was performed to determine the nutrients (Ca, Mg, P, S, B, Cu, Fe, Mn, and Zn) accumulating at aboveground and underground parts of the three different *Agropyron* species, namely *Agropyron cristatum*, *A.desertorum* and *A. elongatum* (Syn. *Elymus elongatus)* under different salt concentrations (control, 5, 10 and 15 EC dS m^{-1}NaCl). *A. cristatum*, *A.desertorum*, and *A. elongatum*species, which are quality forage crops grown in drought and salinity conditions, were determined to Ca content 1.03%, 1.01%, and 1.49% respectively, and Mg content. 0.13%, 0.11% and 0.20% respectively. As salt concentrations increased, Ca, Mg, Cu, Fe, Mn, and Zn in the aboveground organ has increased compared to the control treatment but decreased in the underground organs. Ca and Mg content of the aboveground organs of *A. elongatum* grown at 10 EC dS m^{-1}NaCl increased by 204% and 98%, respectively, compared to the control. Fe content of the wheatgrassspecies in saline conditions was found quite high, and an average of 788 mg kg^{-1} of Fe was found in underground organswhile this value was as 430mg kg^{-1} in aboveground organs. The results showed that *A. elongatum* had more nutrient elements in both underground and aboveground parts of the crop by comparison to the other two *Agropyron* speciesunder increased salinity levels.

1. Introduction

The salinity problem occurs in 6.5% of the world's total areas, and 3.4% (9 million ha) of irrigated farmland. This problem, which is more common in semi-arid and arid regions, is increasing every day with the effect of climate change, poor quality irrigation water and soil structure (Tuteja 2007; Çulha & Çakırlar 2011; FAO 2015).

The high concentrations of ion that cause toxic effects due to the excess of dissolved salts in the root impact area are among the essential causes of salt stress in plants (Kaçar et al 2013). High salt concentration disturbs the balance between ions and objects to intake inadequately plant nutritional elements by plants under salt stress by resulting in the antagonism between plant nutrients (Taban & Katkat 2000). This situation restricts plant production from the early seedling stage and causes productivity loss in agriculture (Demiroğlu Topçu et al 2015; Özkan & Demiroğlu Topçu 2017).Salinity also damages the soil's aggregate structure and harms the water and air permeability of the soil. Soils with excessive NaCl salinity become exposed to erosion. To sustain agriculture in saline soils, the determination of plant species that are resistant to salinity and the ones with high yield potential in salty conditions come into prominence in areas with salinity problems (Güneş et al 2000).

As wheatgrass species (*Agropyron* sp.) differ in terms of feed value, they also differ in salt resistance (Dewey 1960; Sedivec et al 2010). *Agropyron* species grow naturally in rangelands with salinity problems in Turkey (Acar et al 2016). As a result of the researches conducted on salt resistance of the plants, it is expressed that the elemental compositionof the plants

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grown in different salt concentrations were examined. Differences occurred in the elemental compositionin their plant parts (root, stem, young and old leaves, etc.) (Greenway & Rogers 1963; Ueng et al 1994; Kılıç et al 2015; Niu et al 2015; Koç & Acar 2018). This research has been carried out aim to examine the differences occurring in the elemental compositionof the underground and aboveground organs of three wheatgrass species (*Agropyron cristatum, A. desertorum,* and *A. elongatum*) grown in different salt concentrations.

2. Materials and Methods

This research was established as a pot experiment in Selçuk. University. Faculty of Agriculture Department of Field Crops, Plant Breeding Greenhouse, on October 21, 2015. While *A. cristatum* and *A. desertorum* population collected from KOP Region (Turkey) were used, seeds belonging to *Agropyron elongatum* Szarvasi-I variety were used. This trial, which was set with three replications according to the Completely Randomized Design, was planted in pots of 30 x 30 cm in size, with six plants in each cup.

The turf's chemical properties used in the research had pH 5.5-6.5; fertilizer ratio 0.30 g l^{-1}; 30-70 mg l^{-1} N; 30-70 mg l^{-1} P_2O_5 and 40-80 mg l^{-1} K_2O. The turf's physical properties had that degree of dissociation was H2-H8; porosity weight was 96%, moisture content was between 40 and 50%. Electrical Conductive of turf was between 0.12 and 0.22 dS m^{-1}.

In the study, salt concentration [control (0 dS m^{-1} NaCl), 5, 10, 15 EC dS m^{-1} NaCl] applied to three different wheatgrass species was started after tillering and were given to plants with irrigation water 1 liter per week until harvest. In this study, which continued until the grain filling period, while the production of the *A. cristatum* and *A. desertorum* was done on May 16, 2016, *A. elongatum* was done on June 22, 2016, as it matures later than the other two species. During the harvest, the harvests of underground (root) and aboveground (leaf and stem) of the plant were done separately, and the content of Ca, Mg, P, and S contained in both organs was determined as %; B, Cu, Fe, Mn, and Zn content was determined as mg kg-1.

Elemental Analysis: The sample taken from 0.2 mg of the dry plant was weighed and put into a tube. 5 ml of HNO_3 and 2 ml of H_2O_2 were added into each tube. The digesting process was done in a micro oven, and as soon the material was shredded, it was transferred into 25 ml tubes, and the sample was filled with 25 ml of pure water. The solution was filtered afterward, and each sample transferred to the tube was analyzed in ICP-AES (Kaçar & İnal 2010).

Statistical analyses of all the properties that were examined in the trial were made using JMP 7 package program. In the study, the values of statistically significant "Salt concentrations x *Agropyron* Species x Organ" interaction were only grouped, and the MSTAT-C package program was used for groupings.

3. Results and Discussion

The content of the nutrients (Ca, Mg, P, S, B, Cu, Fe, Mn, and Zn) that they accumulate in the underground (root) and aboveground (leaf and stem) organs in different saline concentrations were examined, and the average values and groupings of the triple interaction (Salt concentrations x *Agropyron* species x Organ) in the research are given in Table 1. As the salt concentration increased, Ca, Mg, Cu, Fe, Mn, and Zn content in the aboveground organ increased compared to the control. Still, in the presence of increasing salinity, the content of these elements decreased in the underground organs compared to control.

As the result of research, Ca content in aboveground organs of *A. cristatum* and *A. elongatum* increased while *A. desertorum*'s Ca content decreased by increasing salt concentration. Ca content in the roots of three *Agropyron* species was shown to reduce in the face of increased salt dose, except for underground organs of *A. desertorum* grown in the application of 5 EC dS m^{-1} NaCl (Figure 1).

A. cristatum, *A.desertorum*, and *A. elongatum* species, which are quality forage crops grown in drought and salinity conditions, were determined to Ca content 1.03%, 1.01%, and 1.49% respectively, and Mg content. 0.13%, 0.11% and 0.20% respectively (Figure 2). Minimum Mg content was obtained from aboveground (15 EC dS m^{-1}NaCl) and underground organs (control groups and 15 EC dS $m^{-1}$$NaCl^{-1}$) while the maximum Mg content was determined from the roots of *A. elongatum* grown at 15 EC dS m^{-1}NaCl. Ca and Mg content of the aboveground organs of *A. elongatum* grown at 10 EC dS m^{-1}NaClwere shown to increase by 204% and 98%, respectively, compared to the control.P content was higher in the aboveground organs than the underground organs. Aboveground organs of *A. cristatum* and *A. elongatum* hadthe highest P content. The S content of *Agropyron* species gave changeable results in aboveground and underground organs in different salt concentrations in the research. As a result of the study, as the salt concentrations increased, the boron content of the underground and aboveground organs decreased compared to the control groups. The lowest boron content was detected in the aboveground part of *A elongatum* that was grown in EC dS m^{-1}NaClsalt application.

Cu content was increased in aboveground organs while in underground organs' Cu content was decreased with increased salt concentration. The maximum Cu content was obtained from 17.33 mg kg^{-1} the roots of *A. desertorum* (5 EC dS m^{-1} NaCl) while the minimum Cu content (6.00 mg kg^{-1}) was obtained from aboveground organs of this *Agropyron* species grown in control groups.

Table 1
Average values and groupings belonging to the nutrient elements content in the aboveground (leaf and stem) and underground (root) organs in different saline concentrations

Organ	*Agropyron.* Species	Salt Con. (EC dSm^{-1})	Ca (%)	Mg (%)	P (%)	S (%)	B (mg kg^{-1})	Cu (mg kg^{-1})	Fe (mg kg^{-1})	Mn (mg kg^{-1})	Zn (mg kg^{-1})
Aboveground (Leaf and Stem)	*A.cristatum*	Cont.	0.42^{T}	0.106^{G}	0.241^{EF}	0.12^{D}	14.94^{E}	6.23^{S}	58.93^{T}	38.21^{M}	47.02^{M}
		5	0.51^{R}	0.111^{FG}	0.269^{CD}	0.14^{B}	10.80^{M}	7.21^{Q}	211.00^{P}	34.92^{O}	72.36^{G}
		10	0.82^{O}	0.149^{E}	0.341^{A}	0.13^{C}	11.97^{I}	7.78^{O}	230.42^{O}	75.68^{G}	76.03^{E}
		15	0.96^{L}	0.155^{E}	0.343^{A}	0.14^{B}	14.25^{F}	8.44^{M}	404.41^{K}	136.43^{C}	96.29^{B}
	A.desertorum	Cont.	0.57^{P}	0.076^{H}	0.256^{DE}	0.10^{F}	15.33^{C}	6.00^{T}	151.60^{Q}	49.71^{L}	67.52^{I}
		5	0.56^{P}	0.108^{G}	0.252^{DE}	0.11^{E}	11.14^{L}	7.55^{P}	135.33^{R}	51.20^{K}	70.84^{H}
		10	0.54^{Q}	0.109^{G}	0.236^{FG}	0.12^{D}	11.33^{KL}	7.93^{N}	263.51^{N}	74.22^{H}	70.50^{H}
		15	0.53^{Q}	0.079^{H}	0.237^{FG}	0.09^{G}	13.10^{H}	7.03^{R}	144.79^{QR}	87.93^{E}	75.04^{F}
	A.elongatum	Cont.	0.48^{S}	0.114^{FG}	0.233^{FG}	0.12^{D}	19.38^{A}	7.16^{QR}	80.83^{S}	88.01^{E}	39.35^{N}
		5	0.94^{M}	0.215^{B}	0.352^{A}	0.15^{A}	15.15^{CD}	11.32^{I}	791.84^{F}	112.58^{D}	93.52^{C}
		10	1.46^{G}	0.226^{B}	0.298^{B}	0.15^{A}	14.35^{F}	11.34^{I}	1593.61^{C}	197.00^{A}	138.07^{A}
		15	0.89^{N}	0.215^{B}	0.302^{B}	0.14^{B}	13.50^{G}	11.41^{I}	1094.70^{E}	173.20^{B}	74.54^{F}
Underground (Root)	*A.cristatum*	Cont.	1.57^{F}	0.175^{D}	0.214^{H}	0.13^{C}	13.13^{H}	13.09^{E}	1494.92^{D}	51.45^{JK}	55.66^{K}
		5	1.33^{H}	0.120^{F}	0.302^{B}	0.13^{C}	13.41^{G}	12.15^{H}	358.75^{L}	16.93^{T}	21.31^{S}
		10	1.31^{I}	0.118^{FG}	0.308^{B}	0.12^{D}	10.14^{N}	12.94^{F}	311.94^{M}	18.07^{T}	20.01^{T}
		15	1.28^{J}	0.125^{F}	0.244^{EF}	0.11^{E}	11.76^{J}	10.60^{K}	463.24^{J}	29.45^{P}	50.78^{L}
	A.desertorum	Cont.	1.86^{D}	0.196^{C}	0.176^{J}	0.12^{D}	13.12^{H}	12.80^{G}	1984.31^{B}	54.05^{I}	60.31^{J}
		5	1.97^{B}	0.149^{E}	0.234^{FG}	0.14^{B}	11.96^{I}	17.33^{A}	469.80^{J}	25.18^{Q}	28.79^{Q}
		10	1.22^{K}	0.109^{G}	0.187^{IJ}	0.10^{F}	11.99^{I}	11.32^{I}	233.99^{O}	21.02^{R}	25.69^{R}
		15	0.82^{O}	0.086^{H}	0.228^{GH}	0.08^{H}	11.42^{K}	10.89^{J}	211.72^{P}	19.47^{S}	32.97^{P}
	A.elongatum	Cont.	2.74^{A}	0.220^{B}	0.178^{J}	0.13^{C}	16.84^{B}	15.53^{B}	2354.51^{A}	80.00^{F}	77.03^{D}
		5	1.66^{E}	0.142^{E}	0.276^{C}	0.12^{D}	15.11^{DE}	13.89^{D}	519.52^{H}	36.65^{N}	35.38^{O}
		10	1.89^{C}	0.192^{C}	0.196^{I}	0.15^{A}	13.09^{H}	14.54^{C}	543.36^{G}	52.63^{J}	29.15^{Q}
		15	1.87^{D}	0.244^{A}	0.249^{EF}	0.12^{D}	11.91^{IJ}	9.57^{L}	508.98^{I}	75.80^{G}	17.49^{U}
$LSD_{SALT*AGRO.*ORGAN}$			0.016	0.015	0.0199	0.009	0.197	0.139	9.683	1.183	0.947

Fe content of the wheatgrassspecies in saline conditions was found quite high, and an average 788 mg kg^{-1} of Fe was found in underground organs, while this value was as 430mg kg^{-1} in aboveground organs (Figure 3). The minimum Fe content (58.98 mg kg^{-1}) was obtained from aboveground organs of *A. cristatum* grown in control groups. In contrast, the maximum Fe content (2354.51 mg kg^{-1}) was obtained from underground organs of *A. elongatum* at control group conditions. The aboveground organs of *A. elongatum* grown at 10 EC dS m^{-1} NaCl salt concentration were the interaction having the maximum Mn (197.00 mg kg^{-1}) and Zn (138.07 mg kg^{-1}) contents.

Plants can respond differently to salinity based on species, type, and genotype. Kılıç et al (2015) examined the Ca and Mg content of different forage crops belonging to the *Poaceae* family grown in areas with varying salinity levels. In the study, while results regarding Ca differed from our findings, results regarding Mg showed similarity. Thus, Çulha & Çakırlar (2011) stated that a high quantity of NaCl in the setting unbalanced the ion in the cell, caused Na^{+} and Cl levels to increase and Ca^{+2} and Mg^{+2} concentrations to decrease in the cell.

Ueng et al (1994) grew *Agropyron smithii* in different salt concentrations and analyzed its chemical content. In the study, while Mg content decreased in increasing salinity levels, an increase in Ca content was determined compared to the control as in our study. High Na^{+} concentration causes emptying of internal Ca^{+2} stores by setting $Ca^{+2,}$ which are bound in the inner membrane of the cell-free and increases free Ca^{+2} in the cell. The increase of Ca^{+2} in cytosol starts the stimula-

tion of signal transmission paths associated with salt tolerance (Çulha & Çakırlar 2011).

The plant-affected salt was decreased or limited to intake water and nutrient elements via roots (Ekmekçi et al 2005). Nutrient element uptake in the roots also reduced with an increased salt concentration in our results. Yorgancılar&Yeğin (2012) stated that nutrient elements in the pea root fell under salinity conditions, but Ca and Mg in the stem improved with increased salt concentration. Stragonov (1971) expressed that cotton grown under salinity had more mineral matter in leaves than in roots. As it was similar in our research, Kovda (1947) and Kovda (1949) detailed that some plants grown under salinity could adequately absorb the essential elements such as Ca, Fe and Mn, etc. (Stragonov 1971).

In a research Yorgancılar & Yeğin (2012) conducted on the root and stem of a pea, while P content in the stem increased with increased salinity, no difference was detected in P content in the root. In the same study, as the salinity increased, S content in the stem and root increased. Boron content in the root and stem was stated to have increased with the increasing salinity.

When the Fe concentration in the root and stem of barley grown in salinity conditions, the iron concentration in the roots were found higher compared to the stem in saline conditions (Yausfi et al 2007). *Poaceae* family plants, especially meadow and pasture plants, take the iron from the soil by making the iron in the rhizosphere region beneficial with the phytosiderophores excreted with their roots (Kaçar & Katkat 2007;Taiz & Zeiger 2008).

Similar to our research results, copper, zinc, and manganese intakes were determined to increase in plants in salt stress. However, the mechanism of this situation has not been completely explained (Alparslan et al 1998; Kaçar & Katkat 2007).

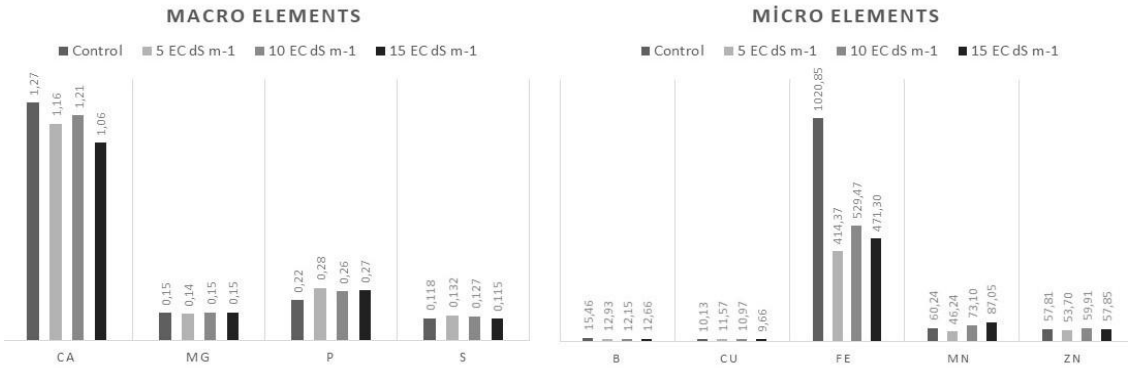

Figure 1

Content of macro elements (%) and micro elements (mg kg^{-1})in different salinity levels

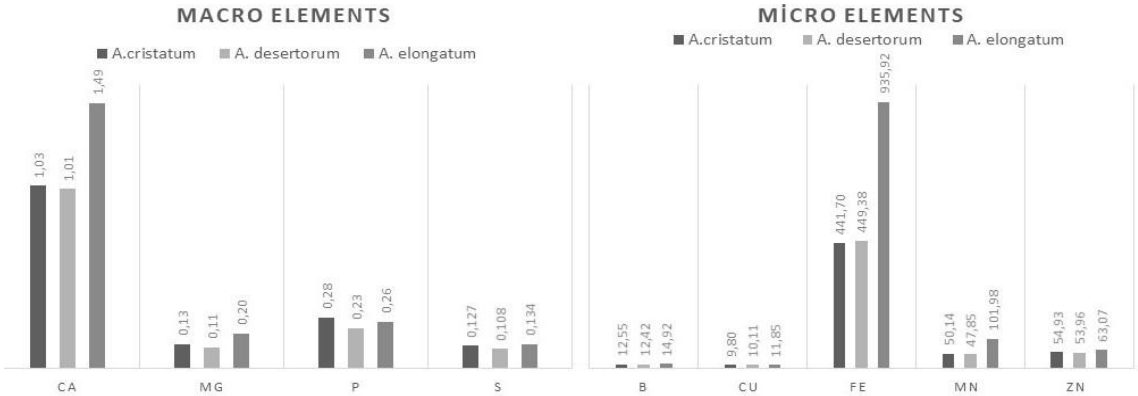

Figure 2

Content of macro elements (%) and micro elements (mg kg^{-1})in *Agropyron* species

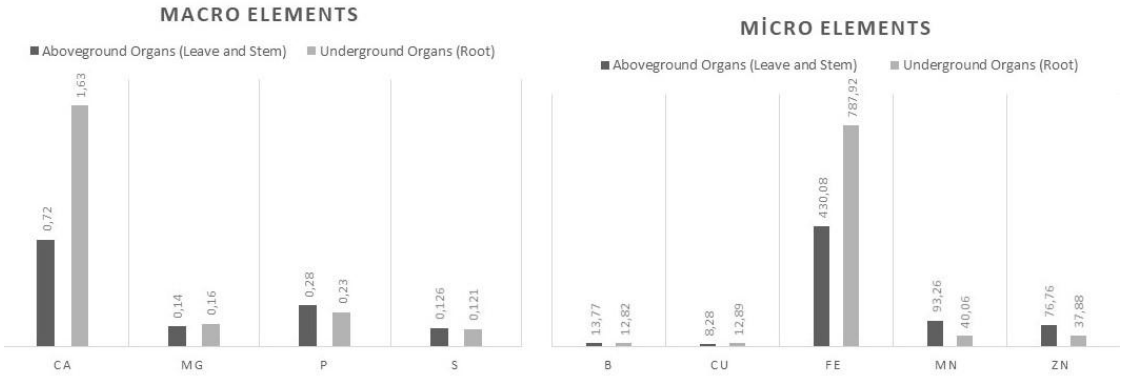

Figure 3

Content macro elements (%) and micro elements (mg kg^{-1})in aboveground (leaf and stem) and underground (root) organs

The plants have different mechanisms regarding salt tolerance and can show different responses at the level of leaves, stem, and root (Lüttge & Smith 1984). While some plants decreased salt density in the meristem area by distributing to salt on the whole body like root, stem, leave, and pedicel, some plants keep Na+ amount transported to xylem from roots at a minimum level by inhibiting to salt in the root zone (Çulha & Çakırlar 2011). Koç & Acar (2018) indicated that while Na content in the root and the stem increased with an increased salt concentration in the *Agropyron* species, these species were accumulated to chlorine in the root zone and decreased to Cl content in aboveground organs with increased salinity. Qiao et al (2007) stated that the growth and development of *A. elongatum* having Na+/H+ antiporter gene transported to salt in the vacuoles weren't affected by salinity at different levels.

4. Conclusions

As a result of the research, the elemental content of the three wheatgrass species has been determined to have changed in the presence of increased salt concentrations in the underground and aboveground parts. Ca, Mg, Fe, Mn, and Zn uptakes in the roots showed decreased while P, S, and Cu uptakes responded varying as increased salt concentration. Boron and Zinc uptakes in the aboveground organs decreased while Cupper uptake differed in the aboveground organs (leaf and stem). However, Ca, Mg, P, S, Fe, and Mn uptakes in the aboveground organs showed an opposite effect by increasing salinity. The maximum element uptakes regarding Ca, Mg, and P were found at a salt concentration of 10 EC dS m^{-1} NaCl. Although salt concentrations increased, *A. elongatum* was found to have higher elemental content than the other two *Agropyron* species.

It can be stated that three wheatgrass species grown at different salt concentrations provide a quality forage source to livestock with elements taken in their organs. The economical product can be obtained from pastureland using these wheatgrass species in rangeland improvement because of being qualified forage of these species at salinity conditions. Furthermore, these species can provide an opportunity to sustainable farming in pastureland as contributing erosion prevention owing to occupy to vegetation in problem (salinity, drought, etc.) areas.

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Identifying Preferences of Red Meat Consumption by Means of Conjoint Analysis

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ABSTRACT

In this study, in order to identify the preferences of red meat consumption in Konya, conjoint analysis was used, which has been quite commonly used in product production and existing market studies. Preference cards used in the study were applied to 201 people. People were asked to put in order preference cards by coding as "1" the mostpreferrable toward they prefer the least, and the full profile method is used.

