INNOVATIVE APPROACHES IN AGRICULTURE, FORESTRY AND AQUACULTURE SCIENCES

GECE AKADEMİ

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INNOVATIVE APPROACHES IN AGRICULTURE, FORESTRY AND AQUACULTURE SCIENCES

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İÇİNDEKİLER

CHAPTER 1

WEIGHT-LENGTH RELATIONSHIP WITH MAXIMUM SIZE RECORD OF THE COMMON SOLE (SOLEA SOLEA LINNAEUS, 1758) IN THE AEGEAN SEA

Özgür CENGİZ[1]

INTRODUCTION

The common sole (Solea soleaLinnaeus, 1758) belonging to the family Soleidae is a demersal brackish marine fish distributed in the eastern Atlantic, southward from the Tronheim Fjord (including the North Sea and western Baltic) and the Mediterranean Sea (including the Sea of Marmara, Bosphorus and southwestern Black Sea). Adults feed on worms, mollusks and small crustaceans at night. They burrow into sandy and muddy bottoms (Froese and Pauly, 2018).

Maximum length and weight are very important theoretical parameters in fisheries science (Dulčić and Soldo, 2005). Directly and indirectly, these measurements enter in most of the models used in stock assessments (Borges, 2001) and could use a tool for a rapid evaluation of growth rates in the absence of basic data (Froese and Binohlan, 2000). For these reasons, updating information about the maximum size of a species that might be commercially or recreationally exploited in the future gains importance (Navarro et al., 2012; Cengiz and Sepil, 2018).

Weight-length relationships (WLRs) have a several uses. They allow (a) tocompare life histories and morphology of species from different habitats and/or regions, (b) to follow seasonal variations in fish growth and to estimate condition indexes, (c) to calculate production and biomass of a fish population and (d) to convert a growth equation in length into a growth equation in weight(Gonçalves et al., 1997; Moutopoulos and Stergiou, 2002).

For the Aegean Sea, the previous studies about WLRs of Solea solea have been conducted by Koutrakis and Tsikliras (2003) in the Porto-Lagos lagoon (Greece), by Karakulak et al. (2006) in the Gökceada Island (Turkey), by Hoşsucu (1992), Özaydın and Taşkavak (2006), Özaydın et al. (2007), Bayhan et al. (2008) and İlkyaz et al. (2008) in the Izmir Bay (Turkey), by İşmen et al. (2007) and Özekinci et al. (2009) in the Saros Bay (Turkey),by Kapiris and Klaoudatos (2011) in the Argolikos Gulf (Greece),by Acarlı et al. (2009) and Acarlı et al. (2014) in the Homa Lagoon (Turkey)and by Bilge et al. (2014) in the southern Aegean Sea (Turkey). There was no information about the WLR of S. solea in Gallipoli Peninsula (Northern Aegean Sea, Turkey). For this reason, this study includes preliminary information on the weight-length relationship for S. solea fromthe Gallipoli Peninsula (Northern Aegean Sea, Turkey), however, it presents the maximum length and weight of species in the Aegean Sea.

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MATERIAL AND METHODS

Samples were collected by spearfishing and trammel nets at depths of 0–40 m from the Gallipoli Peninsula between January 2012 and December 2012 (Fig. 1). Fish were identified based on Mater et al. (2009). The specimens were measured to the nearest 1 mm (total length TL in cm), weighed to the nearest 0.01 g (total weight W in g).

Figure 1.Gallipoli Peninsula and sampling stations.

The sex was determined by examining the gonads macroscopically. The chi-square (X2) test was used to detect the differences in the sex ratio. The student's t-test was used to analyze the differences in the mean length and weight of the sexes. The WLRs were determined based on the formula: W = aLb , where W is the total weight (g), L is the total length (cm), a is the intercept, and b is the slope (allometric coefficient). Parameters a and b were estimated using a simple linear regression analysis of log-transformed data. The b coefficient provides an indication of the growth pattern for a specific population. More precisely, when the b parameter has value greater than 3.0 the species presents a positive allometric growth; values of b lower than 3.0 display negative allometric growth. If b equals 3.0, isometric growth is indicated (Bagenal and Teschi, 1978).

RESULTS

A total of 86 specimens were sampled. On the 16 November 2012, a female specimen of *Solea solea* (Linnaeus, 1758) (39.8 cm total length and 568.22 g total weight) with the maximum length and weight was caught by a spear at a depth of 20 m on a sandy-muddy bottom (Fig. 2.).

Figure 2. The female *Solea solea* with 39.8 cm TL and 568.22 W g from Gallipoli Peninsula.

Of 86 specimens examined, 49 (57 %) were female, and 37 (43 %) males. The sex ratio (F: M) was 1: 0.76, which is significantly no different from equipartition (X^2 test:P > 0.05). The mean ± standard error (and range) of total length were 27.0 ± 0.66 (20.0 – 39.8) cm TL for females and 25.1 ± 0.45 (21.1 – 30.0) cm TL for males (Fig. 3) and total weight were 180.11 ± 16.48 (50.36 – 568.22) g W for females and 137.02 ± 9.28 (62.17 – 261.00) g W for males. The student's *t*-test showed significant the differences between the mean lengths and weights of the both sexes (all P < 0.05).

Figure 3.The length-frequency distribution for females and males of *Solea solea* from Gallipoli Peninsula.

The weight-length relationships were calculated, separately, for females and males as: $W= 0.0024TL^{3.28}$(R^2 = 0.97, 95 % CL of *b* = 3.19 – 3.37), $W = 0.0005TL^{3.39}$(R^2 = 0.97, 95 % CL of *b* = 3.28 – 3.50). The positive allometric growths were obtained both females and males (Fig. 4).

Figure 4. The weight-length relationships for females and males of *Solea solea* from Gallipoli Peninsula.

DISCUSSION

The WLRs (aand b) in the fish could be attributed to the degree of gonad maturity, sex, diet, sample preservation techniques, stomach fullness (Wootton, 1998), number of specimens analyzed, area/season effects, sampling duration (Moutopoulos and Stergiou, 2002), fishing gear used (Kapiris and Klaoudaos, 2011) and size selectivity of the sampling gear (İşmen *et al.,* 2007). The possible reasons for differences in WLRs of *Solea solea* between other studies with present study related to one or more factors given above (Table 1).

Table 1. Comparison of weight-lengthrelationships of *Solea solea* between other studies with present study in the Aegean Sea.

As well known, the individuals in populations exposed to high levels fishing pressure will respond by reproducing at smaller average sizes and ages and so reached maximum lengths may getting and getting smaller. But, the one individual that subjected to no overfishing pressure could be reached that kind of length (Filiz, 2011). On the other hand, any factor that might possibly influence growth has been shown to have an effect, including nutrient availability, feeding, light regime, oxygen, salinity, temperature, pollutants, current speed, nutrient concentration, predator density, intra-specific social interactions and genetics (Helfman *et al.,* 2009). Hereby, it follows from these comments that the regional differences in maximum length and weight depend on the ecological conditions and overfishing pressure.

Figure 4and Table 1 unequivocally indicated that the female common sole were larger than the males. This phenomenon is a common feature in many pleuronectiforms (Landa and Pinerio, 2000; Cengiz *et al.,* 2014). This case could be attributed to differences in metabolism between females and males, such as differences in oxygen consumption (Pauly, 1994), differences in the level of surplus energy between reproduction and somatic growth (Rijnsdorp and Ibelings, 1989), differential food ingestion (Lozán, 1992) and differences in the onset of maturity between males and females (Cengiz, 2015).

In broad terms, the information on maximum length, weight, age, growth and weight-length relationship are required to estimate the population parameters as asymptotic length and growth coefficient of fish, which is essential for fisheries resource planning and management (Agüero *et al.,* 2010). In conclusion, the present study proves that this species can grow above the previous maximum data reported in the Aegean Sea. The information presented here may be used to compare the similar parameters in ongoing fishery studies all over world by providing the scientific support to the fisheries scientists.

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FIGURES

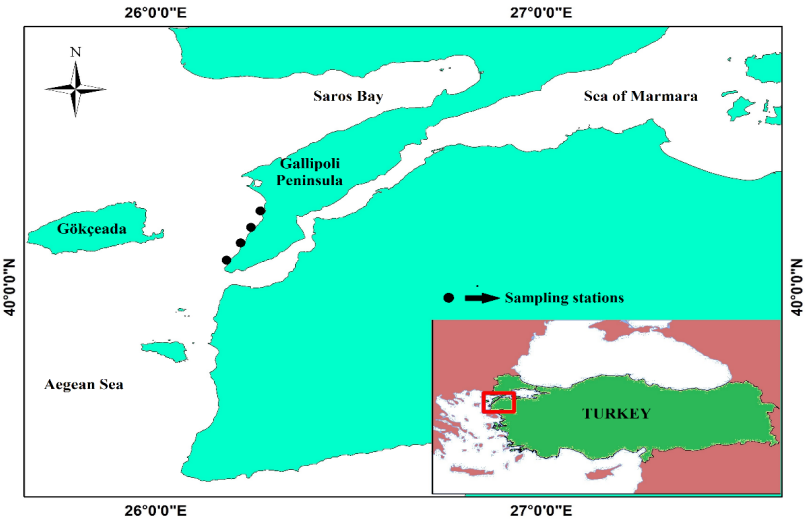


Figure 1.Gallipoli Peninsula and sampling stations.

Figure 2. The female *Solea solea* with 39.8 cm TL and 568.22 W g from Gallipoli Peninsula.

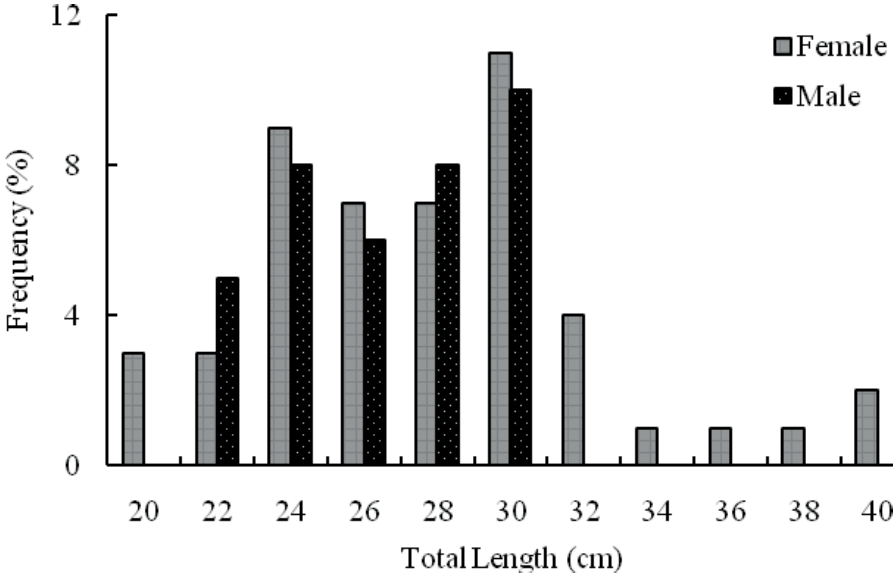
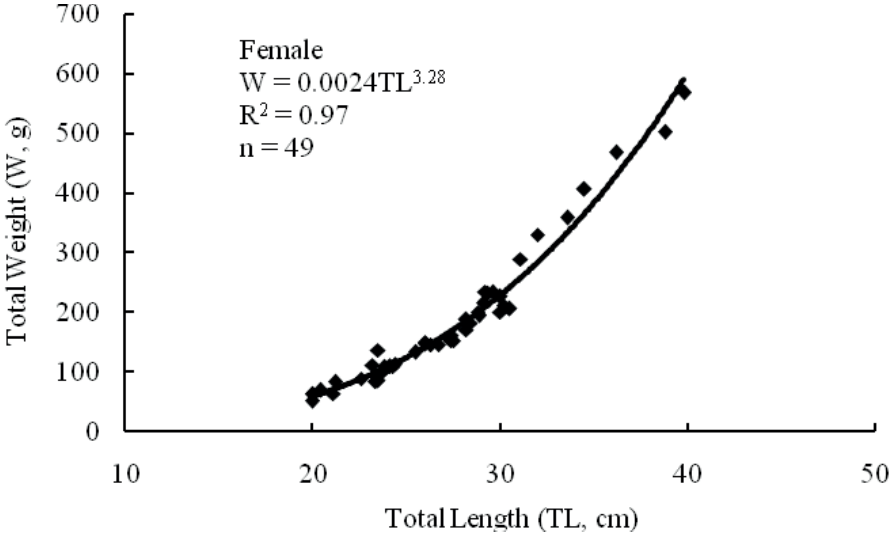


Figure 3. The length-frequency distribution for females and males of Solea solea from Gallipoli Peninsula.



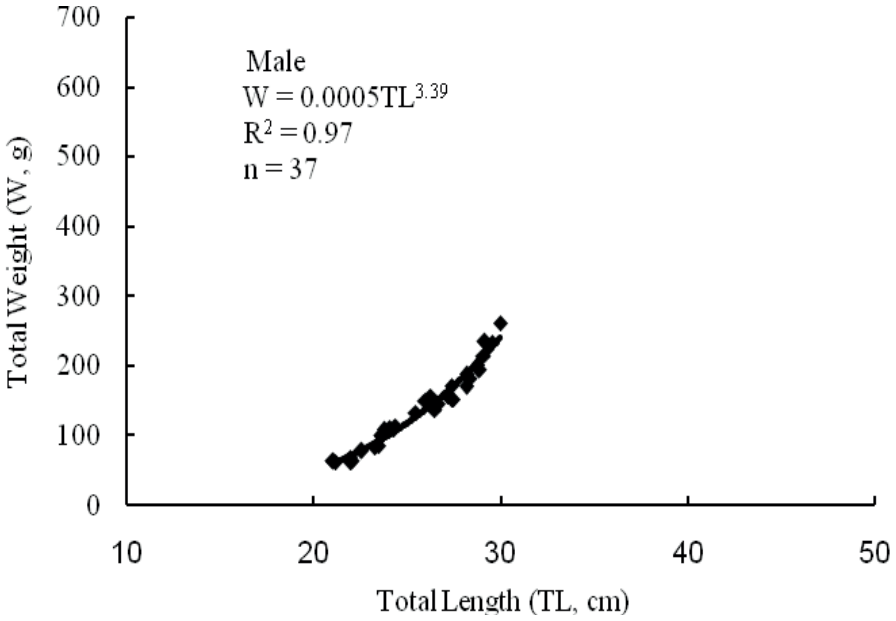


Figure 4. The weight-length relationships for females and males of Solea solea from Gallipoli Peninsula.

TABLES

Table 1. Comparison of weight-length relationships of *Solea solea* between other studies with present study in the Aegean Sea.