Kendall's Tau value stating representation power of the model was identified as 0.974 and Pearson's R, as 0.993. At the end of the study, it was seen that the factors affecting red meat preferences and purchasing behaviors of the people living in Konya were purchasing place (46.5%), sort of meat (17.7%), purchasing way (13.0%), fat rate of the meat purchased (12.9%) and, finally, meat price.

As a result, it was expressed that conjoint analysis would help about which changes businesses could make in their products or services, which points they had to be dealt with product development studies, and in what direction the existing and potential customers in market could react. .

1. Introduction

At the present time, per capita red meat consumption is one of the most importantcriteria determining the development and welfare levels of countries (Ekinci, 2018). The cultural levels, incomes, and social life features of people are also of the most important factors determining habitual meat consumption (Kibar et al., 2019). In the countries having high socioeconomic level, it is seen that per capita rates of meat production are also high (Arısoy and Bayramoğlu, 2015). In addition, also in protecting community health against pandemics such as Covid-19, red meat consumption is important.

In Turkey, as of 2019, there are 17688139 heads of cattle, 184192 heads of water buffalo 37276050 heads of sheep, and 11205429 heads of goat in Turkey, and a total of red meat actualized as 1201470 ton (TUIK, 2019). If the population of Turkey is considered to be 82 million in 2019, per capita consumption of red meat it appears to be about 15 kg.

For communities to be able to be nourished healthily and balanced, it is necessary to increase the production of red meat and meat products and improve their qualities. Together with increasing red meat and meat produstsconsumption as quantity, how to introduce it to consumers becomes an important issue. In such conditions, utilizing conjoint analysis, the features consumer give importance in purchasing meat can be identified.

Frequently used conjoint analysis at the present time (analysis of relationships or togetherness) is an analysis technique preferred by researchers for identifying the characteristics of consumer behaviors. Conjoint analysis enables businesses to acquire important information about the issues such as which changes they can make in their products or services; which points to deal with the studies of product development; how the existing and potential consumers in market will react to these changes; how general tendency in market will affect the product and services; how the balances in market will change, if business continues with its existing products and services or develops the new products and services; in what direction the effects of new products and services of

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rivals on consumers will be; and how pricing will reflect to market (Turanlı et al., 2013).

Conjoint analysis is used in case that some variables cannot be measured in real meaning and are expressed in the form of levels (qualitatively), in order to study the relationships between variables and levels. In conjoint analysis, there are two objectives, in which the efficiency of multi-feature product or service in identifying consumer preferences is revealed. These are identifying of preference ranking of combinations the variables and levels form (general consumption model) and testing the trueness of model potential customer prefers in making decision (individual consumption model) (Tatlıdil, 1995).

This study was carried out to identify preferences of red meat consumption by means of conjoint analysis in Konya City.

2. Materials and Methods

2.1. Material

In this study carried out to identify the red meat preferences and factors affecting purchasing behaviors of the people living in Konya, conjoint analysis was used.The material of the current study are 201 surveys applied to the red meat consumers in Konya City, Turkey

2.2. Method

In the study, plan cards were formed by orthogonal order for meat consumption preferences, and a specific survey containing combinations of factor levels was prepared to put in order preferences. By means of this survey, people were asked to put in order selection cards in such a way that they put in order selection card they prefer the most by coding as 1 toward that they prefer the least, and full profile method was used.

In the survey, for consumers to form preference order or rank combinations, the following questions were raised:

1) Where do you prefer to buy the meat from? (Any butcher, A certain butcher, Market/Supermarket)

2) Sort of meat you buy (Beef, sheep)

3) The way you buy the meat (Mincemeat, In small pieces, Bone in meat),

4) Fat content the meat you buy (Low-fat, Middle-fat, Super-fatted),

5) The price of the meat you buy (Low, Middle, High).

During preparing orthogonal order, while the number of card is wanted to be 16 to 18 until 7 factors with 2 or 3 levels, in case that there are more factors, it was reported that using 20 cards was suitable (Yalnız and Bilen, 1997). The number of levels of the variables dealt with this study is a total selection cards containing all combinations of the levels of 3, 2, 3, 3, 3, respectively and is 3x2x3x3x3x3x2=162. However, since it will be difficult (almost impossible) for responders to rank all of these 162 cards, the amount of the variables and levels determined should be reduced. For being able to reduce the number of the variables and levels, orthogonal model should be used (Cengiz, 2009). Hence, by means of orthogonal test order that is a test order, in which only main features are considered, the number of cards that can represent 162 cards were determined as 18 original cards and 4 holdoutcards. With 18 pieces of cards prepared to be presented to the people that will participate in the survey, the rule of the minimum number of cards that is necessary to be formed was fulfilled. In addition, other than these cards, 4 pieces of simulation (holdout) cards were formed. Thus, utility predictions of 162 cards were calculated through utility obtained from 18 cards. Ranking the utility values found from largeto small, in the framework of features of each card, thus, of each product, with moving from preferences order and this ranking, purchasing behaviors of consumers were identified.

While applying conjoint analysis, it is necessary to reveal the relationships between factor levels dealt with and preference orders. The factor expected to be a linear increase between preference orders and it was defined as “linear more”, linear decrease, as “linear less”, and the factors whose levels are categorical, as "discrete" (Cengiz, 2009).

In the study carried out to identify habitual consumption of red meat in Konya City, for identifying sample volume, the following formula was used (Newbold, 1995;Kibar et al., 2019).

$$n = \frac{Z^2 pq}{d^2}$$

In the formula, n denotes sample size; p, probability of the desired case to occur in population (p = 0.5); q, probability of the undesired case to occur in population (q = 0.5); Z, the value in standard normal distribution table (Z = 1.96 for 5%); and d, the largest amount of error desired (d = 10%). With the formula, the minimum number of people, to whom survey will be applied, was identified as 96 but considering that questionnaires will be left blank or not will be completed, in this study, 201 participants were interviewed one to one and preference orders were formed.

3. Results and Discussion

In the study, consumers were asked to assign preference points or rank combinations to 22 cards (18 original cards and 4 holdoutcards) formed by means of orthogonal plan. As identifying information belonging to the people assigning preference points or asked them to rank the combinations formed, there are the data such as age, gender, marital status, educational status, the number of individual in household, and average monthly income. Some statistics belonging to these features are given in Table 3.1 or Figure 3.1-3.6.

Table 3.1
Some statistics of the people surveyed

Variables	Variable Levels	n	%
Age	<25	42	20.9
	26-35	65	32.3
	36-45	48	23.9
	46-55	37	18.4
	>56	9	4.5
Sex	Male	116	57.7
	Female	85	42.3
Marital Status	Married	108	53.7
	Single	93	46.3
Education Status	Primary School	14	7.0
	Middle School	21	10.4
	High School	65	32.3
	University	96	47.8
	Master/Doctorate	5	2.5
Number of Family Members	2	26	12.9
	3-5	136	67.7
	>6	39	19.4
Monthly Income	<2400	55	27.4
	2401-4000	44	21.9
	4001-6000	52	25.9
	6001-8000	29	14.4
	>8001	21	10.4

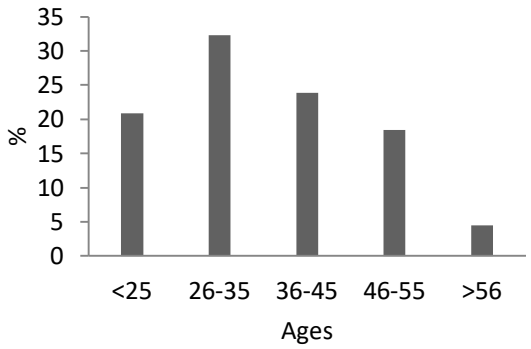

Figure 3.1
Age of the people surveyed

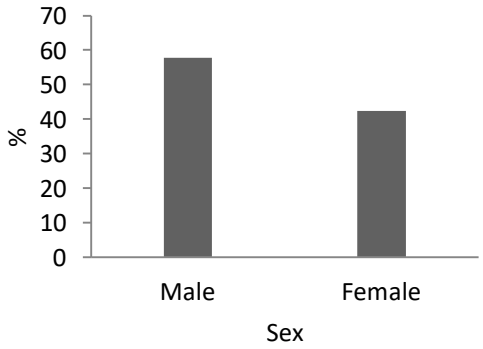

Figure 3.2
Gender of the people surveyed

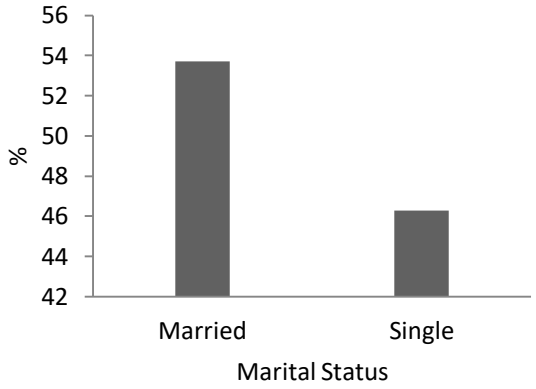

Figure 3.4
Marital status of the people surveyed

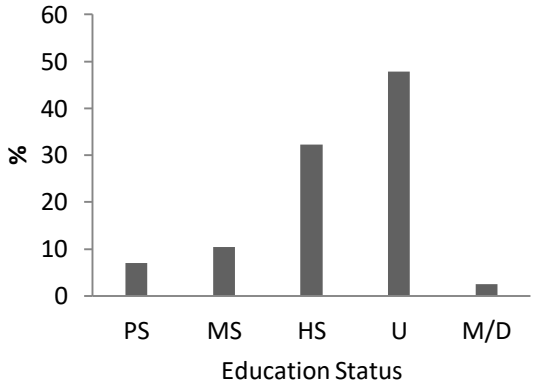

Figure 3.5
Educational status of the people surveyed

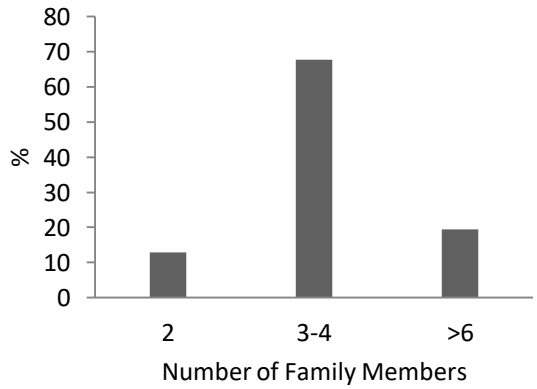

Figure 3.6
Number of family members of the people surveyed

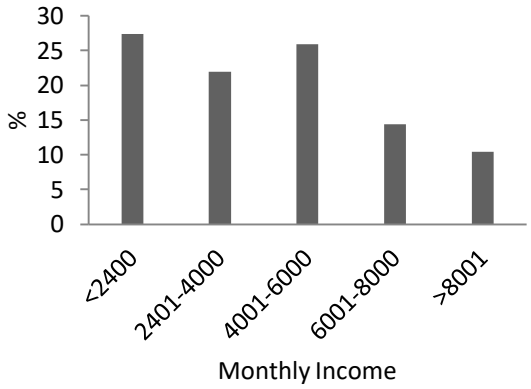

Figure 3.6
Monthly income of the people surveyed

In the study, as a result of conjoint analysis for 201 people, Kendall's Tau value stating representation power of the model was identified as 0.974 (Sig.=0.000). The model set up according to Pearson's R and Kendall's Tau values complies with the preferences of participants. There is 99.3% of correlation between the model set up and the results observed.

According to analysis results, it was seen that the most affecting factor red meat preference and purchasing behaviors of the people living in Konya was firstly purchasing place (46.5%). Kibar and Mikail (2018), in the study they carried out in Siirt City, found that the factor "purchasing place" was significant for the people regularly consuming meat. For the people not regularly consuming meat, purchasing place has the least significance. With utility coefficient of 2.270, it was seen that consumers preferred a certain butcher. This was followed by sort of meat (17.7%). It was seen that consumers preferred beef the most (utility coefficient: 1.060). These variables are followed by purchasing way (13.0%). In purchasing way of meat, utility coefficients were 0.247 for mincemeat and 0.250 for "in small pieces", and these were preferred in the close rate to each other. The fatcontent of meat was effective in 4th rank (12.9%). It was seen that the consumer preferred slow fat meat the most (utility coefficient: 0.426). It was identified that price took place in the last rank in red meat consumption preferences (9.9%) (Table 3.2). According to the results consisting of common evaluations of all participants, an ideal combination of red meat preference formed in the form of a certain butcher – beef – in small pieces meat – low fat meat – low price. The least preferred combination of red meat formed in the form of market/supermarket – sheep – bone in meat – super fatted meat – high price.

Table 3.2
Obtained for the variables "Total Utility Coefficients" and "Proportional Significance Values"

Variables	Variable Levels	TUC	PSV
V1	Any butcher	-0.410	
	A certain butcher	2.270	46.5
	Market/Supermarket	-1.850	
V2	Beef	1.060	17.7
	Sheep	-1.060	
V3	Mincemeat	0.247	13.0
	In small pieces	0.250	
	Bone in meat	-0.497	
V4	Low-fat	0.426	12.9
	Middle-fat	-0.160	
	Super-fat	-0.266	
V5	Low	-0.298	9.9
	Middle	-0.596	
	High	-0.894	

(TUC: Total Utility Coefficients, PSV: Proportional Significance Values, Where do you prefer to buy the meat from: V1, Sort of meat you buy: V2, The way you buy the meat: V3, Fat content the meat you buy: V4, The price of the meat you buy: V5)

The proportional significance values of the factors affecting red meat consumption preferences and purchasing behaviors of the people living in Konya were given in Figure 3.7.

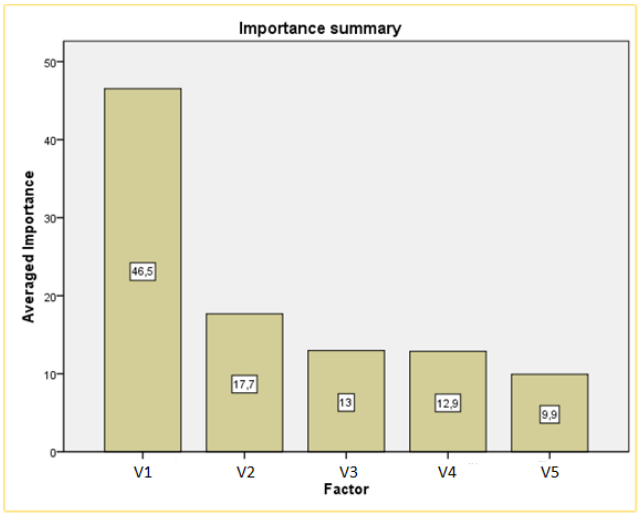

Figure 3.7
Importance rates of factors that affect red meat preference

After total utility coefficients were determined, utility scores of cards were calculated. Constant coefficient (9.375), obtained as a result of analysis, and utility coefficients of level of each variable that pass in the card were added, and utility value of card was calculated as follows:

Utility for 1st card = 9.735 + (-0.410) + (-1.060) + 0.250 + (-0.160) + (-0.894) = 7.461

Utility for 2nd card = 9.735 + 2.270 + 1.060 + 0.247 + (-0.266) + (-0.894) = 12.152

Utility for 12th card = 9.735 + 2.270 + (-1.060) + (-0.497) + (-0.266) + (-0.298) = 9.884

Utility for 18th card = 9.735 + 2.270 + 1.060 + 0.247 + 0.426 + (-0.894) = 12.844

Calculations made for the other cards are given in Table 3.3.

Table 3.3
Utility scores of all cards

CN	V1	V2	V3	V4	V5	US
1	AB	Sheep	ISP	MF	H	7.461
2	ACB	Beef	MM	SF	H	12.152
3	ACB	Sheep	ISP	LF	M	11.025
4	ACB	Sheep	BIM	LF	H	5.860
5	ACB	Beef	ISP	LF	L	9.323
6	AB	Beef	ISP	SF	H	9.475
7	ACB	Beef	BIM	MF	L	12.110
8	AB	Beef	BIM	LF	M	9.718
9	M/S	Beef	ISP	SF	L	8.631
10	M/S	Sheep	MM	SF	M	6.210
11	M/S	Beef	BIM	MF	H	7.394
12	ACB	Sheep	BIM	SF	L	9.884
13	M/S	Beef	MM	MF	M	8.436
14	AB	Sheep	MM	MF	L	8.054
15	ACB	Beef	ISP	MF	M	12.559
16	AB	Beef	MM	LF	L	10.760
17	AB	Beef	BIM	SF	M	9.026
18	ACB	Beef	MM	LF	H	12.844
19[a]	AB	Sheep	BIM	MF	L	7.310
20[a]	M/S	Beef	MM	SF	L	8.628
21[a]	AB	Sheep	BIM	LF	M	7.598
22[a]	AB	Sheep	MM	LF	L	8.640

(CN: Card Number, L: Low, Middle: M, High: H, AB: Any butcher, ACB: A certain butcher, M/S: Market/Supermarket, ISP: In small pieces, MM: Mincemeat, BIM: Bone in meat, MF: Middle-fat, LF: Low-fat, SF: Super-fat, US: Utility Scores)

According to utility scores obtained, utility score of red meat combination the participants preferred the most became no: 18 card combination whose utility score is the highest (12.844). No: 4 card combination became red meat combination whose utility score is the lowest (5.860) and which is preferred the least (Table 3).

4. Conclusion and Suggestions

Conjoint analysis that is analysis method, in which the efficient of a product or service in identifying consumer preferences is revealed, are used to study the interrelations of the variables and levels, in case that some variables cannot be measured in real meaning and that levels are qualitatively are expressed. If a new product is wanted to be developed or studied the status of the existing product, setting out the preferences of consumers, the most desired features of product to be produced and the status of the existing product can be determined. In this analysis, in which qualitative and quantitative data can be used, generally dealing with preference (utility) function as dependent variable, the effects of a number of independent variables on this are studied.

Thanks to conjoint analysis, producers, earlier identifying the preferences and demands of consumers, can remove their worries about whether or not introducing a new product to market. In the surveys made, when many features are asked, very different demands appear. By means of this analysis, which properties of the product are so important to producer can be detected. As a result of survey administered in producers, according to the result of conjoint analysis, each card and question have different values of significance.

The people living in Konya first of all prefer a certain butcher i.e. the butcher they always do shopping, whichever sort of meat they buy. They more preferred beef compared to sheep. In meat preferences, that beef is in small pieces and low fat became a cause of preference. Price, on the contrary to that thought, was the least considered feature.

As a conclusion, conjoint analysis will help about which changes business can make in their products and services, which points to deal with their product development studies, and in which direction the existing and potential customers in market can react to these changes.

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A New Approach on the Determination of the Spatial Criteria and Parameters Affecting Walking Comfort: Selcuk University Example**

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ABSTRACT

Physical inactivity and the diseases such as obesity are the results of increasing environmental pollution caused by developing technology, are shown as the main problems reducing the quality of life today. Succeed in the studies conducted on the topic of active transportation is directly related to the mentioned problems, which is very important in terms of reducing the negative effects. Although different methods are used in the relevant literature, a significant number of parameters are commonly evaluated in many studies. It is seen that these parameters are used in different study areas and there are inconsistencies between the results. Some control studies are needed to reveal the factors that cause inconsistent results. At this point, instead of using a standard set of parameters in various study areas, it would be useful to create a new set of specific parameters based on the characteristics of the related study area. This study aims to determine the spatial parameters affecting walking comfort in a specific study area (Selcuk University) together with the significance levels and to develop a new approach that can be adapted to different study areas based on this example area. In the study, both objective and subjective measurement methods were used to evaluate the potential inconsistency between the obtained results. In 17 of 30 parameters evaluated within the scope of the study, the coefficient determined by the users was higher than that of the experts. Based on the data that more than half of the parameters according to users are more important than those indicated by the experts, it was concluded that the standards and criteria were not fully accepted by the users.

1. Introduction

The use of motor vehicles (passive transportation), has increased as a result of the development of technology, causes a significant increase in greenhouse gas emissions. In Europe, 25.4% of the CO_2 emitted by passive transport is largely due to road transport (European Commission, 2014). With the increase of greenhouse gas emissions, air pollution also increases, especially in urban areas. This increase reflects the negative effects of passive transport on the environment and human health. The main source of the negative effects on human health is the fact that individuals start to adopt a more sedentary lifestyle due to the increase in the use of motor vehicles. At this point, the data that 3.2 million people die due to inactivity every year (WHO, 2010) indicates the significance of the issue.

According to World Health Organization data, physical inactivity (lack of physical activity) has been identified as the fourth major risk factor among global causes of death (WHO, 2010). For this reason, accessible spaces should be created and individuals should be encouraged to use public transport and/or active modes of transport such as cycling and walking, which increase physical activity, instead of using personal motor vehicles (Davison, Ahern, & Hine, 2015).

One of the most important factors that enable an area to function successfully in the context of being physically active is that the place has a high level of walkability or in other words, it has favorable conditions in terms of walking comfort. Several factors affect walking comfort, so the determination of the mentioned factors with their significance levels is essential to increase the level of walkability.

Research on urban design and walking generally focuses on macro-scale features of the physical environment, such as block length and the number of intersections, that can be measured remotely with the help of Geographical Information Systems (GIS) and aerial photographs. In contrast, urban designers emphasize

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**This study has been produced from a part of the first author's doctorate thesis prepared under the supervision of the second author.

the importance of micro-scale features for individuals to experience neighborhood environments (M. Alfonzo, Boarnet, Day, Mcmillan, & Anderson, 2008). Besides, it was stated that there is a need for research on the real effects of micro-scale comfort elements such as urban design facilities (street furniture, fountains, etc.) (M. A. Alfonzo, 2005).

In the literature on the determination of parameters affecting the walking activity and walkability analysis, it is seen that approximately 25 different methods are used. Nyunt et al. (2015) stated that in previous studies (McGinn, Evenson, Herring, Huston, & Rodriguez, 2007; Michael, Beard, Choi, Farquhar, & Carlson, 2006), similar results could not be obtained regarding the objective and perceived (subjective) measures of the built environment, therefore, the same aspects of the built environment should be determined by both objective and subjective measurements. Considering the relevant literature in this context, while only objective measurement methods are used in some studies, subjective measurement methods are preferred in many studies, and in a small number of studies, it is seen that both measurement methods are used together. In the limited number of studies in which both objective and subjective measurement methods are used, it is understood that these 2 methods are not used as tools for comparison of the results, but as parts that contribute to reaching the entire (result).

By using the advanced search feature in the Web of Science database, scientific studies containing one of the terms "walkability", "walkable", "walk-friendly" and "walking comfort" in the title or keywords were searched and it was concluded that there were 1170 studies between the years of 2004-2020 (June). The notable diversity seen in the studies in terms of the research area is given in Figure 1. The fact that the subject is handled by researchers from different areas makes it possible to be shown as the main reason for the variety in the methods used in the related studies. As a result, the use of different methods causes inconsistent results. In this context, it seems that a new approach is needed for future researches on walking to reduce the inconsistencies in the results obtained by various methods used in the literature. The main features that should be found in the suggested new approach can be listed as follows:

- should be decisive about the boundaries of the research field and/or subject,
- should incorporate both objective and subjective measurement methods to increase the reliability of the results,
- should be easily adaptable for use in various working areas with different dynamics.