Author(s)	Area	Sampling Gear	Sex	N	Length range (cm)	Weight range (g)	a	b
Hoşsucu (1992)	Izmir Bay, Turkey	Bottom trawl, Trammel nets	Σ	335	11.0 - 34.5	10.60 - 337.00	0.0051	3.13
Koutrakis & Tsikliras (2003)	Porto-Lagos lagoon, Greece	Beach seine, Fyke net, Gill nets	Σ	21	11.0 - 22.1	-	0.0098	3.00
Karakulak et al. (2006)	Gökceada Island, Turkey	Gill nets, Trammel nets	Σ	1	35.2	445.50	-	-
Özaydın & Taşkavak (2006)	Izmir Bay, Turkey	Beach seine, Bottom trawl, Gill nets, Trammel nets	Σ	74	20.4 - 37.0	53.00 - 395.00	0.0022	3.38
İşmen et al. (2007)	Saros Bay, Turkey	Bottom trawl	Σ	79	14.7 - 39.2	30.00 - 554.00	0.0037	3.24
Özaydın et al. (2007)	Izmir Bay, Turkey	-	Σ	110	19.7 - 31.9	-	0.0021	3.20
Bayhan et al. (2008)	Izmir Bay, Turkey	Bottom trawl	Σ	44	19.6 - 29.5	65.82 - 231.95	0.0232	2.72
İlkyaz et al. (2008)	Izmir Bay, Turkey	Bottom trawl	Σ	72	20.8 - 36.0	-	0.0030	3.27
			♀	30	22.7 - 36,0	-	0.0031	3.27
			♂	42	20.8 - 28.8	-	0.0045	3.14
Acarlı et al. (2009)	Homa Lagoon, Turkey	Beach seine, Fyke net, Fences trap, Trammel nets, Veranda net	Σ	141	14.1 - 30.2	23.00 - 308.00	0.0111	2.96
Özekinci et al. (2009)	Saros Bay, Turkey	Bottom trawl	Σ	130	10.0 - 32.0	9.24 - 330.00	0.0192	2.73
Kapiris & Klaoudatos (2011)	Argolikos Gulf, Greece	Trammel nets	♀	31	11.9 - 28.0	38.00 - 210.00	0.0050	1.81
			♂	44	13.0 - 27.5	21.00 - 151.00	0.0001	2.42
Acarlı et al. (2014)	Homa Lagoon, Turkey	Beach seine, Fyke net, Barrier trap, Trammel nets	Σ	73	8.7 - 20.5	6.30 - 88.50	0.0070	3.05
Bilge et al. (2014)	Southern Aegean Sea, Turkey	Bottom trawl	Σ	171	18.6 - 33.7	-	0.0023	3.36
This study	Gallipoli Peninsula, Turkey	Spearfishing, Trammel nets	♀	49	20.0 - 39.8	50.36 - 568.22	0.0024	3.28
			♂	37	21.1 - 30.0	62.17 - 261.00	0.0005	3.39

Σ: all samples, ♀: Females, ♂: Males, N = Sample size, a and b = the parameters of the relationship.

CHAPTER 2

LEGAL ANALYSIS OF ENVIRONMENTAL IMPACT ASSESSMENT PHASE IN TURKEY

Y. Ozhan TÜRKER[1], Aynur AYDIN[2]

I. Introduction

Environmental Impact Assessment (EIA) is a technical tool and administrative process that involves and functionalizes important principles of environmental law and is widely accepted at the world scale and an important part of decision making process (Turgut 2001; Güneş and Coşkun 2004; Saygılı 2004; Saygılı 2007; Turgut 2009; Güneş 2010; Güneş 2013). EIA system that is required to be taken into hand within the prevention principle of environmental law and an important part of environment protection first occurred in United States of America (Nadlifatin et al. 2015). Different definitions were made for EIA. After a project was carried out, some of them defined this process as ''an appropriate detection tool for decision making'' (Erikstad 2008) while some experts defined EIA that is mentioned as an application taking its environmental impacts into consideration (Salihoğlu 2013) as a planning or management tool that is globally used in decreasing harmful results of the development (Ahammed and Nixon 2006). In other definitions, EIA is sometimes perceived as a ''process at which important impacts of a specific project or development on the environment[3]''; sometimes determination and inspection function of necessary precautions were added to his definition (Güneş and Aydın 2004). At the doctrine, so many other definitions that qualify it as a technical tool transferred into the application (Turgut 1998), a participatory legal method aiming protection of the environment (Saygılı 2007) and a practical tool targeting sustainable development (Albergaria and Fidelis 2006).

When different EIA definitions are reviewed, it is clear that these definitions bear big resemblances and EIA is fundamentally seen as an important tool of environmental protection. Based on these, EIA may be defined as review of any activity that may have important impacts on the environment with participatory methods and scientific technics and methods and takes preventive precautions that may prevent negative sides of this activity and foresees monitoring and inspection at the continuance. This system that aims assessment of environmental impacts of public and private projects that are probable to have important impacts on environment was entered into Euro-

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pean Union Acquis with the Directive No 85/337/EEC[4].

This Directive that is an important step of environmental impact was accepted by European Union Council with the aim of prevention pollution. The Member States were reflected the Directive on the internal laws until 19888 and its functionalization was necessitated and therefore has become a part of environment protection plans of the Union (Saygılı 2007). Various additions were made to EIA directives within the years and finally new EIA Directive no 2011/92/EU was issued in 2011.

The directive no 2011/92/EU is horizontal. The horizontal area is relevant to the environmental legislation that is at the intersection point of differential environmental fields. The legislation concerning to the horizontal sector is a general legislation at which different aspects regarding to the environment protection is assessed together and common rules applied to these areas are determined. This legislation reveals out the methods and mechanisms for development of decision making and legislation and improvement of its application. The directives within the scope of this legislation is relevant to data collection about environment and assessment of these data, participation right of all participators in terms of access to information and decision making procedure, reporting the liabilities to the Commission and preparing environmental impact assessment of recommended projects in case there are projects that may have negative impacts on the environment. The legislation taking place in this part is relevant to methods rather than arranging a specific area[5] and with its this qualification, it is one of the important aspects in environment acquis (Innanen 2004). EIA Directive No 2011 /92/EU requires determination and assessment of direct and indirect impacts of official or private projects relevant to the environment on human, plant, animal, soil, air, climate, tangible assets, cultural heritage[6]. Within AB adaptation process, this Directive and application studies carry a special importance for Turkey due to environment section that is still open at the stage of negotiation.

In order to that Turkey comply to this process, legal preambles of EIA system were continuously undergone changes and today at this stage, a structure that overlaps with EU acquis to a large extent reveals out. Thus this subject is emphasized at Turkey progress report of EU and it is clearly stated that EIA Directive is adapted except for transboundary EIA subject.

4- Amended by Council Directive 97/11/EC (14 March 1997) and Council Directive 2003/35/EC (25 June 2003).

5- Directive 885/337/EEC (97/ 11/EC) concerning to Environmental Impact Assessment, Directive 2003/35/EC concerning to public participation to plans and programs relevant to the environment, Directive 2001/42/EC concerning to Strategic Environmental Impact Assessment, Directive 90/313/EEC concerning to Access to Environmental Information (amended with 2003/4 EC), Reporting Directive 91/692/EEC, European Environment Agency Legislation (Amended with Council Legislation no 933/1999). LIFE (Financial Document for Environment) Legislation 1655/2000, Council Decision of Action Program for Incenting Civil Society Organization 466/2002

6- http://www.ab.gov.tr/index.php?p=92

II. Legal Preambles of EIA

The subjects relevant to the environment has started to gain importance in Turkey in 70s like so many countries. Depending on that, main environmental subjects were defined and frame of environmental policies were drawn and legal and corporate structures were started to be determined. Within this process, legal preambles of the Environmental Impact Assessment (EIA) system that is one of the most effective tools of environment management were started to be become evident; the subject gained legal status Environment Code No 2872 that entered into force in 1983.

In the Environment Code No 2872, the main aspects of environment policy were determined as taking necessary precautions by making research and inspection before pollution, making necessary precautions being taken and providing sustainable development with a conventional approach that is today accepted instead of the efforts for restitution after pollution of the environment. This policy was revealed at 10th article of Environment Code with the expression of; ''*Institutions, organizations and premises that may lead to environmental problems due to the activities that they plan to carry out are liable for preparing Environmental Impact Assessment Report or project introduction file. Unless Environmental Impact Assessment Positive Decision or Decision for Environmental Impact Assessment is not Required is not taken, approval, incentive, building and use license regarding to these projects are not given; investment may not be started and tendered for the project. The projects subjected to Environmental Impact Assessment and plan and programs subjected to Strategic Environmental Assessment and methods and principles concerning to the subject are determined with the legislation to be issued by the Ministry''.* In the application, this article that is the legal basis of EIA process refers to the studies concerning to determining positive and negative environmental impacts of the projects planned to be carried out, preventing the negative impacts and taking the precautions to be taken for minimizing them to an extent that will not damage the environment, determining the selected place and technology alternatives and assessing them and follow up and control of application of the projects. The studies aim to carry out the investments and activities to be done for improvement and economic development without damaging the nature and polluting the environment. Here the main aspects that are tried to be protected is environment and whole of the aspects forming the environment. In this respect, foreseen of EIA for eliminating and preventing the possible and current risks devoted to the environment is a requirement of Constitutional Law article no.56 for protection of environment that is imposed to the Government. Because Constitutional Law Article 56 reveals out constitutional dimension of this subject by the way of ''Everybody has the right of living in a healthy and balanced environment. It is duty of the Government and citizens to protect environmental health and prevent environmental pollution''.

With the aim of bounding the EIA process issued at Environment Code article no.10 with tangible principles and determining the application prin-

ciples, the first EIA regulation[7] was put into effect. With the aim of solving the problems that occur in the application and providing an effective and efficient application, the Regulation was revised in 1997[8]. Then within the scope of adaptation to European Union Legislation, EIA regulation was reissued in 2002[9]. The Legislation[10] was reissued 1 year after this arrangement but it was resubjected to a change in 2004[11]. It is required to change the Regulation once more time within EU adaptation process and new Regulation[12] was put into effect in 2008. But after this regulation entered into force, a need for a new amendment revealed out[13]. At the following process, two revisions were made in 2011[14] and one revision was made in 2013[15].6 months after the final amendment, a new regulation was issued[16]. This regulation is formed from 31 articles and 5 annexes[17].

III. EIA process

In order to define EIA process and understand its follow, 2014 dated EIA Regulation is reviewed under the below titles.

III. I. Project definition and owner

While the project concept is defined at regulation article no 4/s as ''investment that is planned to be carried out'', with the expression of ''natural or legal entity who will carry out the investment that is planned to be carried out'' (article 4/u).

III. II. Authorized Institution

According to EIA Regulation, 4 type decisions may be given for the projects that are subjected to this regulation. The decision making authority such as ''Environmental Impact Assessment is Necessary'' and ''Environmental Impact Assessment is not Required'' is given to Ministry of Environment and Urban Planning. But in necessary cases, decision making authority such as ''Environmental Impact Assessment is Necessary'' and ''Environmental Impact Assessment is not Required'' may be transferred to the Governorates in accordance with extent of authority principle after its boundaries are determined (article 5). But conformity of authority extent that is done with Regulation issuance is to be discussed. Likewise, it is the main rule that the authority may be only used by the institution to which the authority is given at the administrative law and this institution may not transfer its authority to another institution.

7 7/2/1993 dated Official Gazette No 21489
8 23/6/1997 dated Official Gazette No 23028
9 23/6/1997 dated Official Gazette No 23028
10 23/6/1997 dated Official Gazette No 23028
11 23/6/1997 dated Official Gazette No 23028
12 23/6/1997 dated Official Gazette No 23028
13 23/6/1997 dated Official Gazette No 23028
14 23/6/1997 dated Official Gazette No 23028
15 23/6/1997 dated Official Gazette No 23028
16 23/6/1997 dated Official Gazette No 23028
17 23/6/1997 dated Official Gazette No 23028

But it is possible to exempt this rule with the exemption of ''authority transfer'' and ''authority extent''. The Constitutional Court defined this authority extent as "the method of assigning the authorities resulted from public power such as taking necessary decisions for carrying out a part of duties and applying these decisions to an officer" (Tan 2013[18]). Giving such an authority to some competent authorities that they are hard to overcome makes usage of these authorities by these competent authorities impossible. It may be a matter of that specific authorities may be inevitably widened in this way. But it is necessary to fulfill some conditions for extent of the authority. For transfer of an authority that a competent authority has through extent of authority, this transfer is required to be done with the law.

III. III. Application

According to EIA Regulation, real and legal entities that plan carrying out any project within the scope of this regulation are liable to submit EIA Application File and EIA Report for the projects subjected to EIA; make The Project Introduction File being prepared by institutions or organizations authorized by Ministry of Environment and Urban Planning and submitting these to relevant authorities for the projects subjected to Selection and Elimination Criteria (article 6). As a newness to this article, the file may be only prepared by the institutions authorized by the Ministry in terms of preparing file. Also the aspects for being subjected to EIA stated at the definition and selection and elimination criteria are defined at the Regulation.

According to that

- The projects at the Project List (Annex I) to be Applied Environmental Impact Assessment,
- The projects at the Project List (Annex II) to be Applied Selection-Elimination Criteria for Which ''EIA is Required'',
- Increase capacity increase and/or widening concerning to the projects that are within or outside the scope of this Regulation, capacity increase of the projects at or over the threshold value stated at the ANNEX-I are subjected to EIA and it is compulsory to prepare an Environmental Impact Assessment for these.

The projects that are subjected to selection and elimination criteria;

- The projects that take place in ANNEX-II list,
- Increase capacity increase and/or widening concerning to the projects that are within or outside the scope of this Regulation, capacity increase of the projects at or over the threshold value stated at the ANNEX-II are defined as.

18 The Constitutional Court 22.06.1988, E. 987/18- K. 988/23, Official Gazette; 06.11.1988, Issue: 20001, p. 14.

III. III. I. The process for the projects subjected to EIA

The process for the projects subjected to EIA starts with application to Ministry with the EIA Application File that institutions/organizations authorized by the Ministry take EIA general format (Annex III) as basis and power of attorney concerning to that it is authorized by the project owner. The Ministry reviews the file in terms of conformity to the format and in case it does not conform to the format, it is refunded to complete the file. The project to be completed will be resubmitted to the Ministry. If the file conforms to the format, a commission formed from relevant public institution and organization representatives authorized by the Ministry authorities and project owner is established.

A copy of application file is sent to Governorate with the aim of announcing EIA process to public started by the Ministry and providing participation. Within the same object, Ministry makes the same announcements.

In the following stage, the Ministry sends a letter stating Public Participation Meeting and the date of issuing an opinion for scoping and EIA Application File prepared in accordance with the format at ANNEX III to the Commission members. The Ministry may invite universities, institutes, research and professional organizations, trade associations, trade unions, associations, representatives of civil society organizations to the meeting as members in cases the Ministry deems necessary depending on the project. It is a basis that the members carrying out duty as institution and organization representative in the commission have enough occupational information and experience and they are authorized to submit opinion limited to duty fields of the institutions and organizations that they represent.

The Commission reviews and assesses the EIA Report in fifteen days following the first review meeting. The Commission is gathered with absolute majority of the members. The Commission may request project owner to give extensive information concerning to the project, submit instruments and make analysis, experiment and measurement in a laboratory to be determined by the Ministry. In case there is a contradictive status at water, soil and similar analyses, witness sample may be applied.

III. III. II Application at the Projects Subjected to Selection Elimination Criteria

The Selection Elimination process is the process of making decision of which projects are subjected to EIA. With this aim, a project introduction file prepared by the institutions/organizations authorized by the Ministry and an undertaking letter stating that the information at the file annexes are submitted to the Ministry. In case Ministry detects deficiencies at the file, it refunds the file and request to overcome the deficiencies. If the deficiencies are not completed in six months, the project introduction files are refunded and application is declared as null (article 16).