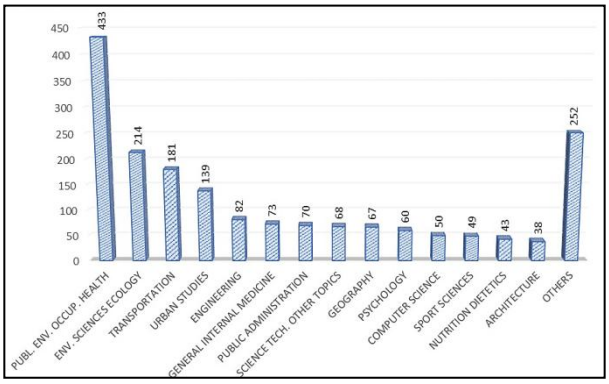

Figure 1

Distribution of studies conducted between 2004-2020 (June) by research areas

Based on the characteristics of the aforementioned approach, the following research questions were sought in this study:

1-) Are the spatial parameters frequently used in the literature about walking valid for every study area?

2-) How should spatial parameters affecting walking comfort be determined for a specific study area?

3-) Are the determining parameters equally significant for users and experts?

University campuses were chosen as the category of the sample study area, as they are places where young people are mostly together. The users of the Selcuk University Alaeddin Keykubat Campus contributed to the study during the subjective measurement process. The reason for the choice of university campuses as a category is that gaining the habit of walking at a young age increases the potential of individuals to continue these habits in the future. For this reason, the following goals were set within this study;

- Determination of spatial criteria and parameters that affect walking comfort in university campuses,
- Determination of the significance levels of the determined criteria and parameters by both expert and user opinions,
- Comparison and analysis of the results obtained by two different methods (objective and subjective)

The results of the study are expected to contribute significantly to the design processes of existing and future university campuses by providing qualified and necessary data to increase the comfort level of walking.

2. Materials and Methods

The possibility of developing innovative, comprehensive, and appropriate solutions as a result of any research is directly related to the elaboration of the study method and the participation of all relevant stakeholders in the process as much as possible. Therefore, in the process of preparing the method of this research, it was decided to include experts from various

professions (architect, landscape architect, urban and regional planner, sociologist, psychologist, etc.) to the study in addition to the users of the Campus of Selçuk University. It was also decided to use both qualitative and quantitative research methods to test the obtained data and reach the most accurate results. To minimize the problems that may be encountered during the research, the study design was completed and the flow chart summarizing the study process was prepared (Figure 2).

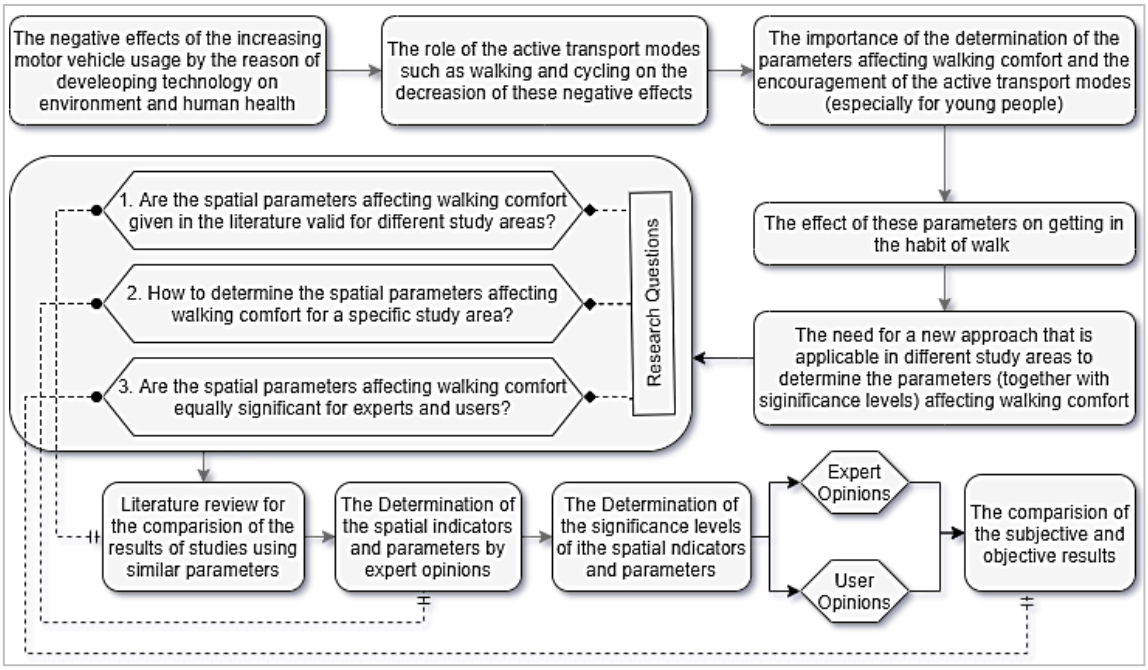

Figure 2

Study design and flow chart summarizing the process

Expert opinions were consulted to determine the criteria and parameters to be evaluated within the scope of this study. Before the expert opinions were consulted, the parameters that were frequently addressed in the relevant literature were determined. The determined parameters were grouped under categories and transformed into tables for the evaluation of experts, and the Delphi Technique was applied. This technique was developed in the 1950s by two researchers, Olaf Helmer and Norman Dalkey, from the USA. The purposes of the Delphi Technique are; to make predictions about the future, to reveal expert opinions, and to reach consensus. Generally, the Delphi technique has three features:

(l) confidentiality in participation,

(2) statistical analysis of group response,

(3) controlled feedback.

The use of the Delphi technique usually includes sequential questionnaires applied to experts. Application results are shared with the participants after each application. This process continues until a consensus is reached. The achieved consensus is the product of this process (Şahin, 2001).

During the Delphi Technique implementation process, an online opinion was requested to reach a wide range of experts. The e-mail addresses of 273 faculty members from 41 universities from the Turkish Republic of Northern Cyprus (K.K.T.C.) and Turkey, where "Landscape Architecture" and "Urban Design and Landscape Architecture" departments are located were obtained from the university web pages. The data repository table (criteria and parameters) created was sent to the addresses obtained and an evaluation was requested. The main reason why faculty members in the departments of Landscape Architecture are chosen as the target audience in determining the criteria and parameters is that the profession that performs open space design studies especially at the micro-level is Landscape Architecture and the subject of study is basically within the field of expertise of this profession.

After the process was completed in line with the opinions and suggestions of the experts, spatial criteria and parameters affecting walking comfort in university campuses were determined. In order to determine the significance (coefficients) of the criteria and parameters, two different (objective and subjective) evaluations were made by applying separate questionnaires to both experts and users based on the study of Maghelal and Capp (2011) (Figure 3).

1-) Objective Evaluation (Expert opinions [Scientists])

2-) Subjective Evaluation (User opinions [student, academic and administrative staff])

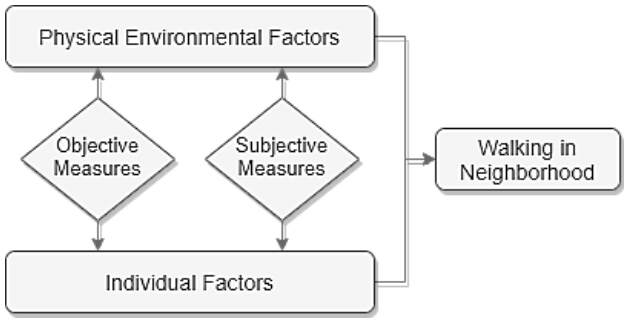

Figure 3

Factors affecting walkability and measurement methods (Maghelal & Capp, 2011)

In both methods, a 9-point scoring system (from 1 to 9 increasing the significance level) was used to determine the significance of the parameters to be evaluated. The values and equivalents in this scoring are as follows:

1-Lowest importance, 3- Low importance,
5-Medium importance, 7-High importance,
9-Highest importance,
2,4,6,8- Intermediate values

As a result of the obtained scores, two different significance levels (both objective and subjective coefficients) of each parameter were obtained.

In the objective measurement phase where expert opinions were questioned, survey forms were prepared on "Google Forms", a professional online survey platform created for users to design surveys and collect data. The e-mail addresses of the academicians to whom the forms will be sent were also obtained from the university web pages. At this point, since different perspectives will greatly contribute to the objectivity of the study, opinions were taken from various professions (Landscape Architecture, Urban and Regional Planning, Architecture, Sociology, Civil Engineering). The scoring forms were sent to 872 academicians, 841 from Turkey, and 31 at the international level, by e-mail. Responses were received from a total of 100 academicians, 95 at national and 5 at the international level. The following equation (Equation 1) was created, showing the mathematical expression of the operations performed in the calculation of the data.

Equation 1: Objective coefficient formula

$$C_o = \prod_{i=1}^{n} S_{ei} \,.\, S_{ec}$$

i= parameter number

C_o= objective coefficient of the parameter

S_e= significance score of the parameter according to experts

S_{ec}= significance score of the relevant criteria according to experts

User scoring forms were prepared in the same format as the web-based scoring forms prepared for experts, to be used in the subjective measurement phase where user opinions are questioned. These forms were filled by the users on the campus by face-to-face interview method. The sample size calculations made for the survey application at this stage are based on the number of 65,000 people who regularly use the Selçuk University AlaeddinKeykubat Campus, reported by the university administration. Using the formula of Newbold (1995), the sample size was calculated as 166 with a 99% confidence interval and 0.1 error margin. The following equation (Equation 2) was created, showing the mathematical expression of the operations performed in the calculation of the data.

Equation 2: Subjective coefficient formula

$$C_s = \prod_{i=1}^{n} S_{ui} \,.\, S_{uc}$$

i= parameter number

C_s= subjective coefficient of the parameter

S_u= significance score of the parameter according to users

S_{uc}= significance score of the relevant criteria according to users

The data obtained from both evaluation processes were compared, inconsistencies were determined and possible reasons for the differences between the results were addressed. As a result of all analyzes, the parameters that should be taken into account in the design processes of the walkable university campuses have been revealed with the data obtained.

3. Results and Discussion

3.1 The Spatial Criteria and Parameters

As a result of the feedback received from the academicians, the table containing the criteria and parameters was created (Table 1). A total of 30 spatial parameters were determined and these parameters were categorized under 4 criteria: Perceptual / Conceptual, Physical / Formal, Structural, and Vegetational. When the distribution of parameters is examined according to the criteria, it is seen that there are 6 spatial parameters under Perceptual/Conceptual criteria, 7 under Physical/Formal criteria, 11 under Structural criteria, and 6 under Vegetational criteria. Short codes shown in Table 1 were defined for the parameters by numbering together with the first 3 letters of the criteria category. Since the effects of the 4 criteria and 30 parameters determined with expert opinions on walking comfort are not the same, the significance levels should be determined before the measurements.

3.2 Characteristics of the Expert Participants

The faculty, department, and academic title information about the experts who participated in the study are given in Figure 4. It is seen that the highest participation in the survey based on faculties is from the faculties of architecture with 34 academic staff. According to academic titles, the highest participation was provid-

ed from the Asst. Prof. Dr. titled academic staff. Based on departments, the highest participation was provided from Landscape Architecture with 45 academicians, Urban and Regional Planning with 23 academicians, and Architecture departments with 14 academicians.

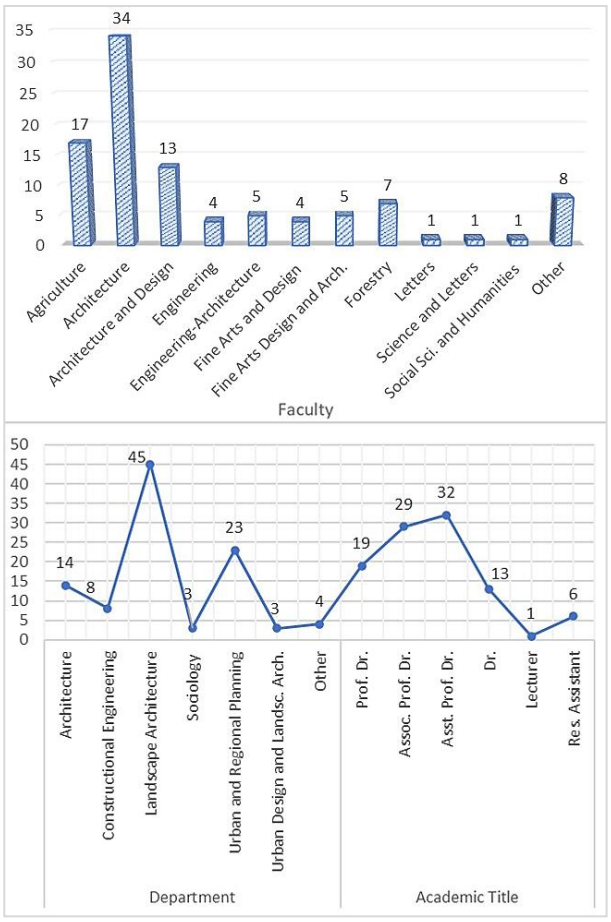

Figure 4

Faculty, department, and title information of the academicians who participated in the survey

3.3. Characteristics of the User Participants

The frequency analysis results of the demographic characteristics and the answers given by the users to the basic questions about and walking behaviors are shown in Table 2.

56.6% of the 166 participants who answered the questionnaire are males. As expected, since the research is carried out on the university campus, 91% of the participants are students; 95.2% consists of young people group between the ages of 18-24. 76.5% of the participants answered “yes” and 22.3% of them answered "partially" to the question of "Do you like walking?". “Transit” response at a rate of 61.4% and “recreation” response at a rate of 34.3% were received to the question of "What is your reason for walking mostly?"

3.4. Significance Levels (Coefficients) of the Spatial Criteria and Parameters

The objective and subjective coefficients obtained as a result of normalizing the scores given by experts and users (so that the sum of the significance scores of all parameters is 100) calculated by using the objective and subjective coefficient formulas (see Equation 1 and Equation 2) are given in Table 1.

3.4.1. Experts’ Coefficients

The number of scores given by the experts for the determination of significance levels of the spatial parameters affecting walking comfort on university campuses is shown in Table 3.

One of the perceptual/conceptual parameters, "pedestrian way occupation" was scored completely (9) by 52 experts. Following this parameter, "vehicle traffic density" got full points from 38 experts.

Among the physical / formal parameters, "continuity of pedestrian way" received a complete score (9) by 49 experts. The "slope" following this parameter received full points from 36 experts.

One of the structural parameters, "lighting", received a full score (9) by 36 experts. Following this parameter, "tactile floor covering material for sight-disabled people" received full points from 35 experts.

Among the vegetational parameters, “shadow trees” were scored completely (9) by 53 experts. Following this parameter, the "plant (green) buffer between pedestrian and motorway" received full points from 25 experts.

In order to increase the legibility of data obtained from experts, the highest number of scores given by experts for each parameter are given in bold format on Table 3.

It can be seen from Table 3, the top 3 parameters that get the most 9 points from the experts are, "Shadow tree", "Pedestrian way occupation" and "Continuity of pedestrian way", respectively. The parameter that gets the most 1 point is "Drinking fountain".

As a result of the expert evaluations, it can be seen from Table 1 that the most significant parameter is "pedestrian way occupation" and the "continuity of pedestrian way " parameter, which has the closest coefficient to this parameter, is in the second place. It can also be seen that the lowest important parameter is "fountain".

3.4.2. Users’ Coefficients

User scoring forms were prepared for campus users in the same format as the web-based forms prepared for experts. The data obtained with the surveys applied to 166 users on the campus were calculated with the subjective coefficient formula (see Equation 2) and the coefficients are given in Table 1.

Table 1
The significance levels determined by experts' and users' opinions (objective and subjective coefficients)

Criteria	Short Code	Parameter	Experts' Coefficient	Users' Coefficient
Perceptual / Conceptual l	Per-1	Pedestrian density	3,7206	3,4307
	Per-2	Vehicle traffic density	3,8135	3,3221
	Per-3	Noise	3,5813	3,5538
	Per-4	Smell	3,5968	3,9229
	Per-5	Visual quality	3,6329	3,6840
	Per-6	Pedestrian way occupation	4,1748	4,3463
Physical / Formal	Phy-1	Walkway shape (linear / curvilinear)	2,6574	2,9148
	Phy-2	Central refuge	2,6777	2,7513
	Phy-3	Slope	3,6685	4,0174
	Phy-4	Direction of pedestrian way (North-South etc.)	2,9927	2,2713
	Phy-5	Width of pedestrian way	3,7650	3,5096
	Phy-6	Continuity of pedestrian way	4,0648	3,6000
	Phy-7	Pedestrian crossing	3,4602	3,3287
Structural	Str-1	Floor covering material (ergonomics)	3,5086	3,6348
	Str-2	Tactile floor covering material for sight-disabled people	3,6224	2,6818
	Str-3	Curb ramp	3,5680	2,9159
	Str-4	Bollard / barrier (between pedestrian and vehicles)	3,1820	2,9226
	Str-5	Drainage condition	3,5284	3,6816
	Str-6	Bicycle road	3,0583	2,6015
	Str-7	Drinking fountain	2,4348	2,4778
	Str-8	Trash cans	2,8653	2,9426
	Str-9	Bench and seating area	3,1820	3,2603
	Str-10	Lighting	3,7659	3,7485
	Str-11	Maintenance / cleaning status of structural elements	3,5581	3,4409
Vegetational	Veg-1	Plant (green) buffer between pedestrian and motorway	3,2002	3,6583
	Veg-2	Shadow tree	3,7551	4,2064
	Veg-3	Shrub	2,6175	3,0230
	Veg-4	Flower	2,6915	3,1522
	Veg-5	Grass area	2,6036	3,3197
	Veg-6	Maintenance status of plants	3,0522	3,6793

Table 2
The frequency analysis results of the user participants

Survey Question	Option	Frequency (n)	Percent (%)	Valid Percent	Cumulative Percent
Sex	Female	72	43,4	43,4	43,4
	Male	94	56,6	56,6	100
Age	18-24	158	95,2	95,2	95,2
	25-34	8	4,8	4,8	100
Participant Type	Student	151	91	91	91
	Administrative personal	2	1,2	1,2	92,2
	Worker	5	3	3	95,2
	Other	8	4,8	4,8	100

Table 2
The frequency analysis results of the user participants

Education	Master degree	14	8,4	8,4	8,4
	Bachelor's degree	130	78,3	78,3	86,7
	Two-year degree	7	4,2	4,2	91
	Not Student	15	9	9	100
Monthly income (TL)	<2020	151	91	91	91
	2020-3500	7	4,2	4,2	95,2
	3501-4500	4	2,4	2,4	97,6
	4501-5500	3	1,8	1,8	99,4
	>5500	1	0,6	0,6	100
Do you like walking?	No	2	1,2	1,2	1,2
	Yes	127	76,5	76,5	77,7
	Partially Yes	37	22,3	22,3	100
What is your reason for walking mostly?	Transit	102	61,4	61,4	61,4
	Sport	7	4,2	4,2	65,7
	Recreation	57	34,3	34,3	100

Table 3
The number of scores given by the experts

Score / Short Code	1 Point	2 Points	3 Points	4 Points	5 Points	6 Points	7 Points	8 Points	9 Points
Per-1	0	0	4	5	6	12	25	20	28
Per-2	2	1	1	4	9	5	21	19	38
Per-3	2	1	3	3	14	10	26	12	29
Per-4	0	4	4	4	10	12	20	15	31
Per-5	0	0	2	6	14	9	29	13	27
Per-6	0	0	0	3	2	7	11	25	52
Phy-1	2	8	18	11	15	12	20	6	8
Phy-2	1	6	17	12	19	14	16	11	4
Phy-3	1	1	6	4	6	8	21	17	36
Phy-4	2	6	11	5	18	9	26	11	12
Phy-5	0	0	2	3	7	10	24	26	28
Phy-6	0	0	0	3	2	6	19	21	49
Phy-7	2	1	4	2	11	14	29	18	19
Str-1	0	4	2	5	6	14	24	12	33
Str-2	1	2	3	1	10	6	23	19	35
Str-3	0	3	5	1	10	9	18	20	34
Str-4	0	4	4	3	23	19	14	13	20
Str-5	0	1	2	4	10	8	34	16	25
Str-6	2	3	6	4	18	16	28	13	10
Str-7	5	7	14	15	20	13	18	5	3
Str-8	1	4	8	11	20	15	24	9	8
Str-9	1	1	5	6	20	14	21	18	14
Str-10	0	1	0	1	6	12	23	21	36
Str-11	0	0	4	4	9	13	23	16	31
Veg-1	1	2	3	6	8	12	27	16	25
Veg-2	0	0	1	3	2	3	12	26	53
Veg-3	1	5	10	10	18	18	24	7	7
Veg-4	1	3	8	12	21	16	19	11	9
Veg-5	2	7	8	10	21	13	22	7	10
Veg-6	2	2	5	7	11	11	26	16	20

As a result of user evaluations, it can be seen from Table 1 that the most important parameter (higher coefficient according to the experts') is "pedestrian way occupation" as in experts', and the "shadow tree" parameter has the closest coefficient is in the second place. The least important parameter is seen to be the "direction of the pedestrian way".

3.5. The Comparison of the Expert and User Coefficients

According to the objective coefficients determined by experts and subjective coefficients determined by users, it can be seen that the subjective coefficient is high in 17 parameters, while the objective coefficient is high in 13 parameters.

As can be seen in Figure 5, parameters that were found more important by the experts are as follows:

- Perceptual criteria,
  - pedestrian density,
  - vehicle traffic density,
  - noise
- Physical criteria,
  - the direction of the pedestrian way,
  - width of the pedestrian way,
  - continuity of the pedestrian way,
  - pedestrian crossing
- Structural criteria,
  - tactile floor covering material,
  - curb ramp,
  - bollard / barrier,
  - bicycle road,
  - lighting,
  - maintenance/cleaning status of structural elements

The parameters that were found more important by the users are as follows:

- Perceptual criteria,
  - smell
  - visual quality
  - pedestrian way occupation (parking on the pedestrian road, etc.)
- Physical criteria,
  - central refuge
  - slope
  - the direction of pedestrian way
- Structural criteria,
  - floor covering material (ergonomics)
  - drainage condition
  - drinking fountain
  - trash cans
  - bench and seating area
- Vegetational criteria,
  - All the parameters in this group

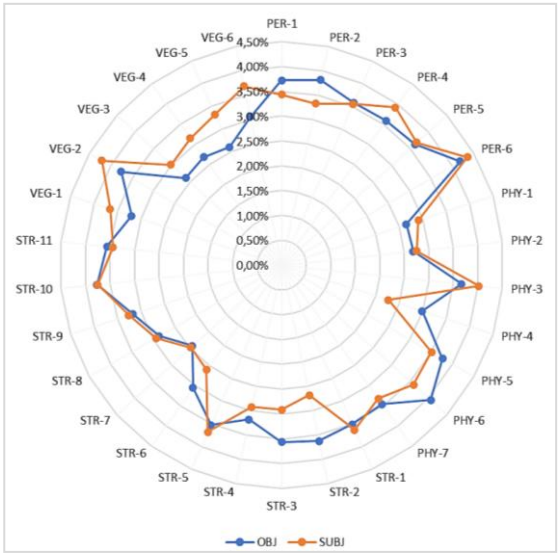

Figure 5

Radar chart of objective and subjective coefficients (significance levels)

Considering based on criteria, in 3 of the 4 criteria, several parameters are considered more important by both users and experts. Only all parameters under the vegetational criteria were found more important by users. Therefore, it is understood that the most significant difference in criteria basis is in vegetational criteria. When evaluated based on parameters, the user coefficient was found to be high in 17 out of 30 parameters. Based on the data that more than half of the parameters are of higher importance according to the users than those indicated by the experts, it has been concluded that the standards and criteria related to the mentioned parameters do not fully meet the users' needs.