As a result of the assessment by the Ministry, a decision as ''Environmental Impact Assessment is Required'' or ''Environmental Impact Assessment is not Required'' may be given. If the projects for which EIA is not Required is not started in five years, the decision is declared as null. In case normal EIA procedure is not started within one year at the projects for which EIA is Required, the application may be declared as null.

III. IV. Participation of the Public

It is seen that special importance is given to participation of the public at the Regulation. The public participation meetings are organized with the aim of giving information to the public concerning to the project and taking opinions and recommendations of the public concerning to the project. The place of this meeting is determined by the Governorate. When determining this meeting place, a center that persons who will be affected from the project may easily access is selected as meeting place. The institutions/organizations authorized by the Ministry put an announcement stating place, date, hour and subject of the meeting on a gazette defined as a common periodic as well as local period broadcast before at least ten days. The meeting is done under the chairmanship of Provincial Directorate of Environment and Urban Planning or an officer authorized by it. In the meeting, it is provided that public is informed about the project and opinions and recommendations relevant to the project is taken. The meeting minutes are sent to Ministry as one copy will be maintained by the Governorate (article 9). After this meeting, scoping and special formatting meeting is done.

III. V. Scoping

Within the frame of opinions and recommendations of commission member institution/organizations and public opinions and recommendations, the Ministry EIA Report Special Format is prepared. This format is given against payment of Special Format prince to be determined by the Ministry within three months following public participation meeting or completion of the meetings. If the relevant cost is not paid within the period, EIA process is terminated. The institutions or organizations authorized by the Ministry is liable for submitting EIA Report within eighteen months following receiving the Special Format. If EIA Report is not submitted within this period, EIA is terminated (Article 10). At the previous Regulation, the period was one year and if it is not submitted within this period, it may be extended. But this Regulation determines eighteen months' period without giving any extension.

III. VI. Submission and Review of EIA Report to Authorized Institution

EIA Report prepared by the institutions or organizations authorized by the Ministry is submitted to the Ministry. It is reviewed by the Ministry that whether this report conforms to special format or not and whether it is issued by the occupational specialists within the study group. In case refunded report is not completed within three months, the application is declared as null.

EIA Report of which conformity is applied is notified to Commission members who will determine place and date of the meeting that will be done in order to review and assess the Report. Also it is announced to public with appropriate instruments by the Ministry and Governorate that project review period is started and Report is submitted to the public opinion. These opinions are reflected on EIA Report by taking into consideration by the commission.

The Commission assesses EIA Report in ten working days following the first review assessment meeting. In this assessment, the commission may request from the institutions or organizations authorized by the Ministry to give extensive information concerning to the project, submit instruments or make analysis, experiment and measurements in the laboratories of private or public institutions or organizations authorized by the Ministry. In necessary cases deemed necessary by the commission, the Commission may make audits at the place and similar facilities where're project is planned to be carried out through its assigned members. In case important deficiencies and errors seem at EIA Report, the Commission may recover these from the institution or organizations authorized by the Ministry or relevant institutions. In this case, the review assessment process is paused. After necessary arrangements are done, it is sent to the Ministry and Ministry Commission is reinvited to the meeting and studies are continued. It may be requested from the institutions or organizations authorized by the Ministry to make amendments on EIA Report only for two times.

At the review assessment meeting done by the Commission; reviews and assessments concerning to whether EIA Report and its annexes are enough and appropriate or not, environmental impacts of the project may be extensively reviewed or not, necessary precautions are done for removing negative impacts that may occur at the environment or not, remedies are done for opinions and recommendations done within public participation meeting and process or not19. As seen at this point, public participation meetings are not a procedure requirement and assessment of the opinions put forth at these meetings are compulsory.

The institutions or organizations authorized by the Ministry submit final EIA Report of which final shape is given with review assessment meeting to the Ministry. The EIA Report of which final shape is given by the Commission is opened to negotiations by the Ministry and/or Governorate trough announcement and internet for ten calendar days in order to take opinion and recommendations of the public. The Ministry may request to complete the deficiencies at the report, make additional studies or reorganize of the Commission within direction of the public recommendations.

The warranty letter stating that final EIA Report and its annexes are under the warranty project owner and notary certified authorized signatures list are submitted to the ministry within five working days. Authorized signatures list is not requested from public institution or organizations.

The Ministry gives its relevant decision regarding to the project within ten

19 25 November 2014 dated EIA Regulation article 12/9.

working days by taking Final EIA Report and opinions and recommendations of the public into consideration. This decision may be as ''Environmental Impact Assessment Positive'' or ''Environmental Impact Assessment Negative''. The Ministry notifies this decision to project owner and relevant institutions and organizations in written. Also the Governorate announces to the public that content of the decision to be taken, preambles of this decision and public opinion and recommendations are reflected on the Report with appropriate instruments. In case the project for which EIA Positive decision is given is not started in seven years without having a force majeure, this decision is cancelled. In case there is change on the conditions that lead to giving this decision for the project for which EIA Negative decision is given, the project owner may make a new application (article 14).

III. VII. Audit

The Ministry monitors and audits whether undertaken aspects relevant to the projects for which ''EIA Positive'' or ''EIA is not Required'' decision is given are fulfilled or not. The Ministry may make cooperation with relevant institution and organizations in case it deems necessary. After the project owner takes abovementioned decisions, he/she is liable for getting the follow up reports concerning to start of the investment and construction period done by the institutions or organizations authorized by the Ministry and these institutions and organizations are liable for submitting these reports to the Ministry within the periods determined by the Commission.

The activities that are started without taking ''EIA Positive'' decision is terminated by the Ministry and activities that are started without taking ''EIA is not Required'' decision is terminated by senior administrative chief of the locality. Unless ''EIA Positive'' or ''EIA is not Required'' decision is not taken, decision of stay of execution relevant to the investment may not be abolished. If these decisions are not taken, investor is liable for restoring the activity field. Also an action pursuant to the relevant provisions of Environment Code No 2872 is taken.

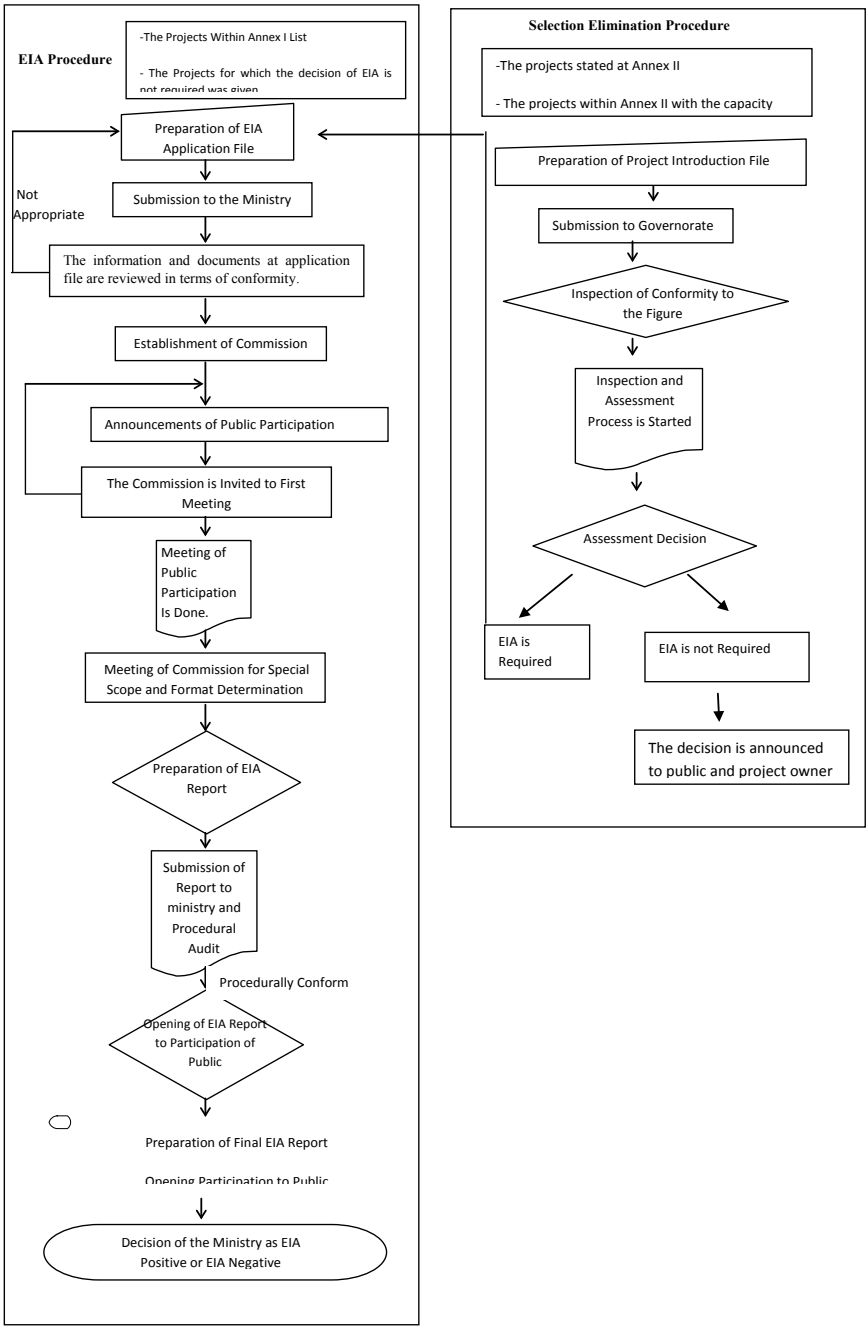
In case it is determined that the aspects undertaken at the final EIA Report or project introduction file is not obeyed by the project owner, extra time may be given by the Ministry or Governorate in order to obey these undertakings and aspects for one time. If undertakings are not obeyed at the end of this period, the investment is ceased. The decision of stay of execution is not abolished unless liabilities are not fulfilled and action is taken pursuant to relevant provisions of Environment Code No 2872 (article 19).

Finally, whole of the time given within the scope of EIA Regulation may be ceased or extended through stating the preamble in the cases of request of institution or organizations authorized by the Ministry and deemed necessary by the Ministry or Ministry directly deems necessary. Also 2014 Regulation allows for change of the project owner[20].

20 25 November 2014 dated EIA Regulation article 20 and 21.

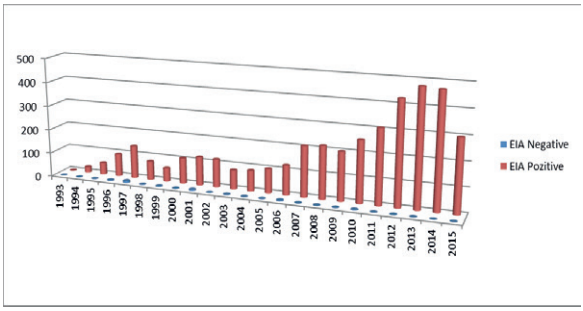
The period that is tried to be summarized above and seems long and complicated is shown at table I in the form of follow diagram with the aim of providing visual easiness and monitoring integrity.

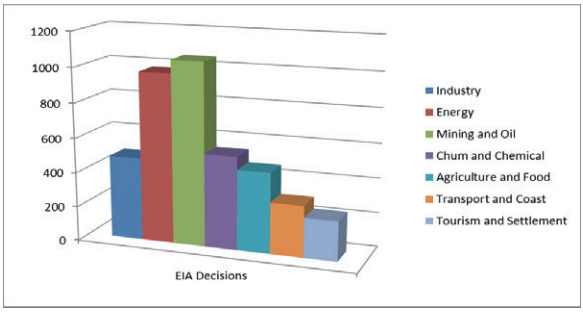
Table I. EIA Follow Diagram



V. EIA Application in Turkey

As seen from above review, EIA has become a process that coincide with EU Directive in terms of legal infrastructure and have settled principles and rules. It is useful to review application of the system that works in theory in this way. For this purpose, 1602 EIA applications were taken into assessment from 1993 when EIA application was started in Turkey until today and it was started to be analyzed over (Annex I) and figures. Primarily, first data (graphic I) is that 99.2% of the decisions that were given as result of EIA report was positive and 0,8% of these decisions was negative[21].





Some provinces come to forefront in terms of these reports and therefore activities that may lead to environmental damages. While Ankara forms a big majority of EIA decisions in Central Anatolia Region with 246 decisions, 288 of the decisions given for Aegean region were given for Izmir. It is seen that 235 decisions given for Mediterranean Region were given for Antalya. In Marmara Region, there is a more balanced distribution. As a conclusion, approximately 25% of total EIA decisions was given for Ankara, Istanbul, Izmir and Antalya that are 4 metropolitan cities of Turkey[22].

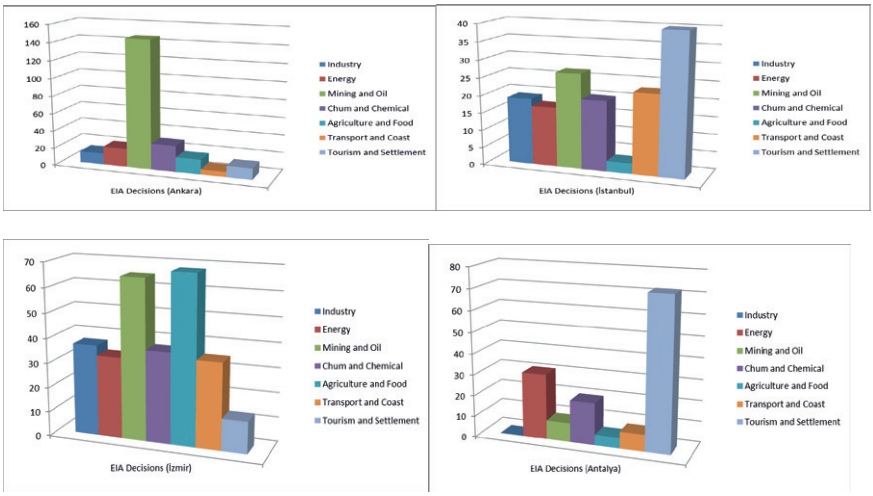
The distribution of EIA decisions according to sectors are very important in terms of determining the activity field among these data. As seen from the graphic, furthermost EIA decisions were given for oil and mining sectors.

21 - Taken from December 2015 dated data of Ministry of Environment and Urban Planning. http://www.csb.gov.tr/gm/ced/index.php?Sayfa=sayfaicerikhtml&IcId=673&detId=674&ustId=673

22- Taken from December 2015 dated data of Ministry of Environment and Urban Planning. http://www.csb.gov.tr/gm/ced/index.php?Sayfa=sayfaicerikhtml&IcId=673&detId=674&ustId=673

Energy, chemistry and industry sectors follow this sector. When this distribution is reviewed in terms of metropolitan cities, it is seen that this is similar in Ankara. It is seen that food and agriculture industry come to forefront in Izmir and oil and mining sector follow this sector. In Istanbul and Ankara, the furthermost EIA decisions were given for Tourism and Settlement fields[23].