As a result, answers were found in the processes of literature review and Delphi technique to research questions related to the determination of parameters and their validity. It was also understood at the stage when expert opinions were taken that the parameters frequently used in the literature on walking may not be valid in all areas. Based on the characteristics of the work area, the number of parameters may increase or decrease depending on the situation. Reaching the result with the feedback and exchange of ideas during the Delphi Technique process has shown that it is a very useful method to get opinions from professionals about the subject on the determination of the parameters. The method used in this study is, in a sense, an answer to the question of "How to determine the parameters affecting walking comfort for a specific area?". Finally, the data obtained in this study showed that the parameters are not equally important for experts and users. For this reason, it is important to organize the responsibilities and activity limits of both groups in the process of determining the parameters and significance levels. Experts need to take a more active role in the determination of the parameters that require more technical information. It is extremely important for the users, who are the owners of the work area in a sense, to take a more active role in the determination of the significance levels of the parameters determined in line by the technical knowledge and experiences of the experts.

4. Conclusions

Environmental pollution, inactivity, and the diseases they bring can be shown as the main indicators that summarize the most serious problems of our age and cause a decrease in the quality of life. Succeed in the studies carried out on the issue of active transportation, which has a direct effect on reducing the effects of the mentioned problems, is very important in this context.

The ongoing increase in the number of researches on active modes of transport is an important indicator that shows the seriousness of the issue. However, it is seen that the results obtained in most of the studies were conducted to contribute to the literature and the quality of life of the society, were not checked for validity. Therefore, it is understood that many studies

have not achieved their goals. In this study, two different results were obtained with the inquiries made to different target groups in parallel with each other. As a result of the measurements, it was understood that some issues should be taken into consideration to reach the goals of the conducted studies.

The most important issues are:

• the determination of the purpose for walking

• the examination of the accuracy of the parameters to be evaluated and the significance levels in line with the determined walking purpose before the measurement process

Determination of the accuracy of the data is possible with the participation of the area users. The issue to be considered in user participation is that the objective measurement method used in the study should be adapted in a way that can be easily understood by the users. In many studies using both objective and subjective methods, it is seen that instead of the determination of the level of accuracy by the methods used, it is aimed to collect data for different characteristics of the field. The objective and subjective data obtained in these studies were used not to question the validity of the results, but as parts that complement each other and provide a single result. In some areas, it may not be possible to apply both methods. Because it is a difficult, expensive, and time-consuming application to get user opinion based on parameters. For this reason, in studies where only the objective measurement method is applied, users should at least be asked to give a score that shows their overall satisfaction with the field, even if there is no separate query based on parameters. Thus, it will be clarified whether the objective measurement results of the study are accepted by the users or not.

As a result, in terms of achieving successful results in researches related to active transportation, it is the most important point that experts and users are two significant parts of a whole. Besides, since each study area has its dynamics, factors determined according to the characteristics of the study area and users should be addressed rather than using a standard set of parameters generally accepted in the literature. In parallel with the success rate in the above-mentioned matters, the rate of contributing to the quality of life in social, cultural, economic, and ecological aspects, especially the environment and human health, will also increase.

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6. Declarations

This research has the approval of the Scientific Research and Publication Ethics Committee of Selcuk University, with the decision numbered E.20083, dated 04/02/2021.

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Analysis of Opinions and Expectations of Farmers in Efeler District of Aydın Province on the Effects of Urbanization

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ABSTRACT

The aim of this study is to determine the opinions and expectations of the farmers on the effects of urbanization on agriculture in Efeler district of Aydın province. For this purpose, six of the villages that have gained the status of neighborhoods, which are around 10 km from the city center, have been selected for purpose. The data of the research was compiled by proportional sampling and survey method from 73 farmers. In the analysis of the research data, firstly the socio-economic characteristics of the farmers were examined and then the opinions and expectations of the farmers about the effects of urbanization on agriculture were revealed. Five-point Likert scale was used in the analysis of opinions and expectations. According to the results of the research, the average age of the farmers is 54.97 years and the average education period is 7.68 years. The average land size of the farmers is 73.01 decares and the average number of parcels is 3.42. When the farmers are asked about the changes and expectations of urbanization; 68.49% thought that their agricultural production was not affected at all, 91.78% thought that their agricultural income never changed, 80.82% thought that the agricultural land sales frequency increased, 95.89% thought that the agricultural land prices increased, 64.38% thought that urbanization could not prevent migration, 58.90% thought that urbanization may affect young farmers negatively. In Turkey, urbanization policies and other regulations should not adversely affect the agricultural structure and should be arranged in a way that does not exclude farmers from agriculture.

1. Introduction

Due to the rapid development of cities by fringing, the income generated in urban areas is higher than the yield of agricultural use and the risk is low, agricultural areas are rapidly transforming into urban uses, especially residential use. During the development of urban fringing, land existence in rural areas is considered as land stock (Sezgin and Varol, 2012). In the face of the sudden increases in the value of the agricultural lands around the settlement area, it becomes difficult to ensure that these lands continue to be used in agriculture (Paksoy and Direk, 1994).

In Turkey, after the Law No. 6360 date 06.12.2012 and published in Official Gazette No. 28489, 14 provincial has won metropolitan status, the metropolitan municipality has been extended to the boundaries of the province. It is foreseen that the Law No. 6360 can bring solutions to some urbanization and settlement problems in the center and districts of Aydın province. With this law, 17 districts of Aydın province became district municipalities affiliated to Aydın Metropolitan Municipality. The legal personality of village, town municipalities, subdistrict and subdistrict organizations within the administrative boundaries of these districts was abolished. In this framework, the legal personality of 490 villages, including 340 forest villages, 36 town municipalities were abolished and they became the neighborhoods of Aydın Metropolitan Municipality and district municipalities (Genç, 2014).

The urban development process, construction has increased both in the empty areas within the city in Aydın. The fertile agricultural areas around the İzmir-Aydın-Denizli Highway have turned into residential, industrial and commercial areas. The district center, town municipality and villages on this route have developed gradually by getting closer to the villages. Due to the lack of suitable areas in the city, some important facilities are located within the borders of neighboring municipalities and villages, and villages and municipalities close to the center are integrated with the city (Erdem et al.,1999; Deniz et al., 2005).

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As the population in the cities increases, the area in which they spread expands and spreads to rural areas.As a result of urban development, natural areas of different types and sizes are transforming into cities (Türkten, 2015). Many studies have been conducted on the effects on agriculture and rural areas of urbanization in Turkey (Erbaş, 1989; Alhan, 1992; Aksoy and Özsoy, 2001; Çelik, 2007; Karataş, 2007; Sezgin, 2010; Sezgin and Varol, 2012; Karakayacı and Karakayacı, 2012; Akseki and Meşhur, 2013; Türkten, 2015; Uzun and Demir, 2016; Sağır and Yalçın, 2016; Partigöç, 2018; Tekçe, 2018). However, it is also necessary to closely follow the effects of urbanization on agriculture in different regions and to take necessary measures by determining the opinions of the farmers.

Efeler district of Aydın province is located on the fertile agricultural lands irrigated by the Büyük Menderes Plain. Aydın province's acquisition of metropolitan status and other regulations put into effect also affect the use of agricultural land and land markets in Efeler district. For this reason, there is a need for studies examining the effects of urbanization on agriculture in Efeler district. The purpose of this study is to determine the opinions and expectations of the farmers in the villages that gained neighborhood status in Aydın's Efeler district on the effects of urbanization on agriculture.

2. Materials and Methods

The main material of the study is the data compiled using a questionnaire method from the farmers in Efeler district of Aydın province. According to data for 2018 of Turkish Statistical Institute, the most densely populated district of Aydin province, with 287,518 people are added to the metropolitan municipality as the new district is the Efeler district (TurkStat, 2019).

There are 83 neighborhoods in Efeler district and 61 villages and towns have gained neighborhood status with the law numbered 6360. 10% of 61 neighborhoods outside the urban area were included in the study, and six of the neighborhoods within 10 km of the city center were selected as purposeful. Accordingly, the neighborhoods of Çeştepe, Işıklı, Kadıköy, Kuyulu, Şevketiye and Tepecik were included in the study (Figure 1). According to the information obtained from the Efeler District Directorate of the Ministry of Agriculture and Forestry, there are a total of 298 farmers registered in the Farmer Registration System in the settlements included in the study. It was decided to include some of the farmers in the scope of the research by sampling method. For this purpose, the following proportional sample size formula was used (Newbold, 1995). This sampling method has been used in many previous studies (Tiryakioğlu and Artukoğlu, 2015; Özdemir et al., 2015; Ulu et al., 2016; Kızıloğlu and Kızılaslan, 2017; Bozdemir et al., 2019; Yüzbaşıoğlu, 2019; Barlas et al., 2019; Susam and Engindeniz, 2020; Değer et al., 2020).

$$n = \frac{Np(1-p)}{(N-1)\sigma^2_{px} + p(1-p)}$$

In the formula;

n = Sample size

N = Total number of farmers

p = The proportion of farmers affected by urbanization (taken 0.5 to reach the maximum sample size)

σ^2_{px} = Variance.

Figure 1. 1/100,000 scaled environmental plan of the research area.

Urban settlement area Urban development area Rural settlement area

Source: Ministry of Environment and Urbanization, 2018.

In the study, calculations were made based on 95% confidence interval and 10% margin of error, and the sample size was determined as 73. In determining the number of farmers to be included in each neighborhood, the shares of the neighborhoods in the total number of farmers were taken as basis. The research data covers the year 2016.

In the analysis of the research data, first the socio-economic characteristics of the farmers were examined, then the farmer's opinions and expectations about the effects of urbanization on agriculture were revealed. The five-point Likert scale was used in the analysis of opinions and expectations.

In the conversion of the population in farms to the unit of male labor force; the coefficients of 0.50 for males and females in the 7-14 age group, 1.00 for males in the 15-49 age group, 0.75 for males in the 50-64 age group, 0.50 for females were based on (Aras, 1988).

3. Results and Discussion

The socio-economic characteristics of the farmers are given in Table 1. The age of the farmers varies between 24-76 and the average age is 54.97. The period of education varies between 5-16 years and the average period of education is 7.68 years. The average agricultural experience of the farmers is 24.59 years.

Table 1
Socio-economic characteristics of farmers

Age of farmers	54.97
Education period of farmers (year)	7.68
Agricultural experience of farmers (year)	24.59
Household size (person)	3.33
Family labor force potential (male work unit)	1.95
Land size (decare)	73.01
Equity ratio (%)	85.42
Partner ratio in agricultural cooperative (%)	84.93

The average household size in the farms is 3.33 and 50.45% of them are men. When examined by age; it is seen that 4.94% of the population is 0-6 years old, 9.47% is 7-14 years old, 40.33% is 15-49 years old, 28.81% is 50-64 years old, 16.46% is 65 and older. Average family labor force potential in farms is 1.95 as a unit of male labor force and 585 as a male labor day.

Average land size of the farms is 73.01 decares. The average number of parcels is 3.42 and the average parcel size is 21.35 decares. When the land ownership status of the farmers is examined; according to the average of the farms, 76.63% of the lands in the farms are operated lands by the owner, 14.74% of the lands are rented land and 8.63% of the lands are operated lands by the partner. Cotton, wheat, corn, maize for silage and vetch are mostly produced on the farm lands. In addition, silage corn is also produced in the farms as the second product.

As the average of the farms, the total assets are 3.1 million Turkish Liras and 90.92% of them are land assets. When analyzed the distribution of assets according to the items; a large share of land assets (83.88%), followed by tools and machinery (6.91%) and buildings (4.99%), respectively. However, 85.42% of the passive capital are equity capital. 62 of the 73 farmers included in the research are partners in at least one agricultural cooperative.

Within the scope of the research, the opinions of the farmers about the changes in their regions with the law numbered 6360 were examined. 93.15% of the farmers stated that there was no change in the legal structure of their land after their became a neighborhood (Table 2).

Table 2
The farmers' opinions on whether there is a legal change in their lands after their villages became neighborhood

Answers	Number of farmers	%
Yes	5	6.85
No	68	93.15
Total	73	100.00

68.49% of the farmers stated that their agricultural production was not affected after their village became a neighborhood (Table 3).

Table 3
The farmers' opinions on whether their agricultural production is affected after their villages became neighborhood

Answers	Number of farmers	%
Positively affected	6	8.22
Negatively affected	15	20.55
Never affected	50	68.49
No idea	2	2.74
Total	73	100.00

91.78% of the farmers stated that their agricultural incomes did not change after their villages became a neighborhood (Table 4).

Table 4
The farmers' opinions on whether their agricultural incomes have changed after their villages became neighborhood

Answers	Number of farmers	%
Increased	1	1.37
Decreased	4	5.48
Not changed	67	91.78
No idea	1	1.37
Total	73	100.00

In the study, when the opinions of the farmers about the indirect effects of their village being a neighborhood are examined; it has been determined that they agree with the statements "land demand and rents have increased" (4.05), "the land has become fragmented" (3.53). It was determined that they did not agree with the statements "marketing opportunities improved" (1.60), "irrigation opportunities improved" (1.74), "employment opportunities increased" (1.95), "public transport caused loss of productivity" (2.44), "transportation opportunities improved" (2.55), "environmental pollution occurred" (2.83) (Table 5).

Table 5
The farmers' opinions on the indirect effects of their village being a neighborhood

Effects	Strongly disagree (1)		Disagree (2)		Undecided (3)		Agree (4)		Strongly agree (5)		Mean
	n	%	n	%	n	%	n	%	n	%	
Irrigation opportunities improved	34	46.6	29	39.7	5	6.8	5	6.8	-	-	1.74
Marketing opportunities improved	39	53.4	27	37.0	4	5.5	3	4.1	-	-	1.60
Transportation opportunities improved	29	39.7	12	16.4	3	4.1	21	28.8	8	11.0	2.55
Employment opportunities increased	37	50.7	20	27.4	3	4.1	9	12.3	4	5.5	1.95
The land has become fragmented	13	17.8	6	8.2	5	6.8	28	38.4	21	28.8	3.53
Land demand and rents have increased	7	9.6	2	2.7	-	-	35	47.9	29	39.7	4.05
Environmental pollution occurred	21	28.8	14	19.2	10	13.3	12	16.4	16	21.9	2.83
Public transport caused loss of productivity	27	37.0	17	23.3	9	12.3	10	13.3	10	13.3	2.44

When the opinions of the farmers about the change in the frequency of land sales after the village where they are located is a neighborhood; 80.82% of them stated that the frequency of sales increased, and 19.18% stated that the sales frequency did not change (Table 6).

Table 6
The farmers' opinions on the frequency of land sales after their villages became neighborhood

Answers	Number of farmers	%
Increased	59	80.82
Decreased	-	-
Not changed	14	19.18
Total	73	100.00

In the study, 95.89% of the farmers stated that the land prices increased after their villages became neighborhoods (Table 7).

Table 7
The farmers' opinions whether land prices have changed after their villages became neighborhood

Answers	Number of farmers	%
Increased	70	95.89
Decreased	-	-
Not changed	3	4.11
Total	73	100.00

Urban fringing may affect the agricultural lands and the purpose of use in the villages on one side, and on the other hand, it can also reduce the migration from rural to urban by solving infrastructure and transportation problems in these areas and increasing employment opportunities with industrialization. Farmers do not think that the migration in their region will decrease with urbanization (64.38%) (Table 8).

Table 8
The farmers' expectations as to whether urbanization will prevent migration in their region

Answers	Number of farmers	%
Yes	24	32.88
No	47	64.38
No idea	2	2.74
Total	73	100.00

In addition, farmers stated that urbanization would negatively affect young farmers (58.90%) (Table 9).

Table 9
The farmers' expectations as to whether urbanization will affect young farmers in their region

Answers	Number of farmers	%
Will positively affect	10	13.70
Will negatively affect	43	58.90
Will not affect	16	21.92
No idea	4	5.48
Total	73	100.00

Urbanization and the gradual expansion of the city center towards the surrounding settlements and villages cause the agricultural land to be used out of purpose. In the study, the farmers evaluate the spreading of the city center towards the villages as negative (75.34%) in terms of land use. Farmers stated that the most common non-agricultural use of agricultural lands in the region is for residential construction (89.87%), then for industry (10.13%). On the other hand, 58.90% of the farmers stated that they would consider selling if their lands were parceled by the municipality, while 40.10% would not sell.

The effects of urbanization on agriculture and agricultural land have been determined in researches conducted in different regions. In a study conducted in Denizli, spatial, social, social and economic factors that cause urban sprawl and fringing were determined and it was determined that this negatively affected agricultural areas meadows, pastures and forests.

In addition, the areas with the highest loss occurring in rural areas are determined as the areas around the main transportation connections and industrial areas (Patigöç, 2018). In a study conducted in Diyarbakır, it was determined that the urban area has grown more than five times. In addition, the city has expanded due to an annual average of 187 hectares of construction, and a large part of the urban development direction has moved towards I. and II. class agricultural lands (Özcanlı et al., 2018). In a study conducted in Samsun, the spread of urban fringing to agricultural areas was examined by using satellite images. In the last 15 years, the urban settlement area has increased by 96.32% and has grown to approximately 3199 ha. It has been determined that the growth is generally towards the agricultural areas (Uzun and Demir, 2016). In a study conducted in Ankara, the effect of urban fringing on the misuse of agricultural land was examined. According to the results, the use of land in housing, industry and infrastructure investments in urban growth causes the misuse of agricultural lands (Sezgin, 2010). In a study conducted in Tokat, the effects of urbanization on land use were investigated. Especially fruit gardens were determined to be destroyed and it was determined that urbanization was possible without destroying the fertile lands. In a study conducted in Tokat, the effects of urbanization on land use were investigated. Especially fruit gardens were determined to be destroyed and it was determined that urbanization was possible without destroying the fertile lands. For this reason, it has come to the conclusion that in order to prevent the problem from reaching much more serious dimensions, the concerned parties should take measures to prohibit building on unproductive areas (Alhan, 1992).

4. Conclusion

Urbanization may affect the agricultural lands in the villages and their intended use on one side, and on the other hand, it can have a decreasing effect on migration from rural to urban by solving infrastructure and transportation problems in these areas and increasing employment opportunities with industrialization. However, according to the research results, the majority of the farmers believe that urbanization cannot prevent migration in the region.

The spreading of the city center towards the villages disrupts the integrity of the agricultural lands and creates fringing areas between the rural area and the city. As a matter of fact, the producers in the region stated that the spread of the city center towards the villages is negative in terms of land use. In these areas where urban sprawl has started, an effective land use policy should be established and necessary measures should be taken.

In the study, most of the farmers stated that the most common use of agricultural lands other than agriculture is housing construction and that they can sell their lands after urban fringing. In Turkey, urbanization policies and other regulations should not adversely affect the agricultural structure and should be arranged in a way that does not exclude farmers from agriculture. Only in this way will the optimum balance between natural resources and urban uses be achieved.

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The Occurrence of Barley (*Hordeum vulgare*) and Wild Barley (*H. spontaneum*) Leaf Diseases in Batman Province and Surrounding Areas of Turkey

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ABSTRACT

Barley (*Hordeum vulgare*) is an important crop in Turkey. In this study, 37 barley fields in Batman central district and Beşiri (Batman), Gercüş (Batman), Hasankeyf (Batman), Kozluk (Batman), Sason (Batman), Kocaköy (Diyarbakır), Kurtalan (Siirt), and Midyat (Mardin) districts were examined for the presence of leaf diseases. In addition, 24 naturally grown wild barley (*H. spontaneum*) populations in Batman central district and Beşiri, Hasankeyf, Kurtalan, and Midyat districts were inspected for the presence of leaf diseases. In barley fields, scald caused by *Rhynchosporium commune* was the most common disease, followed by the spot form of net blotch caused by *Drechslera teres* f. *maculata*, barley stripe caused by *Drechslera graminea*, the net form of net blotch caused by *Drechslera teres* f. *teres*, spot blotch caused by *Cochliobolus sativus*, powdery mildew caused by *Blumeria graminis* f. sp. *hordei* and brown rust caused by *Puccinia hordei*. Among the *Hordeum spontaneum* populations the most common disease was scald, followed by the spot form of net blotch, the net form of net blotch, powdery mildew, and brown rust.

1. Introduction

Barley (*Hordeum vulgare*) is an important crop in Turkish agriculture. In 2019, barley was planted in 28690715 decares of the area in Turkey (TUIK 2020). Barley is used as feed, in malt production, and as green hay. Also, a limited amount of human food is produced (Geçit 2016). In this study, 37 barley fields in Batman central district and Beşiri (Batman), Gercüş (Batman), Hasankeyf (Batman), Kozluk (Batman), Sason (Batman), Kocaköy (Diyarbakır), Kurtalan (Siirt), and Midyat (Mardin) districts were examined for the presence of leaf diseases. In 2019, barley was planted in 15000, 20569,1650, 2733, 6800, 250, 3061, 14000 and 51978 decares of land in Beşiri, Gercüş, Hasankeyf, Batman central district, Sason, Kocaköy, Kurtalan and Midyat districts, respectively (TUIK 2020). Wild barley (*Hordeum spontaneum*), the progenitor of the modern-day barley cultivars, is common in the region. *Hordeum spontaneum* populations are important disease resistance sources (Çelik and Karakaya 2017). Additionally, 24 naturally grown wild barley (*H. spontaneum*) populations in Batman central district and Beşiri, Hasankeyf, Kurtalan, and Midyat districts were inspected for the presence of leaf diseases in this study.

2. Materials and Methods

A survey was carried out in Batman province and surrounding areas of Turkey during April 2019. A total of 37 barley (*Hordeum vulgare*) fields and 24 naturally grown wild barley (*Hordeum spontaneum*) populations were examined. One, 1, 9, 6, 9, 6, 1, 1, and 3 barley fields in Sason, Kozluk, Beşiri, Batman central district, Hasankeyf, Gercüş, Kocaköy, Kurtalan, and Midyat districts respectively were examined for the presence of barley leaf diseases. Two, 8, 6, 2, 1, and 5 wild barley (*H.* spontaneum) field populations in Batman central district and Beşiri, Hasankeyf, Gercüş, Kurtalan, and Midyat districts respectively were examined for the presence of the leaf diseases. Barley fields and wild barley populations were examined every 2-30 kilometers (Aktaş 2001). At each barley field, at least 100 plants were examined. At least 50 wild barley (*H. spontaneum*) plants were inspected for the presence of the diseases at each location. The diseases were

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identified as described by Mathre (1997) and Zaffarano et al. (2011). When necessary, surface-sterilized leaf pieces were placed on blotter paper and conidia were examined under a stereomicroscope. A 1-9 scale developed by Saari and Prescott was used for the determination of the disease severity (Saari and Prescott, 1975).