Graphic for EIA according to Provinces



VII. SWOT Analysis

For organization and application, SWOT[24] analysis (Paliwal 2006) that is a technic foreseeing assisting in defining strategic directives necessitates extensive review of the factors that are the subject of a systematic thinking and analysis (Aktan 2007) and aims to provide information about applicability of the system in future. With the analysis, different points regarding to the subject may be seen together and allows for formation of a successful strategy by increasing strengths, decreasing weaknesses, getting benefit from opportunities and avoiding from threats (Shinno et al. 2006). This technic that facilitates understanding and perceiving through revealing out all aspects of the subject plays an advisor role for managers in decision making processes, their applications and strategy formulations (Toksoy et al. 2009). Therefore, SWOT analysis allows a useful method for review of EIA system (Glasson 1999).

At this stage of this stage, EIA process in Turkey will be tried to be analyzed with SWOT analysis. The data that are necessary for SWOT analysis were obtained through assessment of participation and conclusion reports of I.

23 Taken from December 2015 dated data of Ministry of Environment and Urban Planning. http://www.csb.gov.tr/gm/ced/index.php?Sayfa=sayfaicerikhtml&IcId=673&detId=674&ustId=673

24 The word of SWOT is formed from initials of strengths, weaknesses, opportunities and threats words.

National EIA Workshop25 that was organized in February 2009 with participation of all parts and International EIA Congress that was organized in November 2013.

Strengths

There are explicit provisions concerning to the subject at Turkish Legislation. As stated at the former parts, legal infrastructure of the subject is put forth at the Environment Code No 2872 enacted in 1983. With the aim of stating how EIA process will be applied, a regulation concerning to the subject was enacted. In the following years, this regulation was revised. The EIA Regulation that was revised due to EU adaptation process took its final form in 2014. EIA General Directorate manages the EIA process in Turkey. The General Directorate publishes EIA decisions given within the years and data concerning to continuing projects on the electronic media.

One of the strengths of EIA is the institution number that received EIA competence document. Even if visa period of some of these institutions has been expired, 280 companies received EIA competence certificate. This number is important as only these institutions may prepare EIA reports.

One of another strengths of EIA application is the general acceptance that has started to be formed concerning to that the subject is a necessary and useful application by all parties (Değerli and Ozbek 2013). The parties participated to 1th National EIA Workshop stated opinion concerning to that EIA is a positive application (Anon 2009). In the same workshop; it is among results of the workshop that technologic and scientific projects devoted to prefer of the projects with less wasteful and consuming less water, energy and natural source.

It is another strength that it is a study at which environmental impacts of EIA application is reviewed comprehensively (Bedelioğlu and Güllü 2013).

Also in the Workshop; importance of completion of TEIEN (Turkey Environmental Information Exchange Network) Project and integration to EIONET (European Environmental Information and Observation Network) is emphasized.

25 Total 489 persons including the university representative academicians, Ministry of Environment and Forestry, Turkish Foundation of Environment Protection, Turkish Union of Chambers and Exchange Commodities, Turkish Union of Cement Producers, Union of Iron and Steel Manufacturers, Istanbul Metropolitan Municipality, center and country representatives of public Institution and Organizations, TMMOB, Company Representatives that received EIA Competence Certificate, Semiofficial Chamber, Union and Institutions, representatives of civil society organizations participated to the relevant workshop (COB 2009).

Weaknesses

One of weaknesses of EIA application is the weak application at the assessment of the alternatives (Bedelioğlu and Güllü 2013). Discussion of alternatives give the opportunity preventing environmental damages and application of the project to EIA developers (Glasson 1999). Also assessment of different alternatives will give the opportunity of analyzing by focusing on the differences between the real selections (Glasson 1999). The insufficiencies in terms of monitoring and audit may be deemed among the weaknesses seen in other countries. At the doctrine, this subject is seen as a weakness in the Great Britain (Glasson, 1999). At the Final Declaration of National EIA Workshop in Turkey, it is emphasized to pay attention on preparation of Final EIA Reports covering follow up assessment plans. Also it attracts attention as a weakness that project owners have not personnel for follow up-audit works Along with that, preparation of EIA reports covering Environmental Risk Assessment, Environmental Management plan, follow up Assessment plans were mentioned in the EIA Workshop by showing an integrated approach to EIA process and deficiency of an integrated approach was drawn attention.

One of weaknesses of EIA process is that socioeconomic and social impacts are not taken into consideration in the reports (Glasson and Heaney 1993). Besides that, guide document deficiency at EIA report application is another important weakness.

In the general doctrine (Colakkadıoğlu 2013), one of the weakness occurred in EIA Workshop was that public participation was not given enough place. Public participation was not achieved especially at the activities within the scope of Annex-2.

Another weakness of EIA is environmental database deficiency. It draws attention as an important deficiency that environmental information is not open to share devoted to each shareholder group.

Also technic and legal infrastructure deficiency for putting strategic EIA into life is another weakness of EIA process. In order to minimize the errors against plan decisions in EIA Workshop, it was stated that Strategic EIA is required to be put into life at least one month (Anon 2009).

One of weaknesses of current EIA application is not having a regulatory nor for selection of commission members. This subject leads to insufficiency of commission members and this lead to not assessing the reports in due form.

Opportunities

Environmental policies and values have changed within time. For global environmental problems, precaution applications are revealed out for supporting applications climate for EIA and Strategic EIA (Glasson 1999). EIA application allows opportunities in other fields by taking socioeconomic and cumulative effects.

One of the opportunities that EIA application reveals out is strengthening adaptation to EU directive. In the following years, amendments have been continuously done at EIA regulation and adaptation to EU directive has been tried to be achieved. Also in the recent years, an important increase is seen at the number of the projects subjected to EIA. When the graphics are reviewed at the previous parts of the study, a stable increase is seen even if fluctuations are seen from 1993 when first EIA application was done in Turkey until today. As a result of that, application experience has increased evenly.

One of the study group recommendations in 1st EIA Workshop is recommendation of establishment of Environment Specialized Courts[26]. Therefore, it will lead to give healthier decisions about environmental subjects that establishment of a court that is specialized in environmental subjects.

Another recommendation of EIA Workshop was putting forth an opinion for developing environmental education. It was recommended to develop this subject with the cooperation of Ministry of National Education, Ministry of Environment and Forestry, local administrations, civil society organizations and universities as starting from the environmental education programs from preschool education and covering high school (Anon 2009). Therefore, an environment awareness on a firm basis will be formed at every part of the community starting from especially young parts.

Threats

One of the threats in EIA application is that access to environmental information is hard. It was stated at the EIA Workshop that it is required to provide this information to each shareholder at specific scales by taking interests of the country into consideration (Anon 2009)[27]. Besides that, another threat is insufficiency of public participation. Even if participation of the public is given place at the Regulation, it was stated at the Workshop that current application is insufficient. It was stated that improvement of public participation meeting announcement and participation is required. The most important deficiency that implementers observe was that meeting was not sufficiently announced. The recommendations for increase of public participation are making the meeting announcements with various communication tools and making these announcements out of office hours and weekends that public may be at home.

The change concern of the regulation is also one of the threats foreseen in EIA application. EIA Regulation arranging the subject until today was subjected to change especially in the last years. This situation prevents completely settlement of the process.

26 Establishment of Environment Courts will be an important point in terms of environment protection. But no concrete steps were taken.

27 But current data shows that this situation has been changed. General Directorate of EIA Permission and Audit took total 983 information application on January 2012 – September 2013 and concluded this (Oztürk and Colak 2013).

Competency of the commission members who will assess EIA report leads to another threat. Competence condition is required in terms of preparation of EIA report and Project Introduction File but no competency condition is required for the commission assessing these reports.

Another threat is that institution representatives participating to EIA process reflect opinions of the institutions that they are member not their own opinions.

Data quality and technical scope of EIA reports are not enough in terms of reference studies. It is required to be successful at the planning that local administrations have to be brought to required level technically (expert personnel need, equipment, etc.) and centralized administration show necessary support and effort in this subject (Anon 2009).

SWOT Analysis of EIA Process in Turkey

Strengths

- A legislation concerning to the subject including open and special provisions
- A legislation that conforms to EIU criteria
- A strong corporate structure organized at the level of General Directorate
- Quantitative competence of the companies that have EIA competency document
- Being study that has a wide scope
- The importance given to scientific studies (TEINEN project, etc.)

Weaknesses

- Insufficiency of guide documents (especially concerning to cumulative impact assessment)
- Weak application in terms of assessment of the alternatives (necessity for assessing all alternatives together as including inactivity)
- Insufficient application in terms of follow up and inspection
- Insufficient application in terms of assessing cumulative impacts
- Insufficiency of an effective participation process (insufficiency of public participation for the activities especially within the scope of Annex II)
- Insufficiency of environmental database
- Putting transboundary EIA application into life
- Insufficient of technical and legal infrastructure for putting strategic EIA into life

- Insufficient application level in terms of decreasing environmental impacts
- Insufficiency of an integrated approach between EIA system and planning process
- Insufficiency of a regulatory norm concerning to selection of commission members

Opportunities

- Forming policies in the subject of environment
- Existence of the processes that support international environment law and increase of cooperation opportunities (Cooperation with International accreditation institutions in especially monitoring and inspection subjects)
- Increase of environment awareness in the public
- Strengthening adaptation to EU Directive
- Increasing the project number subjected to EIA and application experience
- Providing adaptation in SCD and forming legal basis
- Establishment of environment specialized courts

Threats

- Information access hardness
- Existence of a part that perceives EIA as money and time loss
- Long decision making processes
- Legal processes that extends to the cancellation
- The concern of amendment of the regulation
- Insufficiency of reflection degree of participation of the community
- Institution representatives change approach of the institution that they represent within the process of EIA
- The models that will be applied and analyses that will be done within the process of EIA are not determined
- Competence level of the commission members that will assess the reports
- Data quality, technical scope and level of EIA reports in terms of reference studies

IIX. Conclusion and Recommendations

Although EIA application was entered into Environment Code in 1983, the first regulation that will show EIA application was put into force in 1993. Efforts of Turkey for adapting its Regulation to EU process have been densified in the following years and EIA Regulation has also got its share and subjected to so many changes. The EIA Regulation that was last put into force in 2014 resembles to EU EIA Directive in soma aspects.

The first EIA application in Turkey was done in 1993 and has continued with an increasing momentum. The EIA decisions that were given may be collected under 7 titles. These are, industry, energy, mine and oil investments, chemistry and waste investments, agriculture and food investments, transportation and coast investments and tourism and settlement investments. A big majority of EIA decisions that were given are mine and oil investments. The chemistry and waste investments and energy investments follow mine and oil investments.

When four metropolitan cities of Turkey are reviewed, similar results to general of Turkey are seen in Capital City Ankara and Izmir. More than half of the decisions in Ankara are relevant to mine and oil. It is seen that the decisions relevant to tourism and settlement investment come to forefront in Istanbul that is the city in which furthermost population of Turkey live in and Antalya that is another metropolitan city.

Nearly whole of the EIA decisions that are given are positive decisions (a little more than 99%). It is an interesting result that such a big part of given EIA decisions is positive. These results bring the result of that how much Final EIA Reports are assessed carefully to the mind.

As a conclusion; as stated at the Swot Analysis, EIA application gave and still has been giving so many positive results. There is an enough legislation concerning to the subject that conforms to EU EIA Directive. Also everybody had got the idea of that EIA application is a necessary and useful method. EIA application gives the opportunity of inspecting the investments that will affect the natural resources becoming restricted day by day. But weak sides and risks that were put forth at the National EIA Workshop has continued their existence in last six years. It shows unwillingness of the administration that a solution has not been found although EIA Regulation has changed three times after the workshop.

It is recommended to try using opportunities mentioned in SWOT Analysis. The arrangements that will allow competence of commission members especially that will inspect EIA reports.

Necessary legal arrangements for EIA are to be done and EIA applications are to be applied. Because EIA process is the process that will minimize planning errors.

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CHAPTER 3

DETERMINATION OF RELATIONSHIPS BETWEEN YIELD AND YIELD COMPONENTS IN ORGANICALLY GROWN AND CONVENTIONALLY GROWN DRY BEAN (*PHASEOLUS VULGARIS* L.) BY CORRELATION AND PATH COEFFICIENT ANALYSIS

Ümit GİRGEL[1], Alihan ÇOKKIZGIN[2]

INTRODUCTION

Correlation and path coefficient analysis helps to significant relationship between various characters. The path coefficient analysis technique, first introduced by Wright [11], was used to determine the features affecting direct and indirect efficiency. Path analysis is an important and effective method of statistical analysis. Path coefficient analysis is an analysis method that reveals the direct and indirect effect of a variable on another variable.

Bean is important food for human consumption. It is currently estimated that the common bean is to be one of the most important legumes in the world [4]. It's provides that 30% of the caloric requirement and 15% of the protein requirement to the world's population [7].

The aim of the study was to determine correlations of agronomic and botanical parameters and to evaluate direct and indirect effects, via path analysis in organically grown dry bean and conventionally grown dry bean.

MATERIAL AND METHOD

Thirteen local (Ardıçlı, N.Paşa, Bademli, Tekpınar, Tepecik, Petekli, Çakmaklı, Değirmenli, Öztoprak, Çatakbahçe, Köprüköy, Madenköprü and Aydıntepe) and three registered common bean (Aras-98, Güngör and Önceler-98) (Phaseolus vulgaris L.) genotypes were used and the study was conducted at Bayburt University, Aydıntepe Vocational School (40°24'05.7"N 40°08'31.3"E) in 2017 growing year. All genotypes were grown both under organic farming conditions and conventional farming conditions. The experiment was established with three replications.

The effect levels of the characters determining grain yield were detected by correlation and path coefficient analysis. Path and correlation coefficients were calculated using the Totemstat statistical analysis program, which is a Windows compatible version of the Tarist statistical analysis program.

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2- Gaziantep University, Nurdağı Vocational High School, Department of Plant and Animal Production, Gaziantep-Turkey

RESULTS AND DISCUSSION

Correlation Coefficient

According to organic farm treatment results, positive and significant (0.633**) relationship was found between the first pod height and grain yield, while there was a negative but significant relationship between stem diameter and first pod height (-0.651**).

Positive and significant relation was determined between pod length and stem diameter (0.598*).

Table 1. Correlation coefficients matrix for organic bean farming

	2	3	4	5	6	7	8	9
1	0.633**	-0.332ns	-0.280ns	0.457ns	-0.161ns	-0.492ns	0.188ns	-0.519*
2		-0.651**	-0.458ns	0.536*	-0.621*	-0.579*	0.478ns	-0.734**
3			0.598*	-0.743**	0.735**	0.583*	-0.481ns	0.503*
4				-0.242ns	0.471ns	0.813**	-0.437ns	0.365ns
5					-0.350ns	-0.404ns	0.329ns	-0.571*
6						0.449ns	-0.484ns	0.483ns
7							-0.640**	0.572*
8								-0.639**

1. Plant height, 2. First pod height, 3. Stem diameter, 4. Pod length, 5. Pod width, 6. Pod number per plant, 7. Seed number per pod, 8. 1000 seed weight, 9. Seed yield

Positive-significant relation (0.536*) between the pod width and the first pod height and negative-significant relation (-0.743**) between the stem diameter were determined (Table 1).

When the correlation coefficients were evaluated in terms of number of pods per plant, negative-significant (-0.621*) and positive-significant (0.735**) relationships were found between the first pod height and the stem diameter respectively.

Seed number per pod have positive and significant correlation with stem diameter (0.583*) and pod length (0.813**). But it have negative and significant correlation with first pod length (0.579*).

There is a negative but significant relationship (-0.640**) between the 1000 seed weight and seed number per pod. Similar results have been reported by Gonçalves et al. [3].