3. Results and Discussion

Six, 1, 1, 9, 9, 6, 1, 1, and 3 barley fields in Batman central district and Sason, Kozluk, Beşiri, Hasankeyf and Gercüş districts and Kocaköy (Diyarbakır), Kurtalan (Siirt) and Midyat (Mardin) districts were examined for the presence of the barley leaf diseases. A total of 37 barley fields were inspected. Scald caused by the *Rhynchosporium commune* was the most common disease followed by the spot form of net blotch caused by *Drechslera teres* f. *maculata*, barley stripe caused by *Drechslera graminea*, the net form of net blotch caused by *Drechslera teres* f. *teres*, spot blotch caused by *Cochliobolus sativus*, powdery mildew caused by *Blumeria graminis* f. sp. *hordei* and brown rust caused by *Puccinia hordei* (Table 1). Scald was present in all districts with the exception of Kozluk and Kurtalan districts, however, only one field was examined in each of these districts. In 2 Beşiri fields and in one Hasankeyf field scald incidences were 100 percent with the severity values of 9. In other fields, scald incidences were between 1-70 percent and severity values were between 5-7. Spot form of net blotch was present in 19 barley fields. In one Beşiri field spot form of net blotch incidence was 100 percent and in one Batman central district field spot form of net blotch incidence was 70 percent. In each of these fields, the disease severity value was 7. In other fields, the spot form of net blotch incidence values were between 1-30 percent and the disease severity values were between 5-7, mostly an average of 5. Barley stripe caused by *Drechslera graminea* was present in 18 barley fields. In these fields, incidence values of barley stripe ranged from 1 to 30 percent. Barley stripe was present in all districts with the exception of Kozluk and Kocaköy districts, however, in each of these districts, only one barley field was inspected. Net form of net blotch was present in 6 barley fields. Net form of net blotch was observed in Beşiri, Hasankeyf, Gercüş and Midyat districts. The net form of net blotch incidence in these fields was between 1-10 percent and severity values were 5 in all fields. Powdery mildew was present in 2 Hasankeyf and Gercüş fields. In both fields, the incidence value of powdery mildew was 1 percent and severity values were 5 in both fields. Spot blotch was found in 2 Beşiri and Gercüş fields. The incidence values were 5 and 10 in Beşiri and Gercüş fields, respectively. The severity values in both fields were 5. Brownrust was detected only in Batman central district field. The incidence value of brown rust was 1 percent and the severity value was 5 in this district.

It appears that the main barley diseases in these areas are scald, net blotch, and barley stripe. Both forms of net blotch were observed, however, the spot form of net blotch was more prominent. Brown rust, powdery mildew, and spot blotch were observed in fewer fields. Scald, net blotch, and barley stripe were previously reported to be common in Turkey (Karakaya et al. 2014, Karakaya et al. 2016a). The other diseases reported in the current study were also detected in earlier studies in the barley fields of Turkey (Çelik and Karakaya 2015, Özdemir et al. 2017, İlgen et al. 2017, Ertürk et al. 2018). In Eskişehir province of Turkey, net blotch and scald were the predominant diseases followed by barley stripe, brown rust, powdery mildew, and *Ustilago* spp. (Çelik and Karakaya 2015). Both biotypes of net blotch were present in Eskişehir province. In the Kırıkkale province of Turkey, scald and net blotch were found to be the most common diseases (Özdemir et al. 2017). In the Kırıkkale province, spot form of net blotch was more common. In this province, powdery mildew and brown rust diseases followed this disease and in a few fields, yellow rust and stem rust also were observed. In another study conducted in the Çubuk district of Ankara province, scald caused by *Rhynchosporium secalis* was the most common barley disease followed by brown rust and net blotch. Both forms of net blotch were found in the Çubuk district. Barley stripe, yellow rust, stem rust, and powdery mildew were also found in Çubuk district fields (İlgen et al. 2017). In the Bala district of Ankara, the net form of net blotch was found as the most common disease followed by the spot form of net blotch and scald. Barley stripe and powdery mildew were also present in some fields in Bala district (Ertürk et al. 2018).

Two, 8, 6, 2, 1, and 5 wild barley (*H. spontaneum*) field populations in Batman central district and Beşiri, Hasankeyf, Gercüş, Kurtalan (Siirt), and Midyat (Mardin) districts were examined for the presence of diseases. No disease was observed at two *H. spontaneum* populations at Hasankeyf district (Table 2). Among the wild barley populations, the most common disease was scald, followed by the spot form of net blotch, the net form of net blotch, powdery mildew, and brown rust. *Rhynchosporium commune* was observed in 14 wild barley populations. The incidence values of *R. commune* in these populations ranged from 1 to 80 percent. Scald was present in 6 Beşiri populations with incidences in the range of 7-80 percent. In one Beşiri population disease incidence was 80 percent with a severity value of 9. On the other hand, scald was found only in one Hasankeyf population with a disease incidence of 1 percent. Scald was detected in 2, 1, and 3 populations from Gercüş, Kurtalan, and Midyat. The severity values of scald were most of the time 5. Spot form of net blotch was present in 1, 2, 2, 1, 1, and 1 wild barley populations in Batman central district and in Beşiri, Hasankeyf, Gercüş, Kurtalan, and Midyat districts, respectively.

Disease incidence values in these populations were between 1-20 percent and disease severity values were between 5-9, mostly being 5. Net form of net blotch was observed in 1, 1, and 2 wild barley populations from Beşiri, Hasankeyf, and Midyat districts, respectively. In these populations, disease incidence percentages ranged between 1-5 and disease severity value was 5 in all of these populations. Powdery mildew disease was detected in 1, 1, 1, and 1 populations from Beşiri, Hasankeyf, Gercüş, and Kurtalan districts, respectively. In these populations, the disease incidence percentages ranged from 1 to 5 and the disease severity was 5 in all of these populations. Brown rust was detected only in one population from the Midyat district. In this population, the disease incidence was 10 percent and disease severity value was 5. Variation related to disease resistance was observed among the wild barley populations. Karakaya et al. (2016b) examined 40 naturally growing *Hordeum spontaneum* populations in Şanlıurfa, Gaziantep, Şırnak, Mardin, Diyarbakır, Siirt, Hatay and Kilis provinces of Turkey for the presence of the diseases. Scald caused by *Rhynchosporium commune* was the most commonly encountered disease. Powdery mildew and net blotch followed the scald disease. Both forms of the net blotch were found. In addition, semi-loose smut, loose smut, brown rust, and barley stripe were found in the *H. spontaneum* populations.

In the current study, scald and net blotch were common in the barley fields and wild barley populations examined. These two diseases appear to be the most common diseases in these areas. Barley stripe was also common in the barley fields investigated. Proper control methods should be implemented in regard to each of these diseases. Barley stripe disease can be controlled by using disease-free seed and/or treating the seed with fungicides. Also, cultural methods will help to reduce the disease. Resistant cultivars to barley stripe exist (Ulus and Karakaya 2007, Bayraktar and Akan 2012, Çelik et al. 2016). Resistant cultivars to scald and net blotch are also present and can be employed (Mert and Karakaya 2004, Karakaya and Akyol 2006, Düşünceli et al. 2008, Taşkoparan and Karakaya 2009, Usta et al. 2014, Azamparsa et al. 2015, Yazıcı et al. 2015). Wild barley populations exhibiting no disease symptoms under natural conditions should be tested under controlled conditions against the major diseases of barley and may be used in disease resistance breeding studies.

4. Conclusions

In this study, 37 barley (*Hordeum vulgare*) fields and 24 naturally grown wild barley (*Hordeum spontaneum*) populations in Batman central district and surrounding areas were inspected for the presence of the leaf diseases. Among the barley fields, scald caused by the *Rhynchosporium commune* was the most common disease followed by the spot form of net blotch caused by *Drechslera teres* f. *maculata*, barley stripe caused by *Drechslera graminea*, the net form of net blotch caused by *Drechslera teres* f. *teres*, spot blotch caused by *Cochliobolus sativus*, powdery mildew caused by *Blumeria graminis* f. sp. *hordei* and brown rust caused by *Puccinia hordei*. Among the wild barley populations, the most common disease was scald, followed by the spot form of net blotch, the net form of net blotch, powdery mildew, and brown rust. Scald and net blotch were common among the barley fields and wild barley populations examined. These two diseases appear to be the most common diseases in these areas. Barley stripe was also common among the barley fields surveyed. Appropriate control methods should be implemented for these diseases. Wild barley populations that showed no disease under natural conditions should be tested under controlled conditions against the major barley diseases and could be used in breeding studies for disease resistance.

Table 1
Barley (*Hordeum vulgare*) leaf diseases observed at Batman province and surrounding areas of Turkey

No	Province	District	Disease situation	*R. comm.*		*Dtm*	*Dtm*	*Dtt*	*Dtt*	*P. hordei*	*P. hordei*	*Bgh*	*Bgh*	*Coch*	*Coch*	*D. graminea*
				Inc.	Sev.	Inc.	Sev.	Inc.	Sev.	Inc.	Sev.	Inc.	Sev.	Inc.	Sev.	Inc.
1	Batman	Sason	present	3	5	3	5									1
2	Batman	Koz-luk	present			3	5									
3	Batman	Beşiri	present	70	7	30	7							5	5	
4	Batman	Beşiri	present	30	5	20	5									
5	Batman	Beşiri	present	25	5											
6	Batman	Beşiri	present													2
7	Batman	Beşiri	present													10
8	Batman	Beşiri	present	2	5	10	7	2	5							1
9	Batman	Beşiri	present	5	7	100	7									2
10	Batman	Beşiri	present	100	9											
11	Batman	Beşiri	present	100	9											
12	Batman	Central	present	65	7					1	5					2

Table 1
Barley (*Hordeum vulgare*) leaf diseases observed at Batman province and surrounding areas of Turkey

13	Batman	Central	present	15	5										
14	Batman	Central	present	15	5										
15	Batman	Central	present	5	5										
16	Batman	Central	present	5	5										
17	Batman	Central	present			70	7								
18	Batman	Hasankeyf	present	60	7										
19	Batman	Hasankeyf	present			10	5	1	5		1	5			3
20	Batman	Hasankeyf	present	100	9										
21	Batman	Hasankeyf	present	2	5	1	5								
22	Batman	Hasankeyf	present	30	5										3
23	Batman	Hasankeyf	present	3	5			10	5						13
24	Batman	Hasankeyf	present			5	5	10	5						
25	Batman	Hasankeyf	present	50	7										
26	Batman	Hasankeyf	present	50	5										
27	Batman	Gercüş	present	3	5								10	5	30
28	Batman	Gercüş	present	5	5										3
29	Batman	Gercüş	present	10	5	2	5	1	5						
30	Batman	Gercüş	present	1	5	10	5								1
31	Batman	Gercüş	present	5	5	3	5				1	5			1
32	Batman	Gercüş	present	5	5	2	5								7
33	Diyarbakır	Kocaköy	present	50	5	1	5								
34	Siirt	Kurtalan	present			1	5								1
35	Mardin	Midyat	present	5	5	5	5								2
36	Mardin	Midyat	present	7	5	3	5	1	5						1
37	Mardin	Midyat	present			20	5								1

(*R. comm*: *Rhynchosporium commune*, *Dtm*: *Drechslera teres* f. *maculata*, *Dtt*: *Drechslera teres* f. *teres*, *P. hordei*: *Puccinia hordei*, *Bgh*: *Blumeria graminis* f. sp. *hordei*, *Coch*: *Cochliobolus sativus*, *D. graminea*: *Drechslera graminea*, Inc.: Incidence, Sev.: Severity)

Table 2
Wild barley (*Hordeum spontaneum*) leaf diseases observed at Batman province and surrounding areas of Turkey

No	Province	District	Disease situation	*R. comm.*		*Dtm*		*Dtt*		*P. hordei*		*Bgh*	
				Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
1	Batman	Central	present			1	3						
2	Batman	Central	present	50	5								
3	Batman	Beşiri	present			20	5						
4	Batman	Beşiri	present	7	5	1	5					1	5
5	Batman	Beşiri	present	40	5								
6	Batman	Beşiri	present	80	9								
7	Batman	Beşiri	present	20	5								
8	Batman	Beşiri	present	20	5								
9	Batman	Beşiri	present	30	5								
10	Batman	Beşiri	present					5	5				
11	Batman	Hasankeyf	present									2	5
12	Batman	Hasankeyf	absent										
13	Batman	Hasankeyf	present	1	5								
14	Batman	Hasankeyf	absent										
15	Batman	Hasankeyf	present			20	7	1	5				
16	Batman	Hasankeyf	present			7	7						
17	Batman	Gercüş	present	1	5							1	5
18	Batman	Gercüş	present	5	5	5	5						

Table 2
Wild barley (*Hordeum spontaneum*) leaf diseases observed at Batman province and surrounding areas of Turkey

19	Siirt	Kurtalan	present	2	5	2	5							5	5
20	Mardin	Midyat	present			3	5	3	5						
21	Mardin	Midyat	present	1	5										
22	Mardin	Midyat	present	15	7										
23	Mardin	Midyat	present							10	5				
24	Mardin	Midyat	present	5	5			1	5						

(*R. comm*: *Rhynchosporium commune*, *Dtm*: *Drechslera teres* f. *maculata*, *Dtt*: *Drechslera teres* f. *teres*, *P. hordei*: *Puccinia hordei*, *Bgh*: *Blumeria graminis* f. sp. *hordei*, Inc.: Incidence, Sev.: Severity

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Wheat Stem Rust Races in Sinop, Turkey**

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ABSTRACT

Stem rust caused by *Puccinia graminis* f. sp. *tritici* is an important disease of wheat in the world. This disease is also common in the Sinop province of Turkey. The pathogen forms new races and these races may overcome the resistance present in wheat cultivars. For sustainable wheat production, identification of the stem races is necessary. During 2016 and 2017, surveys were conducted in wheat-growing areas of Sinop province and from diseased plants, 42 single uredospore pustule isolates were obtained. Using North American differential genotypes stem rust races were identified. The most common race was TTTTF followed by TTKTF, RTTTF, RTKTF, and TTKTC.

1. Introduction

Wheat (*Triticum* spp.) is one of the most important crops in the World. In Turkey, among the cool-season cereals, wheat is planted in more than 70 percent of the areas (Geçit 2016). In Sinop province of Turkey wheat is planted in 181.123 and 190.358 decares of land during 2016 and 2017 with a production of 37.456 and 41.563 tons of yield, respectively (Anonymous, 2020).

Stem rust caused by the basidiomycetous fungus *Puccinia graminis* f. sp. *tritici* is one of the oldest known diseases of wheat (Roelfs et al. 1992). The pathogen forms new races and these races may overcome the resistance present in wheat cultivars. For sustainable wheat production, identification of the stem races is necessary. Race TTKSK caused large epidemics and variants of this race have been identified (Singh et al. 2015). In a study conducted in Turkey 21 different stem rust races have been found (Mert et al. 2012). In their study, race TKTTC was the most common race. Stem rust of wheat caused by *P. graminis* f. sp. *tritici* is common in Turkey (İren 1955; Mert et al. 2012) and in the Sinop province of Turkey (Akci and Karakaya 2017). In this study, wheat stem rust races occurring at the Sinop province of Turkey were determined. The preliminary abstract related to the race TTTTF from the Gerze district of Sinop was previously published (Akci and Karakaya 2019).

2. Materials and Methods

Surveys were conducted in 2016 and 2017 in the Sinop province of Turkey (Figure 1). In 2016, 31 wheat fields in Saraydüzü, Durağan, Boyabat, and Gerze districts of Sinop province were surveyed. In 2017, 12 wheat fields in the Boyabat district were surveyed. A systematic sampling method was used in survey studies (Aktaş 2001). From diseased plants, 42 single uredospore pustules were obtained. Single uredospore pustules were multiplied on susceptible cv Demir 2000. Inoculation, incubation, and disease evaluation procedures were performed as described by Mert et al. (2012). A 0-4 scale was used for evaluation and race identification was carried out using 20 North American differential cultivars (Tables 1 and 2) (Roelfs and Martens 1988; Jin et al. 2008; Mert et al. 2012)

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** Short communication

Figure 1
Map of Sinop province, Turkey (Anoymous 2021)

Table 1
Stem rust differential genotypes used in this study

	Genotypes	Resistance genes
1	ISr5-Ra CI 14159	*Sr 5*
2	*T. monococcum/8*LMPG-6 DK13*	*Sr 21*
3	Vernstein PI 442914	*Sr 9e*
4	ISr7b-Ra CI 14165	*Sr 7b*
5	Lee/6*LMPG-6 DK37	*Sr 11*
6	ISr6-Ra CI 14163	*Sr 6*
7	CI 14167/9 *LMPG-6 DK04	*Sr 8a*
8	Chinese Spring*7/ Marquis 2B	*Sr 9g*
9	W2691SrTt-1 CI 17385	*Sr 36*
10	Prelude*4/2/Marquis*6/Kenya 117A	*Sr 9b*
11	Selection from Webster F3:F4 #6	*Sr 30*
12	Prelude/8*Marquis*2/2/Esp 518/9	*Sr 17*
13	ISr9a-Ra CI 14169	*Sr 9a*
14	ISr9d-Ra CI 14177	*Sr 9d*
15	W2691Sr10 CI 17388	*Sr 10*
16	CnsSrTmp	*Sr Tmp*
17	LcSr24Ag	*Sr 24*
18	Sr 31(Benno)/6*LMPG-6 DK42	*Sr 31*
19	Trident Sr38	*Sr 38*
20	McNair 701	*Sr Mcn*

Table 2
Puccinia graminis f. sp. *tritici* (*Pgt*) code for the 20 *Pgt* differential hosts for *Pgt* in ordered subsets of four (adapted from Roelfs and Martens (1988) and Jin et al (2008))

Subset* and *Pgt* code	Infection types produced on host lines with *Sr* resistance genes			
1st 4 genotypes	*Sr5*	*Sr21*	*Sr9e*	*Sr7b*
2nd 4 genotypes	*Sr11*	*Sr6*	*Sr8a*	*Sr9g*
3rd 4 genotypes	*Sr36*	*Sr9b*	*Sr30*	*Sr17*
4th 4 genotypes	*Sr9a*	*Sr9d*	*Sr10*	*SrTmp*
5th 4 genotypes	*Sr24*	*Sr31*	*Sr38*	*SrMcn*
B	Resistant	Resistant	Resistant	Resistant
C	Resistant	Resistant	Resistant	Susceptible
D	Resistant	Resistant	Susceptible	Resistant
F	Resistant	Resistant	Susceptible	Susceptible
G	Resistant	Susceptible	Resistant	Resistant
H	Resistant	Susceptible	Resistant	Susceptible
J	Resistant	Susceptible	Susceptible	Resistant
K	Resistant	Susceptible	Susceptible	Susceptible
L	Susceptible	Resistant	Resistant	Resistant
M	Susceptible	Resistant	Resistant	Susceptible
N	Susceptible	Resistant	Susceptible	Resistant
P	Susceptible	Resistant	Susceptible	Susceptible
Q	Susceptible	Susceptible	Resistant	Resistant
R	Susceptible	Susceptible	Resistant	Susceptible
S	Susceptible	Susceptible	Susceptible	Resistant
T	Susceptible	Susceptible	Susceptible	Susceptible

**Pgt* code consists of the designation for subset 1 followed by subset 2, etc. Scale values 0, ; ,1, 2 were considered as resistant (low) and scale values 3 and 4 were considered as susceptible (high). For example, race TTTTF is virulent on *Sr5*, *Sr21*, *Sr9e*, *Sr7b*, *Sr11*, *Sr6*, *Sr8a*, *Sr9g*, *Sr9b*, *Sr30*, *Sr17*, *Sr9a*, *Sr9d*, *Sr10*, *Sr36*, *SrTmp*, *Sr38* and *SrMcn* resistance genes and avirulent on *Sr24* and *Sr31* resistance genes. Low (resistant) and high (susceptible) infection types indicate an incompatible and a compatible host-pathogen interaction, respectively

3. Results and Discussion

In 2016, stem rust was found in 25 fields (Akci and Karakaya 2017). In 2017, stem rust was present in 7 fields. In 2016 and 2017, 42 single uredospore pustules were obtained from wheat fields in Saraydüzü, Durağan, Gerze, and Boyabat districts of Sinop province and stem rust races were determined using North American differential cultivars. The most common race in Sinop province was TTTTF followed by TTKTF, RTTTF, RTKTF, and TTKTC. In 2016, from Saraydüzü district stem rust races TTTTF (3 isolates), TTKTF (2 isolates) and TTKTC (1 isolate), from Durağan district RTKTF (2 isolates), TTTTF (1 isolate) and RTTTF (1 isolate), from Gerze district TTTTF (2 isolates), from Boyabat district TTTTF (13 isolates), TTKTF (5 isolates) and RTTTF (3 isolates) were found. In 2017, from Boyabat district race TTTTF (9 isolates) was determined (Table 3, Figure 2).

Table 3
Wheat stem rust races determined in Sinop province of Turkey during 2016 and 2017

Location	Stem rust race	2016	2017
Saraydüzü	T T T T F	3 isolates	
	T T K T F	2 isolates	
	T T K T C	1 isolate	
Durağan	R T K T F	2 isolates	
	T T T T F	1 isolate	
	R T T T F	1 isolate	
Gerze	T T T T F	2 isolates	
Boyabat	T T T T F	13 isolates	9 isolates
	T T K T F	5 isolates	
	R T T T F	3 isolates	

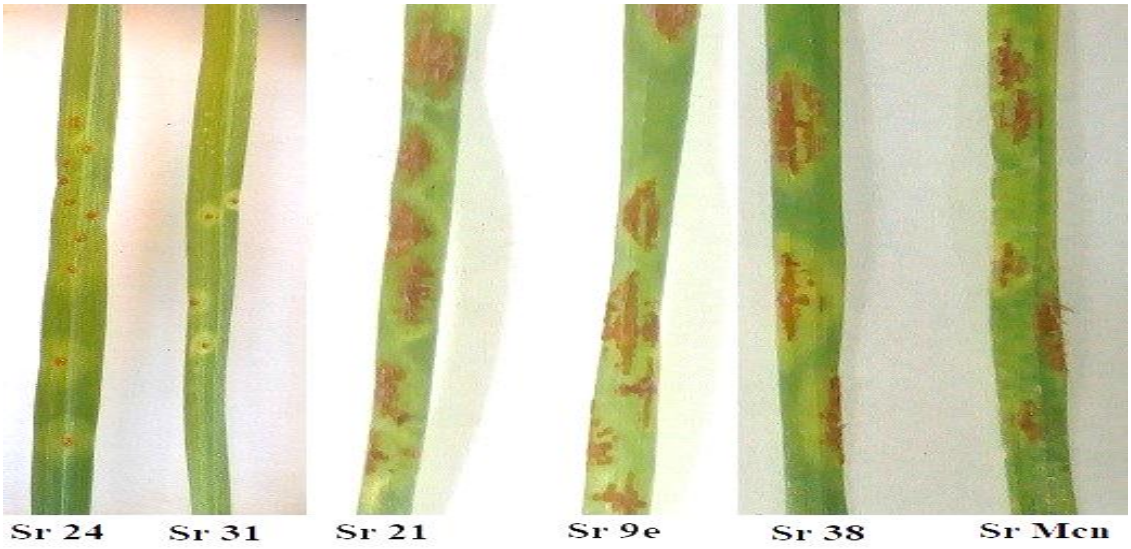

Figure 2
Reactions of stem rust differential genotypes possessing *Sr24, Sr31, Sr21, Sr9e, Sr38,* and *SrMcn* resistance genes to race TTTTF

The percentage of the race TTTTF was 67. The percentages of TTKTF, RTTTF, RTKTF, and TTKTC were 17, 9, 5, and 2, respectively. Differential set genotypes possessing the resistance genes *Sr24* and *Sr31* were resistant to all isolates. Genotypes possessing the resistance genes *Sr9e*, *Sr38*, and *Sr36* showed different reactions to isolates. Genotypes possessing the resistance genes *Sr5*, *Sr6*, *Sr7b*, *Sr8a*, *Sr9g*, *Sr9b*, *Sr9a*, *Sr9d*, *Sr10*, *Sr11*, *Sr17*, *Sr21*, *Sr30*, *SrTmp* and *SrMcn* exhibited susceptible reactions to all isolates. A total of five stem rust races were determined in Sinop wheat fields. Race TTTTF was the most common race followed by races TTKTF, RTTTF, RTKTF, TTKTC. Akci and Karakaya (2021) determined the stem rust races originating from *Berberis* spp. and wheat plants in the neighboring province of Kastamonu, Turkey. In their study, from *Berberis* spp., stem rust races TTTTF, RTTTF, RTTTC, TTTTC, and TTKTF were reported. From wheat plants, stem rust races TTTTF, TTKTF, TTTTC, TTKTC, RTTTF, and RTTTC were reported. From both *Berberis* spp. and wheat plants, the race TTTTF was the most commonly encountered race. Stem rust races TTTTF, TTKTF, and RTTTF were also found in our present study. Mert et al. (2012) determined the stem rust races occurring in Turkey. A total of 21 stem rust races were found. Stem rust race TKTTC was found as the most common race. In their study, race RTKTF was reported from Kayseri, Yozgat, Sivas, and Erzincan provinces, and race RTTTF was reported from Kastamonu province of Turkey. The researchers identified 6 stem rust races in 2007 and 18 stem rust races in 2008.

Lemma et al. (2015) and Abera et al. (2018) reported the race TTTTF from Ethiopia. This race was also reported from Sicily and mainland Italy (Patpour

et al. 2018), Iran (Afshari et al. 2015; Roohparvar and Omrani 2018), and Kenya (Wanyera et al. 2018).

Stem rust races TTTTF, TTKTF, RTTTF, RTKTF, and TTKTC were found in our current study. Race TTTTF was the most common race. This race is virulent on all resistance genes with the exception of *Sr24* and *Sr31*. Especially this race should be monitored in the region and wheat cultivars resistant to race TTTTF should be developed.

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Research Article

Efficacy of Neem Leaf (*Azadirachta indica*), Bitter Leaf (*Vernonia amygdalina*) and Pawpaw Leaf (*Carica papaya*) Powder in the Control of *Callosobruchus maculatus* in Stored Cowpea

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ABSTRACT

A laboratory experiment was carried out to investigate the insecticidal properties *of Azadirachta indica* (Neem), *Vernonia amygdalina* (Bitter Leaf) and *Carica papaya* (Pawpaw) leaf powders against *Callosobruchus maculatus*in stored cowpea. The experiment was carried out using a completely randomized design. The treatments were applied as single and mixed applications at the following rates-3g, 6g and 9g. Each treatment were replicated 4 times making a total of 92 experimental units. Each treatment was applied to 100g. Data collected include adult mortality, larval and pupa emergence, grain damage, weight loss and F_1 progeny emergence. The data collected were subjected to analysis of variance (AVONA) at 5% probability level. The results indicated that, there were significantly differences between plant products treatments and the synthetic treatment over the control throughout the period of the experiment (1 to 8 weeks). However, the various treatment of the plant products used for the experiment proved to be effective in controlling *C. maculatus* of stored cowpea. However, Cypermethrin dust at 0.6g/100g of cowpea was the most effective in controlling grain damage while pawpaw leaf powder and Bitter Leaf powder proved to be most effective in controlling grain damage among the natural botanicals, adult mortality and number of eggs laid by *C. maculatus* on the stored grains. The result clearly indicated the potential values of using plants extracts as complimentary to chemicals pesticides in controlling *C. maculatus* on cowpea grains.

1. Introduction

Cowpea (Vignaunguiculata L. Walp) is one of the most ancient crops known to humankind. Its origin and subsequent domestication is associated with pearl millet and sorghum in West Africa Musa et al. (2009). The cowpea was first domesticated in Africa between 1700 to 1500 before the Current Era (Singh, 2014) and all cultivated varieties grown in the world today originated from East and West Africa Xiong et al. (2016). Cowpea seed pods and leaves are consumed in fresh form as green vegetables in some African Countries (Ghaly and Alkoaik, 2010), while the rest of the cowpea plant after the pods have been harvested serves as a nutritious fodder for livestock (Abebe et al., 2005) and also a source of cash income (Dugje et al., 2009). The nutritive value of cowpea makes it an extremely important protein source to vegetarian and people who cannot afford animal protein (Adeyemi et al., 2012). For human consumption, the cowpea is mainly grown for grain (dry and fresh) and sometimes for fresh pods in West Africa, India, and South America, while also grown for leaves in East Africa. It is an under used legume crop with a high potential for food and nutritional security in South Africa and produced for grain, immature green pods and fresh leaves due to its nutritional composition (Gerrano et al., 2015a; 2017a). The cowpea can be used to produce a large range of dishes and snacks (Uzogara and Ofuya, 1992; Asif et al., 2013). The consumption of the cowpea as a dietary staple in West Africa over millennia has produced extensive and varied culinary practices and many individual foods and dishes. Cowpea consumption in West Africa has led to a culinary practice that requires seed coat removal (also called decortication or dehulling). For example, the popular West African cowpea-based foods, such as *Akara* and *Moin-moin*, are decorticated (Phillips, 2012). The production and storage of cowpea have faced so many constraints, throughout West Africa

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such as diseases and the limited use of fertilizers and irrigation inputs (Brisibe et al., 2011) but major constraints is the insect pest known as *Callosobruchus maculatus* (Musa et al 2009), which infests it before and after harvest consequently leading to loss of economic value (Baidoo et al., 2010). Infestations on stored grains may reach 50% within 3-4 months of storage (Oparekeand Dike, 2005).

2. Materials and Methods

This study was conducted in the Department of Crop Protection laboratory and Ir. Leo Vande Mierop Biotechnology laboratory of the University of Ilorin, Ilorin, Nigeria.

2.1. Source of cowpea seeds and plant materials

The cowpea seeds used for the experiment were purchased from a local market (Oja-Oba) Ilorin, and the natural plant materials, *Azadirachta indica* (neem leaf), *Vernonia amygdalina (Bitter leaf)* and *Carica papaya* (pawpaw leaf) were sourced from the University of Ilorin premises.

2.2. Insect Culture

C. maculatus used for the experiment was obtained from Nigerian Stored Product Research Institute (NSPRI) Ilorin and this was used to establish a culture in the laboratory of the Department of Crop Protection. Freshly emerged dults of *C. maculatus* were used for the experiment

2.3. Preparation of the Botanicals

Fresh leaves of Neem, Bitter leaf and Pawpaw were collected and air dried for 7 days. The dried leaves were ground with mortar and pestle and sieved using 3mm sieve to obtain a fine powder. The leaf powders were separately packed into air tight containers until required for use.

2.4. Experimental Procedure

The purchased cowpea seeds were disinfected by storing in a deep freezer for 72 hours at 4^{o}C to kill any hidden *C. maculatus* in the seeds. 100g of cowpea seeds were weighed and put into transparent plastic containers.

The plant powders were weighed and applied at the following rates; 3g, 6g and 9g respectively. The containers were shaken to ensure uniform covering of the seeds with the treatments. 6 unsexed freshly emerged adult *C. maculatus* were introduced into each container and the container covered with muslin cloth held in place with the aid of a rubber band.

The experiment was carried out using a completely randomized design. There were 23 treatments and each treatment was replicated 4 times giving a total of 92 experimental units. In the mixed treatments, the powders were mixed in equal ratios. Cypermethrin was used as the positive controls at recommended dose (0.6g/100g of cowpea seeds).

2.5 Data Collection

Data were collected on the following parameters: adult mortality of the *C. maculatus* were carried out at 24hours, 3day, day 5, day 7 and day 9 after the treatment and then recorded (A beetle was assumed dead if there is no movement of its legs and antenna and also if it did not respond to a pin probe at its abdomen), larval emergence was taken at 15^{th} day and 17^{th} day post treatment, pupa emergence was taken at 17^{th} day and 19^{th} day post treatment. The larvae and pupae are normally only found in cells bored within the seeds of pulses. For descriptions and a key including *C. maculatus* larvae. The weight loss of the seeds was taken after the whole experiment

2.6. Data Analysis

The data collected were subjected to analysis of variance (ANOVA) and treatment means that were significantly different were separated using the New Duncan Multiple Range Test at P=0.05 level of probability.

Table 1
Effect of the treatments on percentage (%) adult mortality of *Callosobruchus maculatus*

Treatment	Rate(g)	Days after treatment(DAT)				
		1	3	5	7	9
BL	3	8.34±9.62abc	25±9.62bcde	20.83±15.96ab	21.08±15.52ab	4.17±8.34bc
BL	6	12.5±15.96abc	33.33±0abcd	16.67±13.61ab	12.5±8.34ab	16.67±13.61abc
BL	9	25±9.62a	20.83±15.96cde	12.5±8.34ab	20.83±15.96ab	12.5±8.34abc
NL	3	12.5±15.96abc	29.17±8.33abcde	16.67±23.57ab	25±16.67ab	12.5±15.96abc
NL	6	12.5±15.96abc	29.17±15.96 abcde	20.84±8.33ab	16.67±13.61ab	20.84±8.33ab
NL	9	16.67±0abc	20.84±8.33cde	12.5±15.96ab	25±21.52ab	16.67±13.61abc
PL	3	16.67±0abc	20.83±15.96cde	33.33±13.61a	16.67±13.61ab	12.5±8.34abc
PL	6	16.67±13.61abc	37.5±15.96abcd	29.17±28.46a	8.34±9.62b	4.17±8.34bc
PL	9	20.83±15.96ab	41.67±9.62abcd	16.67±0ab	12.5±15.96ab	4.17±8.34bc
BLNL	3	4.17±8.34bc	29.17±25abcde	12.5±15.96ab	33.34±23.57a	12.5±15.96abc
BLNL	6	12.5±8.34abc	50±0a	16.67±0ab	12.5±8.34ab	4.17±8.34bc
BLNL	9	4.17±8.34bc	33.34±19.24abcd	25±9.62ab	16.67±0ab	8.34±9.62abc
NLPL	3	4.17±8.34bc	29.17±15.96abcde	16.67±13.61ab	20.83±15.96ab	25±9.62a
NLPL	6	12.5±15.96abc	16.67±0de	33.33±23.57a	25±9.62ab	12.5±15.96abc
NLPL	9	4.17±8.34bc	29.17±15.96abcde	16.67±0ab	25±9.62ab	8.34±9.62abc
BLPL	3	8.34±9.62abc	33.33±0abcd	20.83±15.96ab	20.84±8.33ab	4.17±8.34bc
BLPL	6	8.34±9.62abc	45.83±8.34ab	29.17±8.33a	8.34±9.62b	0±0c
BLPL	9	0±0c	37.5±8.33abcd	29.17±8.33a	25±9.62ab	8.34±9.62abc
BLNLPL	3	16.67±0abc	29.17±8.33abcde	20.84±8.33ab	16.67±0ab	12.5±8.34abc
BLNLPL	6	12.5±8.34abc	29.17±15.96abcde	16.67±13.61ab	20.84±8.33ab	20.83±15.96ab
BLNLPL	9	20.84±8.33ab	25±16.67bcde	12.5±8.34ab	25±9.62ab	16.67±13.61abc
Cypermethrin		16.67±13.61abc	33.34±19.24abcd	33.33±13.61a	16.67±0ab	12.5±15.96abc
Control		8.34±9.62abc	8.34±9.62e	4.17±8.34b	4.17±8.34b	8.34±9.62b
S.E.M		5.31	6.64	6.95	6.23	5.63

Values with the same letter(s) in the same column are not significantly different 5% level of significance using Duncan's multiple range test

KEY: DAT = Days after Treatment, SEM=Standard error of mean, BL= Bitter leaf, NL=Neem leaf, PL=Pawpaw Leaf

Table 2
Effects of treatments on Larva and Pupa emergence

Treatment	Rate (g)	Days after treatment (DAT)			
		Larva emergence		Pupa emergence	
		15	17	17	19
BL	3	0±0c	0±0b	0±0b	0.75±0.5abc
BL	6	0±0c	0±0b	0.25±0.5b	1±1.15abc
BL	9	0±0c	0±0b	0.5±0.58ab	0.75±0.96abc
NL	3	0±0c	0±0b	0±0b	0.25±0.5c
NL	6	0±0abc	0±0b	0.5±0.58ab	0±0c
NL	9	0±0abc	0±0b	0.5±0.58ab	1±0.82abc
PL	3	0±0abc	0±0b	0±0b	1±0.82abc
PL	6	0±0abc	0.5±0.58ab	0±0b	0.75±0.5abc
PL	9	0.25±0.5ab	0.75±0.5a	0±0b	0.75±0.5abc
BLNL	3	0±0c	0±0b	0±0b	0±0c

Table 2
Effects of treatments on Larva and Pupa emergence

BLNL	6	0±0c	0±0b	0±0b	0.5±1bc
BLNL	9	0±0c	0±0b	0±0b	0.75±0.96abc
NLPL	3	0±0abc	0.25±0.5ab	0.25±0.5b	0.75±0.96abc
NLPL	6	0±0abc	0.5±0.58ab	0±0b	1.75±2.22abc
NLPL	9	0±0abc	0±0b	0±0b	1±1.15abc
BLPL	3	0±0c	0±0b	0±0b	1±0abc
BLPL	6	0±0c	0±0b	0±0b	0.5±0.58bc
BLPL	9	0±0c	0±0b	0.5±0.58ab	1±0.82abc
BLNLPL	3	0±0c	0±0b	0±0b	0.25±0.5c
BLNLPL	6	0±0c	0.25±0.5ab	0.25±0.5b	0.25±0.5c
BLNLPL	9	0±0c	0.25±0.5ab	0.5±0.58ab	0.5±1bc
Cypermethrin		0±0abc	0±0b	0±0b	2±0a
Control		0.25±0.5a	0.75±0.96a	1±0.82a	0.5±0.58bc
S.E.M		0.0737	0.1676	0.1831	0.4235

Values with the same letter(s) in the same column are not significantly different 5% level of significance using Duncan's multiple range test

KEY: DAT = Days after Treatment, SEM=Standard error of mean, BL= Bitter leaf, NL=Neem leaf, PL=Pawpaw Leaf

Table 3a
Effects of treatments on F_1 progeny emergence of *C. maculatus*

Treatment	Rate(g)	Days after treatment (DAT)				
		28	30	32	34	36
BL	3	0.75±0.5abc	1±1.15ac	1±1.15ab	2.5±1.91a	0.5±1b
BL	6	1.25±0.5abc	0.25±0.5c	1±2ab	2.5±3.7a	0.5±0.58b
BL	9	2±1.83a	0.25±0.5c	0.25±0.5b	1.75±2.06a	0±0b
NL	3	0.75±0.96abc	0.5±1c	1.25±2.5ab	5.25±10.5a	1.5±3b
NL	6	0.5±0.58abc	0±0c	0.25±0.5b	0±0a	0±0b
NL	9	0.25±0.5bc	2.5±1ab	1.25±0.5ab	4.25±3.1a	0.25±0.5b
PL	3	0.5±0.58abc	0.5±0.58c	0.75±0.96ab	2±2.71a	0.75±0.96b
PL	6	0.75±0.5abc	0.75±0.5c	3.25±5.19a	10.75±21.5a	3.25±5.25b
PL	9	1.5±1.29abc	1±0.82abc	0.5±0.58b	1.75±1.26a	0±0b
BLNL	3	1.5±1.29abc	1±2abc	0.75±0.96ab	2±3.37a	1.25±1.89b
BLNL	6	0.5±0.58abc	0±0c	0.5±0.58b	0±0a	0.25±0.5b
BLNL	9	1.75±1.5ab	0.25±0.5c	0.25±0.5b	1.25±1.26a	0.75±0.96b
NLPL	3	0.5±0.58abc	0.5±1c	0±0b	2.75±2.87a	1.5±1.73b
NLPL	6	1.5±1.73abc	1±2abc	1±2ab	5.25±10.5a	2.75±3.77b
NLPL	9	1.75±1.5ab	0.5±0.58c	1±0ab	0.5±0.58a	0±0b
BLPL	3	1.5±1abc	0±0c	0.25±0.5b	0±0a	0.75±1.5b
BLPL	6	0.5±0.58abc	0.5±1c	1.5±1.73ab	2.25±4.5a	0±0b
BLPL	9	1±0abc	1±1.15abc	0±0b	2.5±2.89a	0.75±1.5b
BLNLPL	3	0.5±0.58abc	0.25±0.5c	1.25±1.26ab	1±0a	1.25±2.5b
BLNLPL	6	1.75±0.5ab	0±0c	0±0b	0.75±0.96a	0.25±0.5b
BLNLPL	9	0±0c	2.5±2.38a	0.5±0.58b	5±4.55a	1.25±2.5b
Cypermethrin		0±0c	0.75±0.5c	2.5±1ab	7.25±7.23a	0.75±0.5b
Control		0.75±0.96abc	1±0.82abc	2±1.63ab	8±6.63a	7.25±2.99a
S.E.M		0.4692	0.509	0.772	3.112	0.975

Values with the same letter(s) in the same column are not significantly different 5% level of significance using Duncan's multiple range test

KEY: DAT = Days after Treatment, SEM=Standard error of mean, BL= Bitter leaf, NL=Neem leaf, PL=Pawpaw Leaf

Table 3b
Effects of treatments on F_1 progeny emergence of *C. maculatus* (continuation)

Treatment	Rate(g)	Days after treatment (DAT)				
		38	40	42	44	46
BL	3	0.25±0.5bc	0.25±0.5b	0±0a	0±0b	0±0b
BL	6	0.5±0.58bc	1.25±2.5ab	0±0a	0±0b	0±0b
BL	9	0±0c	0±0b	0±0a	0±0b	0±0b
NL	3	1±2bc	0.75±1.5b	0.25±0.5a	0.25±0.5b	0±0b
NL	6	0±0bc	0±0b	0±0a	0±0b	0±0b
NL	9	0.25±0.5bc	0.5±0.58b	0±0a	0±0b	0±0b
PL	3	0.75±0.96bc	0.5±0.58b	0±0a	1.5±3b	0±0b
PL	6	2.25±3.86b	1.25±2.5ab	0.75±1.5a	0.5±1b	0±0b
PL	9	0±0bc	0.25±0.5b	0±0a	0±0b	0±0b
BLNL	3	1±0.82bc	0±0b	0±0a	0±0b	0±0b
BLNL	6	0.25±0.5bc	0.25±0.5b	0±0a	0±0b	0±0b
BLNL	9	0±0c	0±0b	0±0a	0±0b	0±0b
NLPL	3	1.5±1bc	0±0b	0±0a	0±0b	0±0b
NLPL	6	1.5±3bc	0.5±1b	1.25±2.5a	1.25±2.5b	0.5±1b
NLPL	9	0±0bc	0±0b	0±0a	0±0b	0±0b
BLPL	3	0.25±0.5bc	0±0b	0±0a	0±0b	0±0b
BLPL	6	0.25±0.5bc	0±0b	0±0a	0±0b	0±0b
BLPL	9	0.25±0.5bc	0±0b	0±0a	0±0b	0±0b
BLNLPL	3	0.5±1bc	0.5±1b	0±0a	0±0b	0±0b
BLNLPL	6	0±0bc	0±0b	0±0a	0±0b	0±0b
BLNLPL	9	0.75±1.5bc	1.25±2.5ab	1.25±2.5a	1.25±2.5b	2.75±5.5a
Cypermethrin		0.5±1bc	3±3.46a	0±0a	0±0b	0±0b
Control		6±1.63a	2.25±2.87ab	1.25±1.26a	5.75±4.65a	0±0b
S.E.M		0.653	0.697	0.4246	0.694	0.583

Values with the same letter(s) in the same column are not significantly different 5% level of significance using Duncan's multiple range test

KEY: DAT = Days after Treatment, SEM=Standard error of mean, BL= Bitter leaf, NL=Neem leaf, PL=Pawpaw Leaf

Table 4
Effects of treatments on mean seed weight loss

Treatment	Rate	Weight Loss (g)
BL	3	0.48±0.43c
BL	6	2.68±0.63ab
BL	9	1.7±0.54abc
NL	3	2.33±2.24ab
NL	6	1.93±0.48abc
NL	9	2.43±0.5ab
PL	3	1.98±1.09abc
PL	6	2±0.66abc
PL	9	2.45±1.57ab
BLNL	3	1.48±0.43abc
BLNL	6	2.75±0.64ab
BLNL	9	1.88±0.87abc
NLPL	3	2.05±1.52abc
NLPL	6	1.03±0.62abc
NLPL	9	2.73±0.79ab
BLPL	3	1.8±1.37abc
BLPL	6	1.95±0.57abc
BLPL	9	2.7±0.37ab
BLNLPL	3	1.83±0.88abc
BLNLPL	6	1.55±1.99abc
BLNLPL	9	1.55±0.26abc
Cypermethrin		1.48±1.13abc
Control		2.93±0.38a
S.E.M		0.508

Values with the same letter(s) in the same column are not significantly different 5% level of significance using Duncan's multiple range test

KEY: DAT = Days after Treatment, SEM=Standard error of mean, BL= Bitter leaf, NL=Neem leaf, PL=Pawpaw Leaf

3. Results and Discussion

The results of the study revealed that the various treatments used in the experiment had significant effects, mortality increased with increase in level of treatment. The plants leaf powder caused adult mortality of *C. maculatus* at the high and low rates when compared to the control, which was indicative of bioactive characteristics of the plant part. This is in agreement with the report of (Malungu et al., 2007) that the use of plant powders has been reported to produce higher death of insects because of physical barrier with the tendency of blocking the spiracles of the insects, thus impairing respiration leading to death of the insects. BLNL have the highest mortality followed by NLPL. Please cross check to confirm this claim by me. So with the mortality known that will affect the other experiment such as pupa emergence and weight loss.