There are positive and significant relationships between seed yield and stem diameter (0.503*) seed number per pod (0.572*). Relations between other characteristics are insignificant. On the other hand negative but significant correlations were found between seed yield and plant height (-0.519*), first pod height (-0.734**), pod width (-0.571*) and thousand pod weight (-0.639**). These results were in accordance with the results reported by Yücel [12].

If the correlation coefficients of conventionally grown beans are exam-

ined, the values of correlation coefficients are as follows. A positive and significant relationship (0.566*) was found between the first pod height and plant height (Table 2).

A positive and significant relationship was found between the pod length and the stem diameter (0.517*).

There is a positive and significant relationship between seed yield and number of pod in the plant (0.974**). Similar opinions are reported by some researchers [8,3]. Other relationships were found to be insignificant.

Table 2. Correlation coefficients matrix for conventional bean farming

	2	3	4	5	6	7	8	9
1	0.566*	0.169ns	0.011ns	0.010ns	-0.107ns	-0.428ns	-0.002ns	-0.141ns
2		0.100ns	0.228ns	-0.220ns	0.193ns	-0.237ns	0.152ns	0.214ns
3			0.517*	-0.401ns	-0.402ns	-0.245ns	0.377ns	-0.386ns
4				-0.402ns	0.067ns	-0.288ns	-0.086ns	0.001ns
5					-0.038ns	-0.324ns	0.046ns	-0.067ns
6						0.089ns	-0.288ns	0.974**
7							0.068ns	0.054ns
8								-0.227ns

1. Plant height, 2. First pod height, 3. Stem diameter, 4. Pod length, 5. Pod width, 6. Pod number per plant, 7. Seed number per pod, 8. 1000 seed weight, 9. Seed yield

Path Coefficient

In the organic growing bean treatment, the direct effect of pod length (11.9593%) and number of pods per plant (16.5691%) is found to be positive on seed yield on the other hand it was determined that the direct effect of plant height (8.0976%), first pod height (26.4861%), stem diameter (34.8438%), pod width (35.3990%), seed number per pod (2.7959%) and 1000 seed weight (30.3278%) is negative on seed yield (Table 3 for path coefficients and Table 4, it's rates).

The indirect effects are examined; the highest positive effect with a rate of 32.0796% on the seed yield was obtained pod width via stem diameter (0.4686). The highest negative effect on the seed yield was observed the number of pods per plant via stem diameter with 32.0796% ratio (-0.4630). Our results are in agreement other studies [10,6].

Table 3. Path coefficients for direct and indirect effects between parameters in organic bean

	Direct	Indirect Effect							
	Effect	1	2	3	4	5	6	7	8
1	-0.0790		-0.0500	0.0262	0.0221	-0.0361	0.0127	0.0389	-0.0148
2	-0.4236	-0.2680		0.2756	0.1939	-0.2271	0.2632	0.2453	-0.2026
3	-0.6304	0.2092	0.4101		-0.3773	0.4686	-0.4630	-0.3674	0.3035

4	0.1414	-0.0396	-0.0647	0.0846		-0.0342	0.0666	0.1149	-0.0618
5	-0.5450	-0.2489	-0.2921	0.4051	0.1317		0.1910	0.2201	-0.1792
6	0.2392	-0.0385	-0.1486	0.1757	0.1127	-0.0838		0.1073	-0.1159
7	-0.0387	0.0190	0.0224	-0.0226	-0.0315	0.0156	-0.0174		0.0248
8	-0.3929	-0.0737	-0.1879	0.1891	0.1718	-0.1292	0.1903	0.2513	

1. Plant height, 2. First pod height, 3. Stem diameter, 4. Pod length, 5. Pod width, 6. Pod number per plant, 7. Seed number per pod, 8. 1000 seed weight

Table 4. Path coefficients for direct and indirect effect rates between parameters in organic bean

	Direct	Indirect Effect							
	Effect	1	2	3	4	5	6	7	8
1	8.0976		3.1253	1.4498	1.8724	2.3441	0.8809	2.8096	1.1450
2	26.4861	27.4566		15.2324	16.3999	14.7516	18.2345	17.7235	15.6384
3	34.8438	21.4397	25.6402		31.9101	30.4354	32.0796	26.5457	23.4260
4	11.9593	4.0588	4.0466	4.6776		2.2194	4.6155	8.3046	4.7739
5	35.3990	25.4985	18.2654	22.3879	11.1370		13.2303	15.9061	13.8336
6	16.5691	3.9428	9.2897	9.7091	9.5295	5.4436		7.7549	8.9445
7	2.7959	1.9508	1.4008	1.2464	2.6600	1.0153	1.2031		1.9109
8	30.3278	7.5552	11.7460	10.4529	14.5318	8.3916	13.1870	18.1597	

1. Plant height, 2. First pod height, 3. Stem diameter, 4. Pod length, 5. Pod width, 6. Pod number per plant, 7. Seed number per pod, 8. 1000 seed weight

According to the results of conventional agriculture treatment are examined; the first pod height (13.8189%), the number of pods per plant (92.4963%) and the weight of 1000 seeds (13.3887%) were found to be direct positive effect on seed yield. On the other hand, plant height (39.4942%), stem diameter (0.4981%), pod length (47.8610%), pod width (44.2919%) and seed number per pod (40.9013%) direct effects on grain yield were determined as negative (Table 5 is path coefficients and Table 6 is path coefficient rates).

The indirect effects are examined in the conventional treatment, the highest positive effect with a rate of 40.4820% on the seed yield was observed first pod length via pod number per plant (0.1896). The highest negative effect on the seed yield was obtained stem diameter via pod number per plant with 60.3243% ratio (-0.3946). Our results are in agreement Gonçalves et al. [3]. Direct effect of pod number per plant was reported researchers [1,5].

Table 5. Path coefficients for direct and indirect effects between parameters in conventional bean

	Direct	Indirect Effect							
	Effect	1	2	3	4	5	6	7	8
1	-0.1487		-0.0842	-0.0252	-0.0017	-0.0015	0.0160	0.0637	0.0003
2	0.0647	0.0366		0.0065	0.0147	-0.0142	0.0125	-0.0153	0.0098
3	-0.0033	-0.0006	-0.0003		-0.0017	0.0013	0.0013	0.0008	-0.0012
4	-0.1878	-0.0021	-0.0427	-0.0971		0.0754	-0.0125	0.0541	0.0161
5	-0.1541	-0.0015	0.0339	0.0618	0.0619		0.0059	0.0499	-0.0071
6	0.9825	-0.1055	0.1896	-0.3946	0.0656	-0.0375		0.0871	-0.2827
7	-0.1899	0.0813	0.0450	0.0465	0.0547	0.0615	-0.0168		-0.0129
8	0.0510	-0.0001	0.0078	0.0192	-0.0044	0.0024	-0.0147	0.0035	

1. Plant height, 2. First pod height, 3. Stem diameter, 4. Pod length, 5. Pod width, 6. Pod number per plant, 7. Seed number per pod, 8. 1000 seed weight

Table 6. Path coefficients for direct and indirect effect rates between parameters in conventional bean

	Direct	Indirect Effect							
	Effect	1	2	3	4	5	6	7	8
1	39.4942		17.9839	3.8491	0.4277	0.4298	1.5041	13.7176	0.0833
2	13.8189	9.7302		0.9878	3.7529	4.0955	1.1753	3.3052	2.5813
3	0.4981	0.1465	0.0695		0.4295	0.3759	0.1232	0.1720	0.3221
4	47.8610	0.5627	9.1261	14.8411		21.6772	1.1797	11.6469	4.2173
5	44.2919	0.4113	7.2446	9.4499	15.7688		0.5535	10.7437	1.8738
6	92.4963	28.0308	40.4820	60.3243	16.7103	10.7774		18.7666	74.1507
7	40.9013	21.5952	9.6170	7.1099	13.9359	17.6719	1.5852		3.3830
8	13.3887	0.0290	1.6580	2.9397	1.1140	0.6804	1.3828	0.7468	

1. Plant height, 2. First pod height, 3. Stem diameter, 4. Pod length, 5. Pod width, 6. Pod number per plant, 7. Seed number per pod, 8. 1000 seed weight

Considering the results obtained from organic farming, or conventional farming, the number of pods per plant can be used in the selection studies. It is reported that the number of pods per plant is a criterion to be considered in selection studies [9,2].

CONCLUSION

According to correlation coefficient there are positive and significant relationships between seed yield and stem diameter, seed number per pod in the organic farming, on the other hand in the conventional farm there is a positive and significant relationship between seed yield and number of pod in the plant.

In the result of the path coefficient analyses the number of pods per plant is an important criterion for bean breeding.

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CHAPTER 4

EFFECT OF DIFFERENT OSMOTIC PRESSURE LEVELS ON GERMINATION CHARACTERISTICS OF KIDNEY BEAN (*Phaseolus vulgaris* L.)

Alihan ÇOKKIZGIN[1], Ümit GİRGEL[2]

INTRODUCTION

In the world, legumes have less harvest area and less production quantity than cereals, but the most produce in legumes is dry beans (26.833.394 ton). On the other hand beans cultivated on 88.548 hectares in Turkey, 235.000 tons were produced. It also has a yield value of 265 kg/da (FAO, 2016).

Germination is the most critical period in the life cycles of plants (Ahmad et al, 2009). And the seeds exposed to negative environmental conditions such as drought may compromise the seedling growth (Albuquerque and Carvalho, 2003).Water availability has a significant role in vital matters of germinating seeds (Bialecka and Kepczynski, 2010).The negative effect of water shortage on germination and seedling growth has been reported (Mostafavi et al., 2011).Drought stress affects almost every developmental stage of the plant. In particular, the harmful effects of this stress have attracted more attention when it becomes to various stages of growth, such as germination (Khayatnezhad et al. 2010). Water stress is a limiting factor on seed germination duration and seedling growth (Shanon and Francois, 1977).

Polyethylene glycol has been used as an osmotic agent a lot research (Kaufmann 1969; Mcwilliam and Phillips 1971; Woods and Macdonald 1971). Exposure to PEG solutions has been effectively uses to mimic drought stress (Hohl and Schopfer, 1991).In this study, kidney bean seeds were germinated using PEG-6000 chemistry mimic drought stress and germination properties in seeds are examined.

MATERIAL AND METHODS

Seed Material

Nationally registered kidney bean cultivars used (Kınalı and Şelale) in the research. The study was conducted at Gaziantep University Vocational School of Higher Education in Nurdagi, in climate controlled cabinet.

1- Gaziantep University, Vocational School of Higher Education in Nurdağı, TURKEY
2- Bayburt University, Aydıntepe Vocational School, Bayburt, TURKEY

Seed Treatments and Measurements

Firstly kidney bean seeds were surface-sterilized with 5% sodium hypochlorite according to Sauer and Burroughs (1986) and washed with distilled water (2.5 µs/cm). The seeds were germinated in 120-mm-diameter sterilized petri dishes. All Petri dishes were washed with tap water, followed by a rinsing with distilled water, and then sterilized at 170°C for 4 h in hot air sterilizer (Muhammad and Hussain, 2010).

Polyethylene glycol 6000 (PEG-6000) solutions were prepared with osmotic potentials of 0.0 (Control), -3, -6, -9 and -12 bar PEG-6000 solutions were prepared as 0.0 (Control), -3, -6, -9 and -12 bar with using distilled water (Michel and Kaufmann, 1973). The petri dishes were arranged in a completely randomized design (CRD) with three replications. There were 20 kidney bean seeds in each petri dishes. 15 ml of the solution was applied to each petri dish. Germination cabinet adjusted 25ºC temperature and 50% relative humidity. Petri dishes were placed in germination cabinet for 9 days (ISTA, 2011). All petri dishes controlled daily and 5 ml distilled water was added. The following parameters were studied. Radicle wet weight, plumule wet weight, radicle dry weight was calculated according to Keshavarzi (2012). Radicle and plumule length was measured in centimeters with using caliper (AOSA, 1983). The germination ratio was calculated according to AOSA (1983).

Statistical Analysis

The results were evaluated using the Statistical Analysis System software v.9.0 (SAS, 2004). The experimental design comprised completely randomized design (CRD) with three replicates. On the other hand mean separation was performed by Least Significant Difference (LSD) test (Düzgüneş et al. 1983)

RESULTS AND DISCUSSION

According to statistical analysis results, significant differences were found between cultivars in terms of RWW, PDW, RL and PL parameters. The differences between PEG-6000 applications and PEG-6000 x Cultivar interactions are statistically insignificant (Table 1).

[3]Table 1. Summary of the variance analysis for the measurement features[4]

Source of Variation	df	Mean Square						
		RWW	PWW	RDW	PDW	RL	PL	GR
PEG-6000	4	0.00124	0.02148	0.000008	0.00010	0.07935	2.64067	17.917
Cultivar	1	0.00894[3]	0.04665	0.000003	0.00135[4]	6.85452[4]	5.82561[4]	30.000
PEG-6000 x Cv.	4	0.00148	0.00842	0.000011	0.00001	0.57955	0.82864	198.750
Error	20	0.00121	0.01135	0.000011	0.00008	1.51086	1.02810	84.166
CV(%)		28.3	32.9	19.6	25.1	29.4	28.3	10.4

3- Significant at 0.05 (p≤0.05)

4- Significant at 0.01 (p≤0.01) other parameters are non-significant, df: degrees of freedom; CV(%):Coefficient of variation

Differences between PEG-6000 applications are statistically insignificant but the highest values obtained from -3 bar osmotic pressure except RL and GR parameters (Table 2). On the other hand the lowest germination rate was obtained when the PEG was given the most (85.8%). Germination reduction due to PEG is the cause of osmotic stress (Dodd and Donovan, 1999). And high concentrations of PEG reduce the final germination percentages. Similar results gained by other scientists (Siahsar *et al.* 2010; Midaoui et al, 2001). Reduction of ratio of germination under osmotic stress was reported by scientists (Pandya *et al*, 1972; Ashraf and Abu-Shakra, 1978; Thill *et al*., 1979; Akeson *et al*. 1980; Stout *et al.*1980).

On the other hand it is reported that growth of some plants was reduced under the osmotic stress (Hutton, 1971).

Table 2. In terms of PEG-6000 concentrations RWW, PWW, RDW, PDW, RL, PL and GR means and statistically groups

OP (bar)	RWW	PWW	RDW	PDW	RL	PL	GR
0	0.1105	0.3585	0.0155	0.0390	3.98	4.22	88.3
-3	0.1435	0.4115	0.0183	0.0390	4.24	4.34	89.2
-6	0.1102	0.2688	0.0158	0.0312	4.23	2.90	90.0
-9	0.1317	0.2915	0.0173	0.0320	4.19	3.41	86.7
-12	0.1198	0.2868	0.0167	0.0313	4.27	3.05	85.8

OP:Osmotic Pressure (bar), RWW:Radicle Wet Weight (g), PWW:Plumule Wet Weight (g), RDW:Radicle Dry Weight (g), PDW:Plumule Dry Weight (g), RL:Radicle Length (cm), PL:Plumule Length (cm), GR:Germination Rate (%)

In terms of the RWW feature, Kınalı cv. (0.1404 g) has a higher value than type Şelale cv. (0.1059 g) On the contrary, the Kınalı cv. (0.0278 g) has lower value than Şelale cv. (0.0412 g) in terms of PDW feature (Table 3). According to varieties, radicle and plumule weight are variable parameters. This situation is due to genetic structure. Similar opinions are reported by Muscolo et al. 2014.