The insecticidal activity of powders of *Vernonia amygdalina, Carica papaya* and *Azadirachta indica* on larva and pupa emergence of adult *Callosobruchus maculatus at* different Days After Treatment (DAT) shows that there was a significant difference between the treatments and the control for larva and pupa emergence (Table 2 and 3).This could be attributed to the adult mortality already observed (Table 1) and the inhibition of oviposition as well as the remarkably high reduction in survival to adulthood of mature stages of *C. maculatus* compared to the control. This result corroborates that of (Okonkwo and Ewete 1999) in pepper fruit, (Babatunde and Musa, 2020) in *Eucalyptus globulus* leaf extract on cowpea beetle

The plants leaf powder was also observed to have effects in reducing the damage on cowpea seeds by *C. maculatus* (Table 4). Damage on cowpea seeds may have been reduced as a result of the extracts acting as a deterrent to *C. maculatus*, keeping them from infesting and damaging the seeds.

The study reveals that *Vernonia amygdalina, Carica papaya* and *Azadirachta indica* leaf powder could be very effective for use as bio-pesticides for protecting cowpea seeds from *C. maculatus* infestation and damage. It has been reported by the pest management specialists that botanicals are not known to leave any residue in any crop they are used to protect and the protective ability of essential oils could be attributed to interspecific insect responses to oil constituents (Enan, 2001).

The use of natural toxicants from plants as insecticides had been inexistent since the ancient times (Adebayo and Gbolade 1994 and Ismam, 2008, Babatunde et al 2020). The natural insecticides which require low cost to prepare, are readily available, environmentally and ecologically friendly are best suited for use in the storage of produce. (Babatund and Musa, 2020).

4. Conclusion

Plant extracts can be another source of pesticides against stored grain pests. It is recommended that the active molecule in *Vernonia amygdalina, Carica papaya* and *Azadirachta indica* responsible for their activities be isolated for the development of bio pesticides to protect grains in storage. For more effectiveness of plant extracts, a large amount proportional to the quantity of grains is required for post-harvest control of *C. maculatus* in stored cowpea for planting. This study has revealed that *Vernonia amygdalina, Carica papaya* and *Azadirachta indica* extract can be used to protect cowpea grains under small scale storage.

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Prediction of Draft Force and Disturbed Soil Area of a Chisel Tine in Soil Bin Conditions Using Draft Force and Its Comparison with Regression Model

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ABSTRACT

One of our most valuable natural resources is soil. Sustainable agricultural production is achieved with proper soil management. Tillage is considered to be one of the largest operations, as the most energy need in agricultural production occurs in tillage.

The main purpose of this study is to investigate the effects of chisel tine on draft force and disturbed soil area and estimate them using artificial neural networks (ANN) and multiple linear regression equations (MLR). The experiments were carried out in a closed soil bin filled with clay loam soil at an average moisture content of 13.2% (on dry basis). The draft force and disturbed soil area were evaluated as affected by the share width at two levels (60 and 120 mm), forward speed at four levels (0.7, 1, 1.25 and 1.5 ms^{-1}) and working depth at four levels (160, 200, 240 and 280 mm) at three replications. The draft force varied from 0.5 to 1.42 kN, depending on the controlled variables, while the disturbed soil area varied from 260 to 865 cm^2. Test results show that share width, forward speed and working depth were significant on the draft force and disturbed soil area. Input variables of the ANN models were considered share width, forward speed and working depth. In prediction of required draft force and disturbed soil area respectively, on account of statistical performance criteria, the best ANN model with coefficient of determination of 0.999 and 0.998, root mean square error of 0.010 and 0.016 and mean relative percentage error of 0.960 and 1.673 was better performed than the MLR model.

1. Introduction

Artificial intelligence systems are widely accepted as a technology providing an alternative method to solve complex and ill-defined problems. Artificial neural network (ANN) is a technique with a flexible mathematical structure, which is capable of identifying a complex nonlinear relationship between the input and output data (Çarman et. al., 2016)

The tillage system chosen to produce an agricultural product has a significant impact on soil erosion, water quality and profitability. Of course, profitability is determined from product yield and costs. However, it is useful to include evaluations of not only short term yield but also long term effects on soil loss and productivity. Choosing a tillage system is therefore an important management decision (Fawcett and Towery, 2005; Anderson, 2009; Simmons and Nafziger, 2010).

Conservation tillage is generally defined as any crop production system that provides at least 30% (30-60 cm high) on upright stubble after planting and at least 50-60% residual cover on prostrate stubble after planting to reduce soil erosion from water. At least 110 gm^{-2} of flat, small grain residue on the soil surface during critical erosion period to reduce soil erosion due to wind (Fawcett and Towery, 2005; Anderson, 2009; Simmons and Nafziger, 2010; Scott et al., 2010).

The chisel plow is considered the primary soil tillage tool as it is mainly used for initial tillage operations. It is widely used by Middle Anatolia farmers to reduce soil strength and to cover plant materials in recent years.

The most important part of chisel plow is the leg and they are manufactured in different sizes and shapes. Winged chisel plows, which have become widespread in recent years, have become more prominent than conventional chisel plows due to their positive effects on the

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soil (Godwin and O'Dogherty, 2007; Kees, 2008; Salar et al., 2013). Nowadays, wings at certain horizontal angles have been added to both sides of the winged chart leg. These wings cut the soil horizontally from below. One of the major drawbacks of deep work chisel plows is their high drawbar force requirements. Therefore, they cause a significant energy consumption. However, specific energy consumption per unit deformation area decreases due to the large deformation area they cause. The draft force of the machine varies depending on the soil properties, the working speed of the tool and the geometric structure of the tool (Boydas, 2004; Zadeh, 2006; Armin, 2014; Neisy, 2014).

A research has been reported by Abbaspour-Gilandeh et al., (2008) in an attempt to develop the prediction model of draft force and required energy for tillage operation. In this study, artificial neural network model was used. Input parameters such as working speed, tillage depth and different soil parameters (cone index, moisture content, clay and sand percentage) were used. In regard to the high accurate prediction (98.8%) and high accurate simulation (97.6%) the application of Lavenberg-Marquardt algorithm with 2 middle layers including 12 neurons on its first layer and 10 neurons on its second layer was distinguished as the most appropriate algorithm in comparison with other ones. Artificial neural networks were used to predict the draft force of a rigid tine chisel cultivator by Abbaspour-Gilandeh et al. (2020). They found that the average simulation accuracy and correlation coefficient for estimating the draft force of a chisel cultivator were 99.83% and 0.9445, respectively. The linear regression model had a much lower accuracy and correlation coefficient for predicting the draft force compared to artificial neural networks.

Karmakar (2005) reported that artificial neural networks have been used as possible approach to solve problems in the area of soil tool interaction. It is noteworthy that there is a growing interest in modelling draft and energy requirements of tillage implements using ANN due to complexity and unavailable analytical models for all tillage implements. Al-Janobi et al. (2001) used a Multilayer Perceptron with error backpropagation learning algorithm to construct neural network model to predict the specific draft (kN m^{-1}) of four different tillage implements from the field data. The proposed neural network model, by testing, indicated that there is a small variation of measured and predicted data with linear correlation coefficient equals to 0.987 and mean squared error between experimental and predicted specific draft equals to 0.1445.

Rahman et al. (2011) developed an artificial neural network model to estimate the energy needs of a soil cultivation tool from laboratory data. The artificial neural network model was trained and tested with soil moisture content, plowing depths and forward operating speeds as input parameters. The measured energy requirement for a soil tillage tool in silty clay loam was used as the output parameter. Their results showed that the measured and predicted variation in energy requirement was small.

When all these studies were evaluated, parametric studies were not conducted to show the tendency and effect of individual variables on the chisel tine's disturbed soil area and draft force in the soil bin. Occasionally, farm mechanization manager wants to know the magnitude of disturbed soil area and draft force of a tillage implement at levels of separate forward speed and working depth. In these cases, numerous experiments are needed to get draft and deformation area data and the cost is very high. So, simulation technique to generate draft and soil deformation area data using artificial neural networks is useful in this case, because the results obtained depend on data performing in the soil bin.

In general, the objectives of this research can be stated as follows:

1. To evaluate the effect of tine width, forward speed and working depth on soil disturbance area and draft force requirements of chisel tine.

2. Investigating the ability of artificial neural network and multiple linear regression approaches for predicting the draft force and disturbed soil area by chisel tines.

3. Comparison of the accuracy with statistical parameters and soil bin data of draft force and disturbed soil area predictions using artificial neural network and multiple linear regression model

2. Materials and Methods

This study was conducted in a soil bin in Selcuk University Faculty of Agriculture, Department of Agricultural Machinery and Technologies Engineering. The soil bin used in this study is 20 m long, 2.25 m wide and 1 m deep. Soil bin facilities built for testing agricultural equipment were described in detail by Marakoğlu et al. (2013). Test machine moves on rails by means of chain-gear driven with electric engine. The chisel tine has been connected as without stage adjustable on vertical planes to front of test machine. All units of the soil bin are manufactured to be demountable. This situation provides convenience for the repair of any part of the system in case of deformation or failure.

The chisel tine used in the study is fixed and the chisel share have been changed. The construction details of chisel tine are shown in Figure 1. The Chisel share has a rake angle of 34º, a concavity depth of 21mm and a concavity radius of 546mm. The test chisel tine variables included chisel share widths (W) 60 and 120 mm, working depths (D) 160, 200, 240 and 280 mm, and forward speeds (V) 0.7, 1.0, 1.25 and 1.5 m s−1. Chisel tine were tested in a soil bin using fully randomized factorial (2 × 4 x 4) experiments (triple replicates).

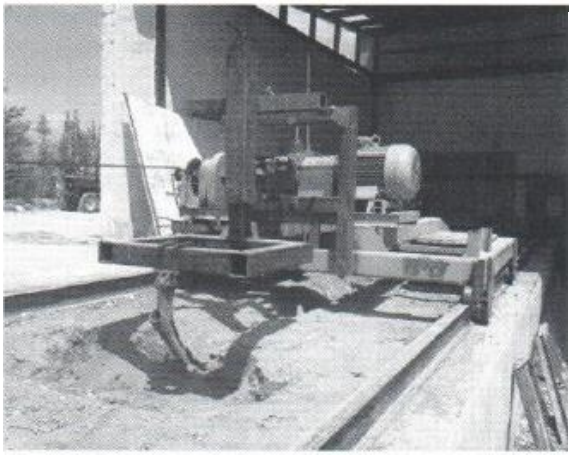
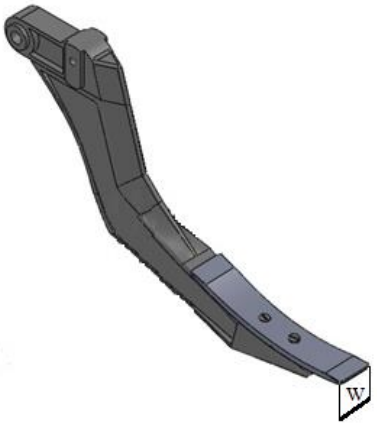



Figure 1
The soil bin and chisel tine used in trials.

The soil bin was filled with a 0.5 m thick layer of clay loam. The soil has a texture of clay-loam (sand: 38%, loam: 27%, clay: 35%) with a moisture content of 13.5 %, a shear stress of 1.50 Ncm^{-2} a bulk density of 1.41 Mgm^{-3} and a penetration resistance of 1650 kPa. The soil surface was leveled with smoothing shovel that had been connected to rear of test machine before each trial, and then the soil compacted by heavy flat roller loaded of 0.9 daN to unit area (cm^2).

A speed measuring system has been developed to measure the forward speed. This system consists of a stopwatch and two speed sensors. The distance between the two sensors is 15m. The forward speed has been determined by considering the distance and time between the two sensors.

To determine the draft requirement of the chisel tine, a load cell was used to measure the draft force during the operation of a chain drive for the front and rear motions of the testing machine. In measurements, a horizontal load cell connecting the analog amplifier and digital data logger was used. In force measurements, 5 values were read per second and these results were averaged by data logger. Obtained force data was recorded as gross traction forces (GF). In addition, the rolling resistance force (RF) of the test machine at idle (no load) operation was recorded. Subsequently, required draft force (DF) of the chisel tine was computationally obtained by means of the following equation.

DF=GF–RF

Where, DF is draft force (kN); GF is gross traction force (kN), and RF is rolling resistance force (kN).

In order to determine the disturbed soil area, a sheet plate of 700x400x5 mm was placed as a perpendicular to the direction of forward and in a vertical plane on the soil treated. The soil on the front of the sheet metal has been evacuated and the sheet metal has been removed. The untreated area in front of the opened profile and the disturbed limit were determined by applying lime with a brush. Three copies of the disturbed soil section profile were photographed after each application. Then the resulting total area of disturbed soil were calculated by plotting the measured coordinates of the cross sections areas using the Fiji image computer package (Topakcı, 2004; Marakoğlu et al, 2013).

The ANNs designed in this study were multilayer back-propagation multilayer networks. Many studies performed for prediction works have used the scaled conjugate gradient, gradient descent with momentum, and Levenberg–Marquardt algorithms (Suzuki 2013). Multilayer networks are beneficial for prediction applications if they have enough neurons in the hidden layer. The multilayer networks are susceptible to the number of neurons in the hidden layer(s). A high number of neurons causes overfitting and the network may lose its ability to generalize, and a low number of neurons can cause mismatch. In network design, minimizing the number of neurons in a hidden layer without affecting the network performance is one of the important criteria. The most important factor in the design of ANNs is the selection of data used as the training data and testing data. The input parameters were share width, forward speed of test machine and working depth. The draft force and disturbed soil area of the chisel tine were the output parameters of the designed network.

To train the designed network and test the network, the collected data were divided into two separate files: 24 of the total data were used for network training and 8 for network testing.

While establishing the ANN model, all the data were normalized between 0 and 1 (Purushothaman and Srinivasa, 1994). For normalization, the following equation was used:

$$y_{nor} = \frac{y\text{-}y_{min}}{y_{max}\text{-}y_{min}} \quad ,$$

To obtain real values from the normalized values, "y" value was calculated using the same formula.

In order to evaluate and compare the performance of ANNs with the multiple linear regression model, the regression models were developed to predict the draft force (DF) and disturbed soil area (DSA) of the chisel tine. SPSS 19 software was used to obtain the multiple linear regression model. The parameters included in the models were the chisel share width (W), forward speed

(V) and working depth (D) as independent variables. The multiple linear regression equation obtained from the experimental data were given below;

DF=-0.0693+0.2862W+0.0475V+0.1655D,

DSA=-185.083+306.125W+28.742V+74.566D,

The commonly used RMSE, R^2 and values, which are accepted as the basic accuracy criterion to determine the performance of the results and based on the concept of mean error, were calculated using the following formulas (Bağırkan, 1993; Bechtler et al., 2001).

$$RMSE = \left(\frac{1}{n}\sum_{i=1}^{n}(x_{1i}-x_i)^2\right)^{1/2},$$

$$R^2 = 1-(\sum_{i=1}^{n}(x_{1i}-x_i)^2)/(\sum_{i=1}^{n}(x_{1i})^2),$$

$$\varepsilon = \frac{100}{n}\sum_{i=1}^{n}\left|\frac{(x_i-x_{1i})}{x_{1i}}\right| \ ,$$

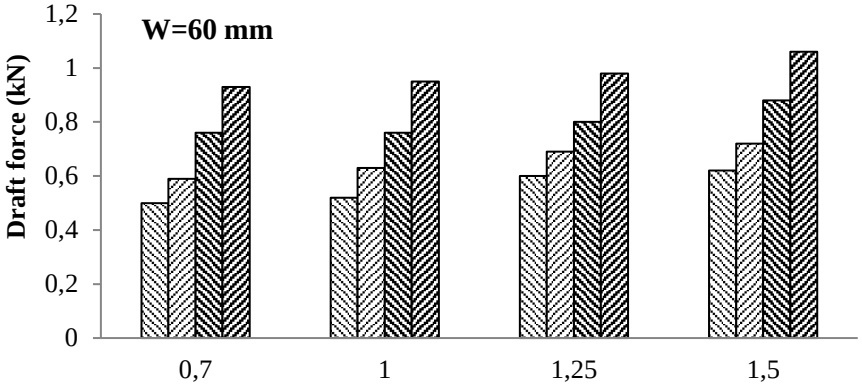
Here, RMSE, Root Mean Square Error, R^2, coefficient of determination, ε, relative error, n, number of data, x, measured value and, x1, predicted value.

3. Results and Discussion

The draft force required of chisel tine increased with increasing share width, forward velocity and working depth (Figure 2). The draft force varied from 0.52 to 1.42 kN. The effect on draft force of share width, forward velocity and working depth were significant ($p< 0.01$). An increased of 100% at share width resulted in a draft force increase of 38 %. Approximately, an increased of 114 % at forward velocity resulted in a draft force increase of 17 % while an increased of 75 % at working depth caused a 49% increased of the draft force. The greatest value in draft force was obtained at a share width of 120 mm, working depth of 280 mm and forward velocity of 1.5 m s^{-1}. Askari and Abbaspour-Gilandeh (2019) found that the highest values of draft force are related to the winged subsoiler in depth of 50 cm and speed of 3.5 km/h as 30.9 kN and the lowest one are related to the bent leg at the depth of 30 cm and speed of 1.8 km/h as 5.6 kN. The draft force was usually higher for higher working depth. Working depth was the major contributory factor on draft force as compared to forward velocity.

The draft force of the subsoil tillage tines is less affected by the forward speed but is much affected by tine type, tillage depth and wing width (Askari et al., 2017). In the study conducted by Çarman et al., (2019), they found that the working depth was more effective on the draft force of the moldboard plough. Manuwa et al., (2010) found that the draft force increased at a decreasing rate with tine width. The increase is also affected by the forward speed since higher draft force values were obtained at higher speed. Boydaş (2017) studied the effect on draft force of various wing mouth forms in chisel plough shank. Draft force was significantly affected from the wing forms. The highest draft force (222.70 N) obtained from the smooth mouth wing, and the lowest draft force (183.45 N) occurred with the narrow angle teeth wing.

Al-Suhaibani and Ghaly (2013) found that increasing the chisel plowing depth and decreasing the forward speed increased the specific draft force. Increasing the working depth from 115 mm to 230 mm (100%) increased the specific draft force by 161-165 % while increasing the forward speed from 0.75 m/s to 2.25 m/s (200%) decreased the specific draft force by 52-53 % for the heavy duty chisel plows.



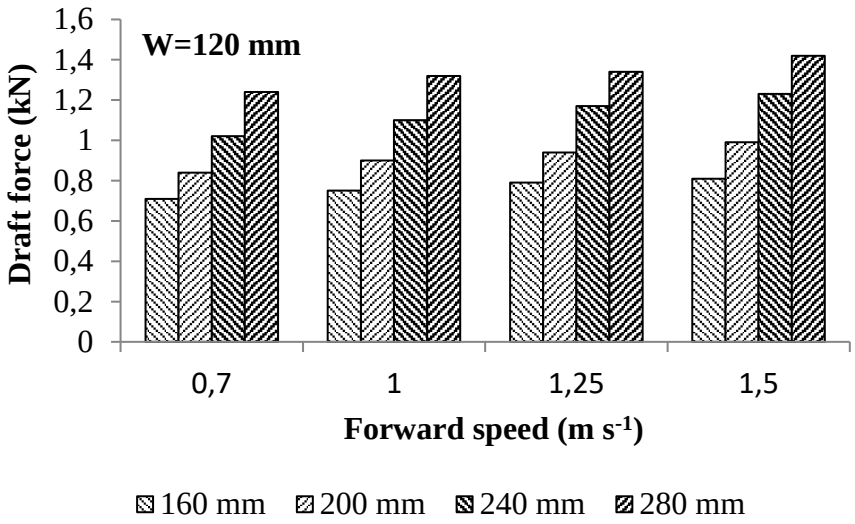
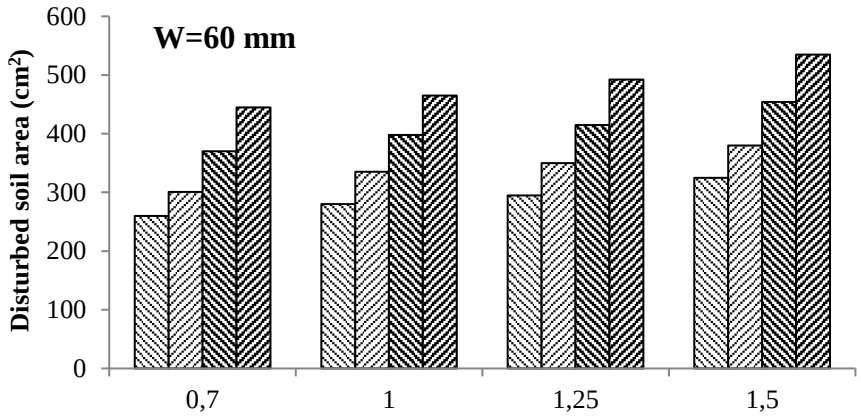


Figure 2
The draft force requirement of chisel tine as a depending on share width, forward speed and working depth.

The disturbed soil area of chisel tine in a clay loam soil under varying operating conditions were given in Figure 3. The disturbed soil area was varied from 260 to 865 cm^{-2} as depending on different share width, forward speed and tillage depths. Averagely, the lowest value of disturbed soil area was obtained at share width 60 mm, speed of 0.7m s^{-1} and working depth of 160 mm, and the highest value was obtained at share width 120 mm, speed of 1.5 m s^{-1} and working depth of 280 mm. An increased of 100% at share width resulted in a disturbed soil area increase of 80 %. Approximately, an increased of 114 % at forward velocity resulted in a disturbed soil area increase of 17 % while an increased of 75 % at working depth caused a 53 % increased of the disturbed soil area. The increase in tillage depth was more effective on the disturbed soil area compared to the increase in forward speed. The results obtained from the experimental data were analyzed using analysis of variance. (ANOVA). The results showed a significant difference among the disturbed soil area values for the two different share width, four different forward speed and working depth at 1% probability level.



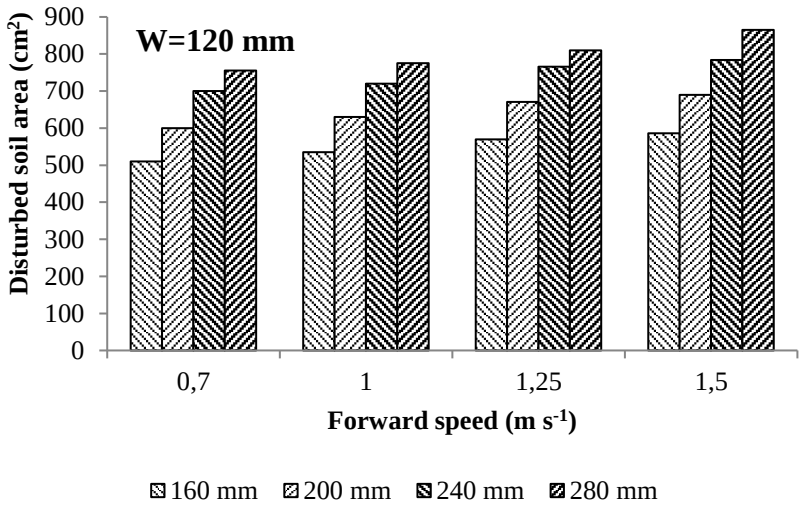


Figure 3
The disturbed soil area of chisel tine as a depending on share width, forward speed and working depth.