On the other hand our results were similar to those reported by Shanon and Francois (1977), Smith et al. (1989), and Livingston et al . (1990).

Table 3. In terms of cultivars RWW, PWW, RDW, PDW, RL, PL and GR means and statistically groups

Cultivar	RWW	PWW	RDW	PDW	RL	PL	GR
Kınalı	0.1404A	0.2840	0.0171	0.0278 B	4.66 A	3.14 B	87.0
Şelale	0.1059B	0.3629	0.0164	0.0412 A	3.70 B	4.03 A	89.0

Means followed by the same letter are not significantly different (LSD test)

Similar to the RWW, the RL value was also found to be higher in Kınalı cv. (4.66 cm) and lower in Şelale cv. (3.70 cm). In parallel with the PDW, the PL value was also found to be higher in Şelale cv. (4.03 cm) and lower in Kınalı cv (3.14 cm). Relationships between the other parameters examined are statistically insignificant. It is reported that different results are obtained according to varieties (Muscolo et al. 2014).

CONCLUSION

According to the results obtained from research, no significant differences were observed among PEG-6000 treatments. But the highest values obtained from -3 bar PEG-6000 osmotic pressure except radicle lenght and germination rate parameters. On the other hand radicle-related properties have higher values for the Kınalı variety, whereas plumule-related properties have higher values for the Şelale variety. Despite, it is statistically insignificant; in terms of germination rate, the Şelale cv. has a higher value than Kınalı cv.

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CHAPTER 5

VITICULTURE IN TURKEY

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INTRODUCTION

Grape, as well as all over the world, is one of the plant products received in the first culture in the border with Turkey. With its phenolic and antioxidant value, taste and aroma, adaptation to many ecologies, visuality and the ability to be converted into different products, it has emerged as a culture for thousands of years. In Turkey, as in the world, although the species *Vitis vinifera*, being grown on their own roots, is a widespread species, American species as rootstock is widespread because they are resistant to some soilborne diseases, nematodes and phylloxera, emerged in 1900s, , Grape, which is more than a fruit within the borders of Turkey, has been a part of Turkish culture.

It has also become an important resource for the country's economy by moving the country to the foremost position in raisin export and the second position in raisin production in the world (Table 4, 5). Turkey, in 2017, with 2 109 000 metric tons of table grape production, and with 1 603 000 metric tons and 488 000 metric tons of raisin and dry grape wine productions, total of 4.2 million metric ton at 4.169 million hectares, (Table 2) is ranked 4th in the world (Table 3).

History of Grape and Viticulture Culture in Turkey

Situated on a fairly favorable climate for viticulture, Turkey also has an old and deep-rooted viticulture because Anatolia is one of the most important grapevine centers. It has been determined that the viticulture in Anatolia dates back to 3500 BC. There are lots of figures and reliefs associated with grapes on the decorations located in large parts of the historical artifacts from archaeological excavations in Turkey's various regions (Anonymous, 2018a).

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Figure 1. Ivriz rock monument (Konya). Warpalawa, King of Hittites, worshiped arhunza, god of thunder, with a bunch of grapes in his hand (Anonymous, 2018a).

When the history of viticulture and wine-making in Anatolia was mentioned, the civilization that came to mind was Hittite civilization from 1900 BC onwards; It is known that the Hittites learned viniculture from the people who lived in Anatolia before. The Assyrians, an important civilization of Lower Mesopotamia and Anatolia, have advanced in trade as well as wine. In the excavations carried out in Diyarbakır province, the existence of tools and equipment related to grape fossils and wine-making belonging to 1300s BC shows that this civilization is much older. According to the results of the excavations, Assyrians were found to carry dried grapes and wine from one place to another, and they concluded that they made trade in raisins and wine (Gürkan, 2014).

Figure 2. Museum of Anatolian Civilizations (Hittite, 3000 BC) made of solid gold, wine jug and wine glass with feet (Deliorman Orhan et al., 1999).

When we look at other mysterious beauties of Anatolian history, as a result of the excavations in Van, there are outstanding samples such as the remains of the Early Iron Age found in Yedikilise Village, the grape seed that is left behind from the grapes presented as gifts to the dead; the Menua (900-3000 BC) remaining from the Urartu (Semiramis, Şamran) the irrigation canal and the vineyards around it; the inscriptions mentioned grapes and the established vineyards in the Ercis-Van district; and the church Akdamar, with exterior decoration and especially decorated with adorable grapevines frescoes, built by the Vaspurakan King Gagik by the years 915-921. In Hisarlık-Çanakkale, grape seed fossils were found as 3000-4000 years ago. It is seen that the lamp belonging to 1750 BC, which carries many bunches of grapes side by side in Konya Karahöyük, is also used in the wall tiles of mosques and palaces in the Seljuk and Ottoman periods. In line with this information, the role and importance of grapevines in human life has been understood in Anatolia for thousands of years (Deliorman Orhan et al., 1999; Gazioğlu Şensoy and Tutuş, 2017; Anonymous, 2018b).

Grape has been accepted as a sacred fruit in the regions where viticulture develops, especially in the Aegean, Mediterranean, Middle East and Anatolian civilizations, which has been the sign of abundance, fertility and productivity. It was used as a powerful symbol in the mystical and religious systems and literary traditions. In the works of Mevlâna Celaleddin Rumi, who is a well-known Turkish thinker and sufi, there are Turkish viticulture related words such as "üzüm (grape), kuru üzüm (raisin), üzüm salkımı (bunch of grapes), salkım (bunch), üzüm tanesi (a grape), üzüm çubuğu (grapevine stick), üzüm yaprağı (grapevine leaf), asma (grapevine), asma yaprağı (grapevine leaf), asma dalı (grapevine branch), koruk (unripe grape), üzüm suyu (grape juice), üzüm şarabı (wine), şarap (vine), bağ (vineyard) and bağcı (vine grower) (Akarpınar, 2005). Again, the great Turkish traveler Evliya Çelebi also mentions a lot in the places he visited in Anatolia, the magnificent vineyards and the high quality grapes (Temelkuran and Aktaş, 1986).

Anatolia is the cradle of many civilizations to this day and is the homeland of vine culture and winemaking. Because the oldest ruins have come out of the Anatolian soil until now, and it is possible to find remains related to grapes in the ongoing research (Refik, 1926).

Grape Production Values in the World and Turkey

Grape cultivation in the world is generally spread between 20°-52° altitudes in the northern hemisphere and 20°-40° altitudes in the southern hemisphere (Anonymous, 2015). More than half of the world's grape production is realized in the European continent (Duran, M., 2003). It is estimated that there are over 10 000 grapevine varieties in the world. Turkey, which is the fatherland of grapevine, has more than 1 200 grape varieties. However, only about 50-60 of these are considered to be economically significant (Anonymous, 2015, Semerci, 2015).

Table 1. Amount of certified grapevine saplings (pieces).

Years	Grapevine
2005	2 276 862
2006	5 179 290
2007	6 157 120
2008	2 958 185
2009	2 032 860
2010	3 407 915
2011	3 499 880
2012	3 393 588
2013	7 129 690
2014	5 465 230
2015	4 981 436
2016	4 349 560
2017	3 826 412

(Anonymous, 2018c)

Table 2. Grape production areas and production amounts for years in Turkey

Years	Areas (1000 Ha)	Production Amounts (1000 metric tons)			
		Total	Table grape	Raisin	Wine
2005	5 160	3 850	2 000	1 400	450
2006	5 138	4 000	2 060	1 496	444
2007	4 846	3 613	1 913	1 218	482
2008	4 828	3 918	1 971	1 478	470
2009	4 790	4 265	2 257	1 532	476
2010	4 778	4 255	2 250	1 544	462
2011	4 725	4 296	2 269	1 562	465
2012	4 623	4 234	2 220	1 614	401
2013	4 688	4 011	2 133	1 424	455
2014	4 671	4 175	2 167	1 563	445
2015	4 620	3 650	1 892	1 335	424
2016	4 352	4 000	1 991	1 537	473
2017	4 169	4 200	2 109	1 603	488

(Anonymous, 2018d)

Table 3. Grape production in the World (1000 metric tons)

Country	12/13	13/14	14/15	15/16	16/17 (Jun)
China	38,500	39,680	40,920	42,600	43,500
European Union	12,207	11,865	13,636	12,659	12,295
United States	4,049	4,690	5,067	4,502	4,649
Turkey	2,900	2,930	2,289	2,740	2,700
India	1,915	1,900	1,900	1,900	1,900
Iran	1,693	1,693	1,693	1,693	1,693
Chile	1,420	1,310	1,210	1,335	1,410
Russia	1,264	1,417	1,409	1,311	1,335
Ukraine	1,211	1,211	1,211	1,211	1,211
Brazil	1,231	1,377	1,263	1,041	1,045
Other	5,244	5,437	5,526	5,445	5,426
Total	71,635	73,510	76,124	76,437	77,165

Foreign Agricultural Service/USDA Office of Global Analysis (Anonymous, 2017a.)

Table 4. World Raisin Production (1000 metric tons)

Countries	11/12	12/13	13/14	14/15	15/16	16/17 (Sept)
United States	349	314	368	332	348	315
Turkey	250	310	242	320	220	300
China	100	150	165	180	190	185
Iran	150	180	160	130	139	150
Uzbekistan	35	22	18	52	70	73
Chile	74	68	69	65	68	62
South Africa	37	46	46	66,	53	53
Argentina	31	32	21	37	41	40
Afghanistan	30	24	31	370	33	35
Australia	13	13	10	12	15	18
Others	22	21	20	20	20	20
Total	1,092	1,179	1,150	1,250	1,196	1,251

Foreign Agricultural Service/USDA Office of Global Analysis (Anonymous, 2017a.)

Table 5. World raisin production (Exports) (1000 metric tons)

Countries	11/12	12/13	13/14	14/15	15/16	16/17(Sept.)
Turkey	216	247	187	260	202	220
United States	133	124	159	127	114	125
Iran	122	150	131	102	113	120
Uzbekistan	33	20	16	49	68	70
Chile	73	67	66	62	67	60
South Africa	25	32	35	53	45	45
Argentina	29	29	16	30	35	35
Other	71	65	79	70	78	74
Total	702	734	689	753	722	749

Foreign Agricultural Service/USDA Office of Global Analysis (Anonymous, 2017a.).

Except very high sections of Eastern Anatolia and Eastern Black Sea coastline having annual rainfall of 1000 mm, viticulture has been done all parts of Turkey, which ranks fourth in the world's vineyard area (Uysal, 2015).

Organic Viticulture in Turkey:

Turkey is in sixth place in organic grape production with 10,645 ha area and follows Spain, Italy, France, China and United States. A significant portion of organic grape production in Turkey is cv. Sultani seedless consumed as raisins. All organically produced raisins are exported (Willer and Lernoud, 2017, Köse and Odabaş, 2005).

Grape Products in Turkey

1-Table Grape Production

In World production of table grapes, Turkey, with an annual production 2.7 million metric tons, is placed in # 4 after China, the European Union and United States (Anonymous, 2017a). A large number of table grape varieties, which belong to the region or are imported outside the country and have been adapted, are produced in the country. Amasya Beyazı, Alphonse Lavalée, Alppehlivan, Cardinal, Çavuş, Değirmendere Siyahı, Erenköy Beyazı, Edincik Karası, Hafızali, Osmancık, Pek, Pembe Gemre, Pembe Çekirdeksiz, Perlette, Sultani Çekirdeksiz, Yuvarlak Çekirdeksiz, Hacıbalbal, Hacıoğlu Siyahı, Hamburg Misketi, Italia, Kozak Beyazı, Kozak Siyahı, Muscat Reine des Vinges, Müşküle, Razakı, Kömüş Memesi, Gül Üzümü, Kadın Parmağı, Parmak, Karaerik, Tahannebi, Hönüsü, Dımışkı and Şilfoni are the standard varieties that are cultivated the most in different regions of the country (Çelik at al., 2005).

Figure 1. Table Grape (Photo: Elver AKCAN)

2-Use of Grapes as Raisin

In World production of raisins, Turkey, with an annual production 300 000 metric tons, is located in # 2 after United States. In raisin export, Turkey, with 220 000 metric tons, is a world leader (Anonymous, 2017a). The country is home to a large number of grape varieties for raisin, which belong to the region or have been adapted outside the country. Besides the Sultani Seedless variety, which is the most important cultivar of the country, Yuvarlak Çekirdeksiz, Akdimrit, Karadimrit and Besni are the standard varieties which are cultivated most in different regions of the country (Çelik at al.,1998).

Figure 2. Raisin production
(Photo: Hicran AKAALP)

Figure 3. Raisin grapes

3-Use of Grapes as Wine

The Anatolian lands have thousands of years of history about wine making. However, despite being one of the most suitable countries for the world's wine production, only 2 percent of the grapes grown in Anatolia have been used in wine production.

Figure 4. Wine grapes

4- Use of Grapes as Pekmez (Molasses)

Although the production of pekmez in Turkey has been very long and in large quantities, the production technique has not changed and the necessary standardized technology has not been obtained nationwide. For pekmez, grape juice extracted in various forms is heated after the addition of soil special for pekmez production, and then filtered and to darken on the open flame in the boilers. The pekmez obtained by this method is very clear and its color is very dark. The dark color in pekmez is due to caramelization of sugars and acids in the composition to the reaction with other substances as a result of boiling the syrup at high temperature in the open air (Birer, 1983, Şimşek at al., 2002, Kaya at al., 2005, Batu, 2006, Gazioğlu Şensoy and Akcan 2014, Akaalp, 2007), Zile's Pekmez: White Zile's pekmez belong to Zile town of Tokat province is a laborious traditional food which must be beaten to the whiteness as the last step made by adding egg white and soil for pekmez in the grape syrup (Batu, 2006).

Figure . 5. and, 6. Molases production

5- Confectionery products made of grape syrup

Sucuk with walnut

It is made with pekmez and walnuts and produced in many parts of Turkey. Fresh walnuts (it might be also made with almonds, peanuts or hazelnuts) lined in a string are dipped into a mixture of pekmez, starch/flour, and water mixed thoroughly and cooked in a pudding consistency, then hanged and dried (Sürücüoğlu and Çelik, 2013, Gazioğlu Şensoy and Akcan**,** 2014).

Figure 7. and 8. Sucuk with walnut production
Figure 9.Sucuk with walnut
(Photo: Hicran AKAALP)

Pestil

Nearly 5-12% of starch crushed with warm grape juice was added to the boiling grape juice almost becoming pekmez and cooked and then spread on clean cloth and dried. The back of the cloth is wetted and separated (Sürücüoğlu and Çelik, 2013). The split pestil is cut into pieces in the size of the book page. These pestil leaves are folded in half and folded into smaller pieces and starched to prevent sticking (Birer, 1983).

Kofter

Pekmez, starch and water are mixed first, then cooked in the consistency of the pudding. Then the prepared mixture poured in thin layer on a tray spread with starch. When dried, it is cut in the shape of a baklava slice, stored in soil troughs. It can be consumed fresh or dry (Baysal, 2007, Gazioğlu Şensoy and Akcan 2014)

Figure 10. Kofter

Bastık

The syrup, which is prepared as if is in pestil, is poured thicker, then dried and sliced (Gazioğlu Şensoy and Akcan 2014).

Muska

The fresh pestil, which is peeled from the cloths, is cut into strips 4-5 cm wide and 20-25 cm long. Walnut, pistachio or almonds, cloves, cinnamon, are powdered. This mixture is put into the pestle strips. It is folded in equilateral triangles. The ends of the wrapped muskets are glued together with water (Birer, 1983).

Figure 11. Muska

Brined Leaf Production

The grapevine leaf which has an important place in the culinary culture of Turkey is an important flavor that embellishes Turkish cuisine. Brined leaf production is being done in many places where vine is produced in the country. Production of brined leaf is economically produced in Tokat in the

first place in Turkey. Selection of varieties is very important in grapevine leaves to be used as food. Grapevine varieties show different characteristics in terms of traits such as shape, thickness, hairiness, and slices of the leaves. Though the leaves in the edible property are thin, low haired and unsliced as possible are desired by consumers, but thick, hairy and sliced ones are not liked by consumers. Today, in Turkey, the most preferred grapevine cultivars for the production of brined and canned grapevine leaves are cv. Sultani Seedless in Aegean region, cv. Narince in Tokat province and cv. Yapıncak in the region of Thrace (Çelik at al., 2005, Göktürk at al., 1997, Gülcü at al., 2011, Gülcü and Torcuk 2016, Cangi at al., 2005).

6-Soap Production from Grape Seeds

The soap with antioxidant properties and skin clearing is produced using grape seeds in different regions of Turkey (Gazioğlu Şensoy and Akcan 2014)

Figure 12. Soap production from grape seeds

7-Vinegar Production

Vinegar; is a product obtained by fermentation of alcohol and then acetic acid by fermentation of fresh or dried grape with sugar in its structure. Vinegard production can be carried out in modern facilities or in home conditions in Turkey and it can be used for different purposes such as in pickles, or in salads (Gazioğlu Şensoy and Akcan 2014).

Figure 13. Vinegar

8-Production of Floury Products from Grape Seeds

In recent years, grape seed and pulp have been transformed into flour products with different grinding techniques by a study carried out by Dicle Development Agency (DIKA) (Anonymous, 2014).

9- Use of Grapevine as Ornamental Plant

In Turkey and in the world, grapevines as ornamental plants and shadows in pergolas are widely used in front of the house, in parks and gardens (Gazioğlu Şensoy and Akcan 2014).

Figure 14. and 15. Pergolas with grapevines

10- Viticulture and Tourism

Turkey is a potential tourist paradise with its cultural and natural beauty. However, it is mostly based on foreign visitor profile, sightseeing and cultural tourism. For people who are longing for nature and natural life, there are a variety of agro tourism options. (Ak, 2006). Vineyard tourism, which is located in agro tourism, is of great importance in terms of being environmentally, ecologically sustainable, economically practical and socially acceptable. Compared to most countries, Turkey has a rich geography, culture and nature; although it has great potential, it does not receive adequate share of agricultural tourism. In this context, as a contribution to the development of vineyard tourism in our country, the promotion of our cultural values, touristic initiatives in the region, paving the way for the agricultural industry will help the development of the labor force and therefore will help to solve the social problems (Türkben at al., 2012).

According to the Mayan civilization, the legend, as well as the world's one of the most mysterious places Sirince village of Foca, and Cesme (Alacati) in Izmir province, is one of Turkey's best example in terms of rural tourism. Şirince Village is an important place of viticulture tourism with its wine houses and local wine sales shops and grape-themed souvenirs. The Urla Vineyard Road, which is also developed in Urla (Izmir), is home to many local and foreign visitors with its "Agro-tourism-Vineyard Tourism Project" and its vineyards and wineries.

Thrace vineyard-wine route is one of the centers of tourism activities in viticulture tourism. Bozcaada, the second largest island of the Aegean Sea, provides winemaking training for its visitors with its extensive vineyards, 4 wine factories and numerous small factories. Avşa Island, which has a special micro air conditioner, is one of the most important centers in the area of aquaculture and agro-tourism, especially in the province of Balıkesir with the grape variety Adakarası and in recent years the cultivation of grape varieties such as Syrah, Cabernet Sauvignon and Merlot.

Located in Turkey's Anatolian region of Cappadocia Region, in areas with volcanic tuff soil dominates the intensive viticulture potential, and significant touristic importance of, in the wine and viticulture, tourism stands out as one of the major centers. In the same region, Kalecik district is one of the important centers with its Kalecik Karası variety. In the South Anatolian Region, Diyarbakır and Elazığ, Öküzgözü and Boğazkere are important vineyards with wine grapes. In 1937 for the opening of the railway line that will extend to Iran and Iraq, Atatürk came to Elazığ and ordered the establishment of a wine factory in the region; it was the basis for the revival of vineyard tourism. Moreover, in Turkey's Eastern and Southeastern Anatolia, Mardin, Kahramanmaraş, Şanlıurfa, Elazığ, Diyarbakır, Gaziantep and Kilis provinces with intensive viticulture, and the widespread production of traditional products derived from grapes of this region's history and had the cultural fabric; grape-derived products such as pekmez, köfter, and sucuk wih walnut add value to the region in terms of tourism. Furthermore, there are all high potential for agro-tourism for Şarköy and Mürefte in Tekirdağ province, Pamukkale in Denizli province, and İznik in Bursa province; and it might contribute to the development of tourism in Turkey (Soykan, 2003; Yıldız, 2009; Türkben at al., 2012, Yücel ve Kasmelieva, 2014; Karataş al al 2015; Anonymous, 2017b; Anonymous, 2017c Anonymous 2018d).

11- Use of grape in food

Current is produced especially in Gülnar (Mersin province) and Senirkent (Isparta province) in Turkey. In Turkish cuisine, grape is mostly used in pilafs, stuffed vegetables, compote, cakes, desserts and Noah's pudding.

Grape seed also is a grapevine product whose consumption has increased rapidly in recent years. Due to its high level of antioxidant, it is very important for health. As a result, it is increasingly used both in medicine and as a spice (Akın and Altındişli, 2010).

12- Grape Juice

Grape juice production in Turkey is lower than other fruit juices. Grape juice's foreign trade income is also lower than the World and EU rates (Kiracı and Şenol, 2010).

As as a result grape is very important for Turkey. İn the World these common usage areas in the world, grape is consumed in different forms such as molasses, vinegar, sucuk, bastik, muska etc. in the geography of Turkey; brined grape leaves are consumed; and also its vine can be used for shade and landscape purposes.

Regions Where Intensive Viticulture Done in Turkey

Marmara Region

Papazkarası, Gamay, Yapıncak, Cinsault and Semillon are among the most produced cultivars of grapes in Tekirdağ province (Anonymous, 2018a). Ça-

nakkale and Bozcaada, excels with the cultivars Vasilaki (Altıntaş) and Kuntra (Karasakız). In Bozcaada, especially in recent years, wine production has been increasing with the establishment of new vineyards and the opening of new factories. Moreover, the production of Merlot is also common in near Saros. In Avsa and Marmara islands, the wines made with cv Adakarası are important and unique to these islands (Anonymous, 2018d, Çavuşoğlu, 2012).

Central Anatolia and Inner Black Sea Region

Nevşehir province, having significant portion of the large wine production plants in Turkey, produces mainly cultivars Emir, Kayseri Karası, Dimrit and Şıradar. There are many wine production facilities in Ankara province. Among the significant other grape varieties grown in the region are Kalecik Karası and Hasandede (low-acid and fairly sweet white grape cultivar having its name from a town of Kırıkkale province). The cv. Narince (with old white wine in wooden barrels) is found in Tokat province (Altıncı at al., 2017, Anonymous, 2017b).

Aegean Region

Among the grapevine cultivars for wine grown in İzmir province, there are Cabernet Sauvignon, Carignan, Alicante Bouchet,. Shiraz, Bornova Muscat and Foca Karası. In recent years, Urla and Çeşme districts outside the province center of İzmir have come out with wine and grape production. Denizli, another province famous for the wine of the Aegean Region, is known for cv. Sultaniye and cv. Çal Karası which are used in the production of Rose wine and named for Çal town (Anonymous, 2017b).

Eastern and Southeastern Anatolia Region

Anatolia's most valuable red wine grape is obtained from cv. Öküzgözü grown in vineyards in Elazığ and Malatya provinces. The cv. Boğazkere grown in Diyarbakır stands out with the acrid taste for wine enthusiasts due to its high tannin content. The wine resulting from the mixture of Öküzgözü and Boğazkere grapes are among the most famous and preferred wine brands of Turkey. The wine produced in Midyat and Mardin provinces of Southeastern Anatolia, is produced from Mazruna and Kerküş varieties of local grapes by the dwindling numbers of Syrian Othodoxies known for its wine-making tradition. Moreover, Van Province and its vicinity still have a very old and deep-rooted viticulture practices that continue throughout civilizations, even though it has lost a large part of the vineyard areas for various reasons. (Anonymous, 2017b, Gazioğlu Şensoy and Akcan 2014, Akaalp, 2007, Gazioğlu Şensoy at al., 2018,, Gazioğlu Şensoy and Tutuş, 2017).

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A SURVEY OF ATTITUDES TOWARD WATER USER ASSOCIATIONS BASED IRRIGATION MANAGEMENT ON TURKEY'S GAP-HARRAN PLAIN

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1. Introduction

Water is a strategically important resource in the present and will be in future, as it was in the past, because it cannot be found at any time, at any place, in desired quantity and the quality. Population growth, urbanization, industrialization, and agricultural irrigation are placing increasing pressure on water resources. Even though water is a renewable resource, its quantity and quality decline daily as usage rises. In terms of sectoral water usage, as well as in Turkey and in the world, agriculture is the largest water consumer group. These rates differ depending on the level of development of the countries, but the usage of water in agriculture has great importance for every country. Agriculture consumes 70% of the world's water use (UNESCO-WWAP, 2003) and 72.7% of that of Turkey (Anonymous, 2014), where water consumption rose 373% between 1980 and 2012. The quantity of water used in irrigation rose 356% within this period (Anonymous, 2014). Turkey has 8.5 million ha of technically and economically irrigable land and around 5 million ha of land under irrigation (Anonymous, 2005). Water is one of the most important inputs of agriculture. Irrigation makes agriculture possible in arid and semi-arid areas where rainfall is not enough during the growing season of the crops and the farmers are aware of benefit of irrigation and contributes to food safety, GDP, and employment. As consumption rises and global warming brings droughts, serious water problems are expected. Therefore, management and operation of efficient irrigation systems are crucial. Currently, irrigation management is largely carried out by Water User Associations (WUA) in Turkey.

1.1 History of Irrigation Management in Turkey

The Çumra Irrigation and Drainage Project, built during the Ottoman Empire in 1908–1914, was Turkey's first modern irrigation and drainage project. After the Republic of Turkey was established, the national government drained marshlands to prevent malaria and built small irrigation projects. Turkey's first WUA, Korkuteli WUA, was established in 1942 and placed under the district governor and gendarmerie following a dispute between two districts that drew water from the same river in 1942. It ceased operations

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in 1943 and resumed in late 1949. Today, around 5,000 ha of irrigated area takes water from the Korkuteli Dam, which has taken over the operation and maintenance of irrigation facilities serving about 5,000 farmers.

Turkey's State Hydraulic Works (DSI) was founded in 1954 as the country's main water management authority. The DSI oversees investment in water resources and has constructed dams, irrigation systems, potable water projects, and flood control structures. Operation and maintenance of irrigation services are provided by DSI or are transferred to real and legal entities that are granted the responsibility to manage and maintain facilities but not their ownership.

As elsewhere, Turkey conducts operations and maintenance services in two primary ways:

- Irrigation management by the state
- Irrigation management by the organizations created by beneficiaries and/or local administrations.

The state managed irrigation facilities until 1993, although DSI transferred management of small-scale ancillary facilities with no permanent organization that it could not manage efficiently. Since 1993, DSI has transferred 2,000 ha of small irrigation networks to WUAs annually. Further, DSI has encouraged a participatory approach by transferring 62,000 ha of irrigation areas to limited liability irrigating groups.

Starting in 1993, large irrigation facilities were transferred wholly or in units with similar characteristics, including natural boundaries and drainage of rivers, to WUAs which were established with the regulations prepared by the Ministry of Interior and have a public legal personality. WUA is responsible for the operation, maintenance, repair and management responsibility of the facilities it has taken over in accordance with the principles laid down in the framework and transfer agreement. These regulations were far from reflecting the field needs and irrigation management. The objective was to form optimal field size for delivering service. If necessary for effective management, units were merged. Transfers were made in three ways:

- **Unofficial Transfer:** The General Directorate of Rural Development, later closed and transferred to provincial administration, built small-scale structures.
- **Joint Management Participation:** DSI constructed irrigation facilities, later transferred according to arrangements contracted among organizations.
- **Full Transfer:** DSI constructed irrigation facilities, later transferred under state-approved contracts to organizations such as WUAs. The transfers facilitated farmers' participation, decentralization, and reimbursement, encouraged self-regulation by representatives of beneficiaries, and reduced operating and maintenance expenses.

1.2. Current Situation and Legislation in Turkey

To increase users' sense of owning the irrigation systems, DSI primarily transferred operations fully to WUAs, which are now a significant presence in irrigation management. To encourage efficient operation, DSI after 1993 began transferring management of irrigation systems to WUAs, based on the regulations of Ministry of Interior, created by water users and farmers and 96% eventually were transferred (Anonymous, 2016). These transfers, which were not based on any irrigation laws, have created serious problems in the transferred irrigation areas. Accordingly, the public, DSI, has prepared the law on irrigation unions. Law No. 6172 (Anonymous, 2018a) bestowed significant responsibilities and burdens on WUAs in 2011. It specified that they must meet all expenses for management, maintenance and repair, refund of investment, finance, personnel and energy costs, and purchase of goods and services. However, most of the existing WUAs did not have the capacity to carry out these tasks with their existing structures. Thereafter, an additional article has been introduced to Law No. 7139 (Anonymous, 2018b) and some new regulations have been introduced in 2018. As a result of these new arrangements, the operation of the irrigation facilities can now be transferred to the Municipalities and Special Provincial Administrations under the specified conditions, as well as to private persons and legal entities through service procurement. Although these new regulations are of a kind that will contribute to the improvement of irrigation management, it is likely that they will bring new problems. There are structural problems in irrigation management in Turkey. These are: problems arising from irrigation systems, problems arising from irrigation management, legal and structural problems, pricing and problems arising from water users and WUAs.

The problems based on WUAs is examined in this section. The WUAs were unable to meet these legally specified responsibilities under their existing structures and pricing policies. One of the most important problems of WUAs is the election which is based on the delegate system. Delegate system is the representative of the farmers among the farmers and selected by the farmers based on land size. Delegates can reflect their personal expectations when they negotiate with candidates of WUAs' managers during the election period. There is no clarity on the number of members of the WUAs council. Each WUA council must have at least 15 and no more than 100 members. Each residential area is represented by at least two members on the WUA council; with the approval of the founding group, this number can reach 150 for WUAs with more than 40 residential units. Therefore, it is unclear how many members will be on a WUA council. There are problems with the collection of irrigation fees by WUAs from the water users. Accordingly, WUAs have a problem of budget equivalence which is compulsory by law. The WUAs have a multitude of public inspections, which can be problematic in practice. Public audits are not effective. The audits are carried out predominantly on the basis of procedures, not on the basis of efficient use of resources. WUAs have problems with the way and number of personnel recruitment. The transfer agreements signed between DSİ and WUAs must be developed. There is a need to solve

the legal, technical and economic problems of the WUAs and irrigation cooperatives where public irrigation facilities are handled and to improve their management structures.