Topakcı (2004) studied under the controlled conditions with chisel tine in soil bin. The experiments were carried out the different tine wing arrangements and leading tine arrangements. The disturbed soil area was varied from 893.8 to 1655.2 cm^2. It can be said that the greater values obtained from our study were caused by wing arrangements and deeper operating conditions. Marakoğlu et al. (2013) found the total disturbed soil area as 939 and 639 cm^2, respectively, in their study conducted with winged and simple chisel tine in soil bin.

In the ANN model, the structure of the network is 3-(6-8)-2, and it was designed as 3 input layers, 2 hidden layers and 2 output layers, and the neuron numbers of hidden layers were obtained as 6-8 (Figure 4). In the structure of the created network, logsig in the first hidden layer, purelin in the second hidden layer and tansig transfer functions in the output layer are used. For the network, the lowest training error value was obtained at 96 epochs. Abbaspour-Gilandeh et al. (2008) conducted trials to develop the prediction model of draft force and required energy for tillage operation. In this study, parameters such as forward speed, tillage depth and different soil parameters were used. Artificial neural network model is used in this study. The best training algorithm was selected based on the comparison of made networks (in training and data test stages). In regard to the high accurate prediction (98.8%) and high accurate simulation (97.6%) the application of Lavenberg-Marquardt algorithm with 2 middle layers including 12 neurons on its first layer. 10 neurons on its second layer was distinguished as the most appropriate algorithm in comparison with other ones.

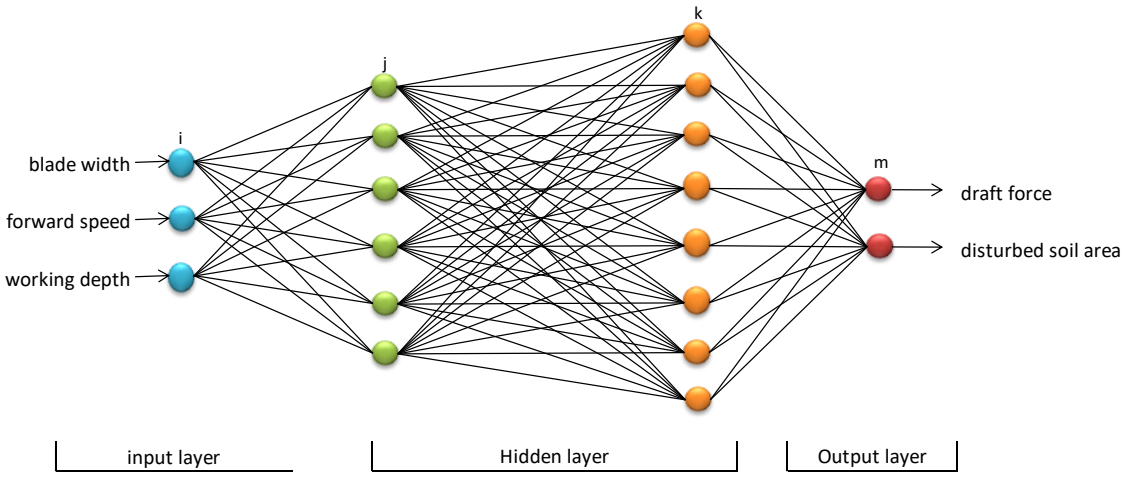


Figure 4
The network structure of the ANN model

The prediction ability of the developed models is investigated according to mathematical and statistical methods. Table 1 shows the mean values of RMSE, R^2 and Ɛ of the ANN and regression models to predict each of the two output parameters. For draft force, the statistical values RMSE and R^2 in ANN model were found as 0.010 and 0.999, respectively. In ANN model, the mean relative error values were found as 0.960 %. The statis-

tical values RMSE and R^2 in regression model were found as 0.040, and 0.992, respectively. In regression model, the mean relative error values were found as 3.756 %. Abbaspour-Gilandeh et al. (2020) compared the performance of ANNs with a linear regression model, and the data obtained from the two models were compared to estimate the draft force of the chisel cultivator. They found that the correlation coefficient and prediction accuracy for the linear regression model were 0.592% and 61%, respectively, and the correlation coefficient and prediction accuracy of the ANN model were significantly lower than the prediction accuracy of 0.9445% and 89%, respectively. These results are consistent with the results of our study. Draft force data for chisel plows working with different soil conditions and operational parameters were obtained with the help of simulation results using artificial neural networks by Aboukarima (2007). The coefficients of determination (R^2) of of prediction were found higher than 93%.

Manuwa (2009) reported that a good relationship between draft force measurements and predicted using ANN was acquired. The relationship between depth and draft force had a curved shape and was described by means of an exponential function. An artificial neural network (ANN) model, with a back propagation learning algorithm was developed to predict draft requirements of two winged share tillage tools by Akbarnia et al., (2014). The developed model predicted the draft requirements with a mean relative error of 0.56 and mean square errors of 0.049, when compared to measured draft force values.

For disturbed soil area, the statistical values RMSE and R^2 in ANN model were found as 0.016 and 0.998, respectively. In ANN model, the mean relative error values were found as 1.673 %. The statistical values RMSE and R^2 in regression model were found as 0.023 and 0.997, respectively. In regression model, the mean relative error values were found as 2.802 %.

Table 1 shows that R^2 was very close to 1 for the ANN model. The ANN model gave smaller RMS values compared to the regression model. The ANN model gave the worst results compared to the other model.

Table 1
Performance of the ANN and Regression models to predict each of the two output parameters

Models	Performance Values	Draft Force (kN)	Disturbed Soil Area (cm^2)
ANN	RMSE	0.010	0.016
	R^2	0.999	0.998
	Ɛ	0.960	1.673
Regression	RMSE	0.040	0.023
	R^2	0.992	0.997
	Ɛ	3.756	2.802

The correlations between the predicted (ANN and regression) values and actual values for draft force and disturbed soil area are shown in Figure 5 and 6. As the correlation coefficients approach 1, the prediction accuracy increases. In the case presented in this study, the correlation coefficients obtained are very close to 1, indicating a perfect match between the ANN predicted values and the actual values.

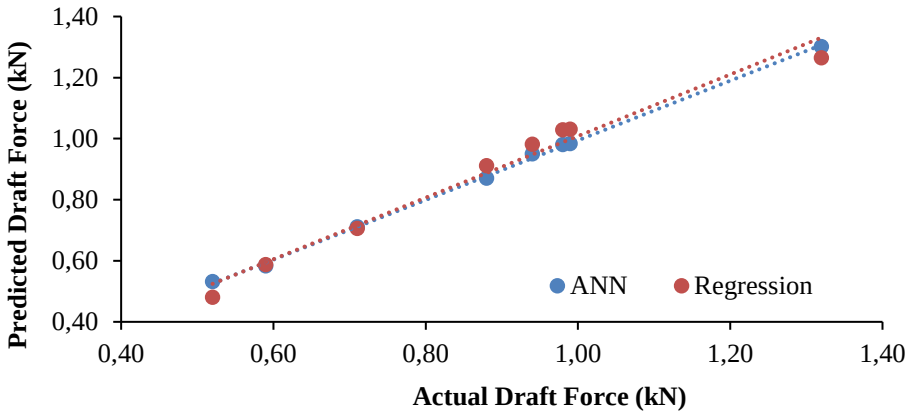


Figure 5
Correlation between predicted and actual values of draft force

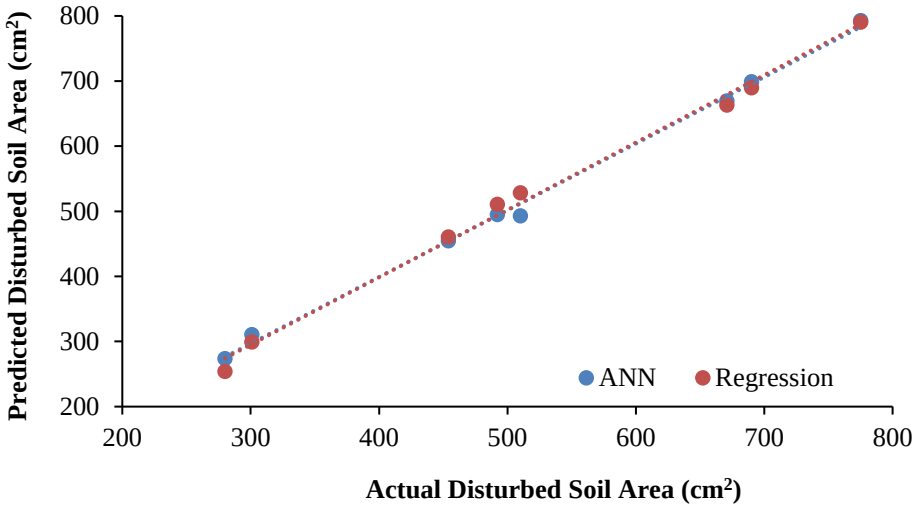


Figure 6
Correlation between predicted and actual values of disturbed soil area.

As can be seen in the figures and tables, the estimation results and the actual results are in good agreement. The deviations between predicted and actual results are very small and negligible for any draft force and disturbed soil area. These results show that the best results have been obtained with the ANN model.

4. Conclusions

The experiments to estimate the draft force of the chisel tine and the disturbed soil area were carried out in the soil bin under different working conditions. In the ANN model, Feed Forward Back Propagation, Multilayer Perceptron network structure the multilayer recurrent backpropagation artificial neural networks were used to predict the draft force and disturbed soil area of the chisel tine. The structure of the ANN model developed was designed to have 3 inputs, 2 hidden and 2 output layers. The input parameters of the ANNs were sharing width, forward speed and working depth. The draft force and disturbed soil area of the chisel tine were the output parameter of the designed network. To train the network, the training algorithm used was the Levenberg-Marquart algorithm. In the ANN model, R^2, RMSE and relative error were found to be 0.999, 0.01061 and 0.96% for draft force and 0.998, 0.01683 and 1.67% for disturbed soil area, respectively. In the multiple linear regression model (MLR), R^2, RMSE and relative error were found to be 0.992, 0.04097 and 3.75% for draft force and 0.997, 0.02399 and 2.80% for disturbed soil area, respectively. Therefore, the model developed in this paper is useful for predicting the draft force and disturbed soil area of a chisel tine and designing a chisel tine with low draft force and high disturbed soil area. It is proposed that experiments be undertaken at several soil textures, the different soil conditions and chisel tine geometries order to develop a model with high accuracy and high generalizability. In addition, this system can be compared with other artificial intelligence methods such as Fuzzy Inference System and Adaptive Neuro-Fuzzy Inference System method to get the best method to simulate the soil-chisel tine interaction under different working and soil conditions.

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Review Article

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From Climate Change and Biodiversity Towards Sustainable Agriculture

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ABSTRACT

Agriculture is part of both problem and solution of climatic change besides being one of the most important entire global financial systems. Human pressure on climate is changing quite faster than ever and predicted irreversible destructions over the world. Strategies environment conservation are focused on nature, atmosphere, soil, and every single component of the organisms. From this perspective, all the living organisms are threatened by climatic effects. The worst affects and extinction have been started to be seen on many endemic species. Climate and biodiversity are under destructive effects of human activities while irreversible affects might be destructive for human as well by the main effects on human health, extinction of species, narrowing on living space, disruption of life balance, changes in climate, ecological problems, natural disasters, exhaustion of natural resources, loss of efficiency and yield, etc. disasters which are tending to the term of sustainability of life. Threats to environment might be decreased by support of governments but actually possible by volunteering of public in national and global scales. Present paper reviews the highlights about current statues of climatic changes and threats on biodiversity by summarizing some important issues. Climate-friendly management strategies are required to decrease the agricultural N_2O emissions, increasing of people (especially for farmers) awareness, pay attention for sustainable agriculture systems, composting of organic wastes, support to carbon sequestration, well planned grazing of livestock, using of renewable green and effective energy, government investments for protection of biodiversity. It is also recommended that; nature education for everyone is an important issue and essential for solving the problems. Giving information to human about the nature should be well-planned by governments and every single person should be aware the global importance of the topic.

1. Introduction

Ecosystems include biodiversity while number of species is higher in the tropics and some other localized areas and usually lower in polar areas (WCMC, 1992). Amount of damage to biodiversity is related with altitude, climate, soil, latitude and interactions among species (Pidwirny, 2006).

See by the history of world, it is fair that climate changes over time.Similarly, patterns of biodiversity also change depending on climate (NASA, 2011), like eight cycles of ice enlargement through the last 750000 years in total (Williams, 2009) while the last ice age realized around 7000 years before and that is the time of human civilization (Brooks, 2004). Likewise, climatic changes take very big carefulness due to it is estimated to be induced by human efforts and unexpected climate changing ratios during the last 1300 years (Ramaswamy et al., 2006; Solomon et al., 2007). Changes in climate are welded by many factors that may be listed as following (Beton, 2011); sea level rise about 17 cm in the last century (Church and White, 2006), global temperature rise (Allison et al., 2011) warming oceans about 16x1022 J (8.425x1019°C) in the top 700 metersfrom 1969 to 2008 (Levitus et al., 2009), shrinking ice sheets by 150 to 250 km^3 of ice lost in Greenland from 2002 to 2006 and 152 km^3 lost on Antarctica from 2002 to 2005 (Velicogna and Wahr, 2005; NASA, 2011), the decline of Arctic sea ice (Polyak et al., 2010), glacial retreat including Africa, Andes, Alaska, Alps, Himalayas, Rockies (NSIDC, 2011; WGMS, 2011), extreme climatic events since 1950 (NOAA, 2011), ocean acidification; since 1750s welded by industrial revolution by increasing carbon dioxide content rate around 2 billion tons per year

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(NASA, 2011), 30% higher acidity in the ocean (Sabine et al., 2004). On the other hand, plant breeders give a lot of effort to increasing of yield and quality (Toker et al., 2019; Sari et al., 2020) and on this point, biodiversity is indispensible factor to succeed.

Consciousness of human about sustainability of life is very important not only local scale but also important for global scale. Changes in climate, environmental pollution, extinction of species, threats on biodiversity, reduction of productivity and quality, difficulty of breeding plants to adapt for a long time are closely relevant to health, hunger, malnutrition, welfare and the other components of mankind. Present paper describes some approaches for factors of global climate changes and interactions with biodiversity.

1.1. Climate and Biodiversity

Biodiversity defines the living nature. Land, sea and other aqua ecosystems are components of the ecology. Biological diversity focuses on the several biotic and abiotic factors by views of their living area, changes in life statues, their relations with other living and nonliving organisms, changes depended on place and time, genes, species, ecosystems and all functions (Graham et al., 2004). Genetic diversity is affected by (Çepel, 1997); natural factors (climate, soil, landforms), paleogeography (shift of continents, climatic changes) and biologic factors (human, animal and plants) while it occurs by (Schulze and Mooney, 1994); geographic region, life time, migration, providing of the demands for life (food, water, genetic temperature etc.) which remind and/or closely depended to climatic factors,.

Interdependent statues of climate and biodiversity give rise to certain harmful effects of climate on species especially for their characteristics and dispersions. Some of the various predicted effects are listed; changes in number of species, increasing of habitat disruption, changes in lifecycles (Blaustein et al., 2010), increasing of infectious diseases spreading by several agents (Pounds et al., 2006; Bosch et al., 2007; Wake, 2007)that may be also including Coronavirus (Covid-19) already caused many deaths and infectious pandemic diseases recorded over the world such as Plague, Smallpox, Measles, Yellow fever, Cholera, HIV, AIDS, Ebola, Sars and Mers (Pitlik, 2020; WHO, 2021)

Changes in climate have already affected many species. First of all, human need to realize detailed fieldwork and should determine the endangered species. On the other hand, combination of the agreed methods should be implemented to evaluation of the current situation. Additionally, it is important to have information about the direct and indirect effects to climate and adaptation mechanisms of the species. That may be clear by focus on relations between species and environment, dynamics of landscape and population, combined effects of climatic changes.

1.2. Agricultural Biodiversity and Sustainable Agriculture

Agricultural activities (over tillage, fertilization, and pesticide use) pose the most important threats to natural bio-diversity. Plants are used today especially for health, nutrition, environmental protection and various industrial purposes. Insects in natural biodiversity interact with plants so that they can survive directly or indirectly. Thanks to this interaction, approximately 67% of the plant species are dependent on pollination by insects (Coleman, 2018). Following parts divided by insects and plants relationships with the topic.

1.3. Importance of Insects in the Sustainable Agriculture and Environment

Everyone especially farmers need to get the crucial value of insects to agriculture and food security. Insect and disease damage, when combined with climate change, is a big global challenge for a sustainable environment. Additionally, the key to sustainable agricultural production is the biodiversity of natural ecosystems which a fundamental trait more than any other human activity. Arthropods, for more than 400 million- year-exist, have been part of the ecosystem for 40% of biodiversity. Besides insects have had a wide range of vital ecological functions in their natural ecosystems, as herbivore, carnivore and feeding organic material (detritus), insects are commonly sensed as pests. However, their main ecological functions are ecological recycling, pollination, predation or parasitism, and being decomposers. If insects are guided in agricultural systems, they can take a role asfundamental instrumentation of the vital ecosystem (Coleman, 2018). And also insects are supported as an alternative protein source for human food, livestock and fish feed worldwide (Van Huis et al., 2013; Van Huis and Oonincx, 2017).

One of the cultivated areas and production of crops analysis indicated that the producers in the US have a permanent and significant need for all insect pollinators (honey bees, non-Apis pollinators etc.). And also that a reduction in managed or wild pollinator populations might be seriously threatenedby intensive agricultural systems of insect pollinated crops besides crops that are grown by seeds resulting from insect pollination (Calderone, 2012). The action of abiotic forces (wind, water etc.) can result from pollination which relies on animals, including bats, flies, butterflies, beetles and other insect (National, 2007; Coleman, 2018). The majority of insects pollinators are bees (Anthophila) (Grimaldi and Engel, 2005), of which there are approximately 17,000 defined species and as many as 30.000 species world-wide (Michener, 2000; National, 2007) whose (with rare exclusion) collect pollen and nectar from flowers. There is recently a renewing interest in the affecting health of honey bees and other insect pollinators (National, 2007), because of their pollination services that provide in both natural and agricultural ecosystems (Kearns and Inouye, 1997;

Allen-Wardell et al., 1998; Kremen and Ricketts, 2000; Kevan and Viana, 2003; Gallai et al., 2009; Buchmann and Nabhan, 2012). It is believed that new practices for integrated management of both honey bees and diverse wild insect assemblage will improve universal crop yields in the world where have declined the diversity and abundance of wild insect pollinators (Garibaldi et al., 2013).

1.4. Possible Influence of Climate Change on the Insects

If we deal with the world's climate is changing at rates much faster than rates ever experienced before according to the last forecast, many ecosystems probably will not be able to settle for the change under these conditions (Houghton et al., 1990; Fleming and Volney, 1995). Nowadays there are a lot of statements about climate change on the Earth, the most famous theory is that average temperature will increase as a result of higher atmosphericCO_2 concentration (Jaworski and Hilszczański, 2013). Therefore, the warming will probably lead to increased numbers of insect pests and also public health pests and insect vectored diseases too (Quarles, 2007). Also, climate changes are important for phytophagous insect species, and there are effective directly and indirectly basic climate parameters as temperature and humidity. According to researchers, (1) Polyphagous and eurytopic species have higher ecological plasticity and adapting abilities thanks to global warming. (2) The role of species especially thermophilous has currently increased and resulted in increased numbers and greater damage done by the pests. (3) Some phytophagous species status is changeable, can increase or decrease. For instance, the increased geographical range, increased numbers of generations, and higher densities are determined on some crop pests. (4) The number and the role of phytophagous species overwintering in egg stage have increased than in other development stages which have seen higher mortality at that time. (5) The dynamic of phytophagous insect population can affect by water shortage stress on plant. (6) The invasive phytophagous insect species can also increase because of climate change and absence of effective natural enemies in the new ecosystem (7) The changing of insect population is vital subscribers to cycling of nutrient and carbon, energy flowing, and decomposition of biomass (8) The relationship of pests and predators can have a profound effect like encourageable or not by temperature increases and parasitoid populations may also be exchanged by heavy status and variable climate (Haack and Byler, 1993; Parry, 1998; Stireman et al., 2005; Parmesan, 2006; Quarles, 2007; LaštůVka, 2009; Jaworski and Hilszczański, 2013). However, in most state the insect population growth is still indefinite whether the acceleration in development will be detrimental or not (Visser and Both, 2005).

1.5. Importance of Plants in the Sustainable Agriculture and Environment

Using of plants is as old as the history of humans. Health care purposeful plant based drugs are around 250 in Mesopotamia, 600 in Grecian and 4000 in Arabian Persian period (Baytop, 1999; Gencay, 2007). Today, traditional public drugs are becoming a science called as “ethnobotany” and this science deals with relations between plants and humans. The term “ethnobotany” was used by an American botanist - John W. Harsberger in 1895 and the scientist published the first book in 1896 (Balick and Cox, 1996; Polat, 2010). Today, there has been limited study on ethnobotany still that is an essential need for sustainability of life by many advantages on bio-conservation of species that were used by many people in ancient times for several purposes such as health care, food, building material, clothing, meadow-pasture and forage crop, fuel, biofuel, apiculture, sericulture, ornamental plant and landscape etc. basic needs besides economic development.

Global climate changes cause pressure on agriculture which tends to study drought stress and the response of plants by physiological and other growing statues etc. phenomena that the other climate change – related projects (Kucukbasmaci and Sabir, 2019). Important notes are given under three points by NSAC (2019) as; policy recommendations about climate and agriculture, decreasing of greenhouse gases (GHG) emissions and knowledge transfer by focus on future generations. Additionally, promoting of family farms, opportunities for farming, equal opportunity for all races, fairness of farmworkers, farming systems providing sustainability of human welfare, environmental quality, controlling of biological cycles, economic feasibility, ecosystem owing to soil – water – pollinator and wildlife health.

More than 1 billion people suffering worldwide which is equal to suffering over-nutrition, 155 million overweight or obese people, 148 million undernourished people while deaths worldwide every year 29 million due to overeating and 36 million due to lack of food. In another way, there are 1 billion cars while 2 billion people suffering from food access. Similarly, consumption of corn in the United States is around 390000 m^3 annually while 55% is used as food and 45% is used for ethanol production for fuel. In the Worldwide, there are almost 3 billion farm animals while about 1/3 of the total foods are used to feed these animals which means a serious effect on changes in climate (minimum 50% of the emissions welded by agriculture). Additionally, the demand for farm animals for water is 27.5 billion m^3 in 2020 and estimated at around 45 billion m^3 in 2050. There are 4 highlights of the multidisciplinary reports for solving the concerns on the topic; food for all, food for sustainable growth, food for health and food for culture (Anonymous, 2021).

2. Conclusions

Protection of nature is focused on species especially. Species are under effects of environmental factors that are mainly affected by climate and humans. Today, intensive pressure of human on the environment has been increased remarkably. The serious changes in human activities are considered as destructive effects on all living organisms in addition to natural resources. Climatic changes, biodiversity and other components of the earth are directly and indirectly connected while the main factor is human. So, human should pay attention to sustainability principles in all activities especially in agriculture. Therefore, there is a need to rising of awareness on sustainability of life and understanding the relations between human and nature that might be realized by education of nature for everyone.

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