It is questionable whether transferring management of irrigation systems to WUAs management is yielding the desired benefits. Political bias, members' insufficient education and training, and ignorance of natural resources present serious structural problems in irrigation management in Turkey.

2. Examined Area: the GAP–Harran Plain

The Southeastern Anatolian Project (GAP, Figure 1) is a multi-sectorial and integrated regional development project that seeks to use the GAP's water and soil resources to increase regional incomes and living standards, eliminate regional disparities, and encourage economic development and social stability. At present, 22 dams, 19 hydroelectric power plants, and irrigation of 1.8 million hectares of agricultural land fall under its scope. The total investment cost is US$32 billion (GAP, 2014). Harran Plain is located within Şanlıurfa's Haliliye, Eyyübiye, Harran, and Akçakale districts. A hot, semi-arid climate, average precipitation is 300–365 mms, and the annual evaporation rate is 1,848 mms (DMİ, 2014). Irrigation of Harran Plain under GAP supervision began in 1994. Initially encompassing 30,000 ha, irrigation now covers approximately 150,000 ha (Anonymous, 2016).

Figure 1. Turkey, GAP-Harran Plain (Source: Anonymous)

From 1994 to the present, 22 WUAs have been conducting operations, repairs, maintenance, and management under DSI's supervision. One of the most important problems in irrigation management in the GAP-Harran plain is the large number of WUAs. They serve with different numbers of personnel and equipment in different amounts. This often leads to a lack of effective and efficient use of resources, in other words, to a waste of public resources. Throughout their history, WUAs operating under GAP have been unable to provide the required services for numerous reasons, most of them related to irrigation and drainage (Yenigün and Aydogdu, 2010).

2.1. Materials and methods

2.1.1. Interviews

The first survey was conducted in 2012 and then observation is repeated between the years of 2012-2016 on a yearly basis. Although there are slight differences depending on years, the results are generally the same. In this study, data of the first year are included and the comments are made based on the ones obtained in the whole process. The 21,904 farmers lived and worked in the 22 WUAs on the Şanlıurfa-Harran Plain. During the irrigation season, we held 568 face-to-face interviews with four groups of farmers, chairmen and managers of WUAs, and DSI staff. We interviewed all 22 chairmen and 22 managers of WUAs and chose at random 471 farmers and 53 DSI staff responsible for irrigation, management, and operation.

2.1.2. Method

Although 377 questionnaires would have met statistical confidence at the 95% level, I distributed 471 questionnaires seeking respondents' views about WUAs, water pricing, and payments and measured responses on a Likert scale. Within this scope, all WUAs were visited. To enhance reliable results, villages were selected by purposeful sampling to represent each WUA. To reduce farmers' misgivings, surveys were conducted with the help of pollsters from the area who speak the local dialect and were acceptable within the area's tribal and ethnic demographics. The questionnaires applied to farmers and data obtained from visits and interviews were transferred into Excel using a general coding plan to create a flexible database.

3. Results and discussion

3.1. Basic attributes of farmers

It is surveyed with male farmers because of the region's patriarchal family structure. Average of respondents were middle-aged, about 21 years of farming experience and 95% were married. Although 60% were literate and had primary school education, 7% were university graduates. On average, their households contained 7.05 persons. This number is large compared with urban households, but large families provide more workers and convey social status in the region. On average, each respondent cultivated 15 ha, and more than half owned their property. The remainder either rented land or partnered with other farmers. Most of the land was traditionally furrowed and employed gravity irrigation. Around 10% used modern, pressurized irrigation systems. Cotton is the main crop, followed by wheat, corn and barley, red lentils, vegetables, orchards, vineyards, and gardens.

3.2. Farmers' views, perceptions, and expectations of WUAs

Figure 2 shows responses to the question, "Are you satisfied with the WUA?" Respondents who answered "disagree moderately" or "no" generally operate farms distant from main irrigation channels and/or are located downstream. They cannot get enough water during irrigation season and believe the WUA is not fully performing its duties and excluding them.

Respondents who expressed satisfaction with WUAs were asked to elaborate. According to the received responses, the most important factors were easy access to WUAs by farmer, acceptance and interest shown to them with 62% rate, both in choices and in index-based rating in satisfaction. Other reasons for satisfaction included equal and fair treatment to all members, sufficient irrigation services, repair-maintenance and distribution, collection of water fees, and water pricing, respectively. Although irrigation services were expected to be the foremost consideration, this result may be attributable to the value that the region's inhabitants place on personal acceptance. Aydogdu et al. (2015a) showed that 68.5% of farmers indicated land ownership as their greatest source of satisfaction.

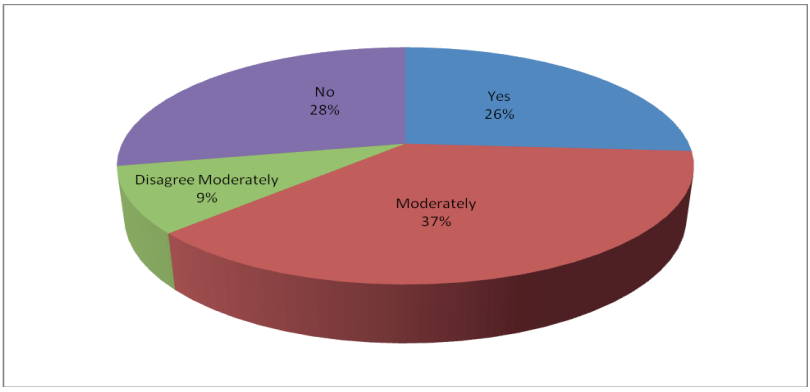

Figure 2. The satisfaction rate of the farmers from water user association

Respondents who expressed dissatisfaction with WUAs were also asked to elaborate. The WUA's lack of interest in them, except during elections, ranked foremost (43%) both in the survey and in an index-based rating. Other reasons include not treating every member equally and fairly, insufficient irrigation services, inadequate repair-maintenance and distribution, high water fees, and pressure to pay the fees.

Almost, one-third of respondents expressed extensive knowledge about the WUA, one-third moderate knowledge, and one-third insufficient knowledge. Their knowledge was mainly based on services provided by WUAs. So, one in three respondents do not have sufficient knowledge regarding the purpose, duty and function of WUA. I found that only 13% of respondents had read official documents from WUA (e.g., agreements, regulations, and instructions) and 43% had not. Survey results indicated that 22% of respondents had good knowledge of the organizational, technical, and financial structure of WUAs, 39% had moderate knowledge, and 39% had little or no knowledge. Respondents indicated that their knowledge of WUAs came principally from observing WUA services in the field and talking with other members, not from reading WUA documents.

In general, respondents indicated that the number of WUA technical personnel (engineers, technicians, and operators) is insufficient and that

WUA employees do not keep them sufficiently informed. In addition, 64% of respondents believed WUA's investment and management decisions were insufficient or unsatisfactory, and 41% believed that WUAs' financial structure and income are adequate to provide services. Respondents considered the quality of services provided by WUA to be insufficient. Respondents' major source of discontent is their belief that WUA's have financial resources adequate to carry out their duties but are not doing their best. Respondents' unfavorable perception of the sufficiency and coherency of the WUA's investment and operational decisions is an important finding.

The WUAs are farmers' unions and management being elected by the farmers. The farmers believe that they have a right to say something about decisions by 1% and the management as a whole (the union president, council, and committee), they have right to do by 88% in the WUA. Approximately 49% of the respondents believe the board is less than satisfactory or unsatisfactory in fulfilling its duties. Aydogdu (2015) found that farmers' hold higher regard for engineers, technicians and field employees of WUAs more than for union management. More than half (52%) of the survey respondents believed that members of the union board and their relatives benefit most from WUA's services, 23% believed all members receive equal treatment, and 25% believed that the farmer applying to the WUA benefit more.

In addition, 53% of respondents indicate they receive sufficient amounts of water, 22% stated they receive a moderate amount, 18% stated that they receive less than a moderate amount, and 7% stated that they receive a very insufficient amount of water. Respondents in the final two groups are located at the ends of the main irrigation channel. Those who receive sufficient water are located immediately beside the main channel or at the beginning of the irrigation field. Asked if they participate and have a say in decisions regarding irrigation services (e.g., preparing water distribution plans), 18% indicated they participate actively, 33% described themselves as moderately active, and 49% indicated little or no participation. Respondents generally believe they have no say in irrigation decisions. This response validates responses to the previous question "Who has the most say in the WUA?"

Among respondents, 17% indicated they sought external help with technical issues such as irrigation period, the amount of water released, and the amount required by their crop and 83% indicated they sought no external help. Of those who receive technical support, 49% inquire at state institutions, 28% receive support from the private sector, 12% ask public employees when available, and 11% receive support from universities and research institutes. It is quite significant that universities and research institutions take the last place.

The survey sought to determine respondents' contributions to preserve irrigation facilities (e.g., channels, water intake structures, and drainage) and which they rated as most important: 47% indicated preserving the irrigation systems, warning nearby farmers, and reporting those who damage it. The remaining respondents pointed to carrying out minor maintenance wit-

hout excessive cost, cleaning the channels, and doing nothing, respectively. Respondents generally believe the state should perform these services and feel little responsibility to contribute. The choice for using modern irrigation methods to increase system productivity was selected the least with 2%. In any case, 10% of respondents use modern irrigation methods, thus validating this outcome. Situations observed during survey field work are coherent with these results.

Respondents were asked to reveal their expectations of WUAs and rank their importance. It is categorized their responses by distributions, index-based rankings, and percentages. Their most important expectation (22%) is to receive water when required, followed by treating farmers equally and fairly, easy access to WUA, and low irrigation fees (although respondents do not find irrigation fees excessive). Only 12% of respondents mentioned information and consulting services as meaningful expectations. Respondents generally believe they are not accepted in WUAs, find them difficult to access, and think authorities lack interest. As a result, they believe it is difficult to receive information and consulting services or that the services will be substandard. Other respondents referenced individual expectations as important, such as erasing water debt or creating employment. Field interviews revealed that respondents have expectations of WUAs related to irrigation, such as providing cheap and high-quality agricultural inputs, support in processing and marketing products, and provision of suitable credits for agricultural activities.

Respondents were asked whether they agree, moderately agree, or disagree with several statements concerning WUAs' activities. Table 1 displays the distribution, index listing, and ranking of their responses. Irrigation interval and water supply ranked first in choices and in index based ranking. Respondents generally obtain irrigation water when they need it. Collection time and method of fees were second both in the ranking of choices and in index ranking. Respondents generally feel that fee collections are flexible and they are not being forced to make payments. Developing irrigation, training, and extension services were last both in ranking of choices and index ranking.

Table 1. Distribution of respondents' opinions concerning WUA activities (Aydogdu et al., 2015b).

Subject About WUA Activities	Agree	Moderate	Disagree	Index	Ranking
Management activities	26%	51%	23%	958	4
Irrigation planning and its time interval	26%	55%	19%	974	3
Water supply and irrigation intervals	32%	52%	16%	1016	1
Irrigation fees	21%	44%	35%	875	6

Repair and maintenance of irrigation systems	20%	50%	30%	894	5
Time and method of collecting fees	31%	50%	19%	997	2
Irrigation development, extension and training	9%	29%	62%	699	9
Equipment and agricultural input supply	10%	37%	53%	738	8
To deal with the problems of farmers	18%	39%	43%	828	7

Survey results indicate that respondents lack knowledge about WUAs and derive it generally from observations and conversations. They believe they are not being informed about technical issues and that WUAs' investment-management decisions are unsatisfactory. They believe WUAs have adequate resources to provide services but do not use them rationally and productively. They believe WUA managers generally do not fulfill their duties completely, although opinions about WUA's technical personnel are more positive. Results indicate that respondents believe WUAs do not accept them and that they are not relevant in decisions. Respondents perceive that union management and their relatives benefit most from WUA services and express significant discontentment about it. The most important factor is the respondents' opinion that management lacks interest in them except during elections. The second-most important factor is the respondents' request for equality and fair treatment. They prefer that DSI manage WUAs because of being public institution and experienced about irrigation network.

The farmers' most important expectation from WUAs is to receive water when they need it. They also expect lower water fees, easy access, equal and fair treatment, information, and consulting services, in that order. Furthermore, they expect provision of low-cost agricultural inputs and help processing and marketing their products. Respondents generally are content with the current frequency and quantity of water (expect downstream farmers), the time and method of collecting fees, and irrigation plans, time, and management.

Farmers need training and information concerning the issues indicated above. They should be provided before irrigation season, either by WUAs or in central villages, by securing participation of other farmers, in a language and manner they can understand.

3.2. Stakeholders' attitudes toward irrigation water management

Agricultural irrigation faces structural and legislative problems. Water re-

sources must be operated and managed effectively and efficiently based on current and future needs. Increasing user ownership and efficiency of irrigation systems are basic expectations uncovered by our survey results. However, it is clear that current arrangements cannot provide expected benefits. The problems can be solved only by the parties to act together. These parties are called as stakeholders which are farmers, WUA management (chairmen and managers) and DSI. Table 2 presents descriptive statistics of survey stakeholders.

Table 2. Descriptive statistics of survey stakeholders (Aydogdu et al., 2015c).

Factor	Number of participants	Age	Education (year)	Years of experience
Farmers	471	44.6	7.0	21.4
Chairmen	22	47.7	6.1	6.5
Managers	22	38.3	14.5	8.8
DSI Staffs	53	50.5	13.3	17.2
Weighted Average		45.1	8.1	19.6

It is asked survey participants to define problems by answering predetermined questions. Table 3 presents collective responses to questions about the adequacy of WUAs' investment and management decisions.

Table 3. Participation rate of investment and management decisions of WUAs are adequate

Actor	Strongly Agree	Agree	Fair	Disagree	Strongly Disagree
Farmers	4%	8%	25%	30%	33%
Chairmen	0%	31%	39%	17%	13%
Managers	5%	10%	35%	35%	15%
DSI staffs	0%	5%	25%	32%	38%
Weighted Average	3.4%	8.8%	26.1%	29.9%	31.8%

Table 3 indicates that 12.23% of respondents strongly agree or agree that WUAs make adequate investment and management, whereas 61.65% disagree or strongly disagree. These results indicate WUAs decisions do not satisfy respondents' needs and expectations. These problems appear less serious among respondents upstream and more serious among respondents downstream on the Harran plain, especially type of irrigation management results to waste of water. Furrow irrigation is commonplace and night irrigation is limited. Furrow lengths are longer, producing greater salinity in some areas and water shortages at peak irrigation season. Imambakır WUA covers 7,464 ha affected by over-irrigation under high groundwater level and suffers from salinity problems and significant loss of yields (Aydogdu et al., 2014a). Ay-

dogdu et al. (2014b) calculated that excess salinity reduced cotton yields by 1,840,625 kg and income by US$935,711 in 2009 in the Akçakale district on the GAP–Harran plain.

This situation sours the viewpoints expressed by survey respondents. The WUAs collect crop pattern information from farmers to define their water needs and inform DSI about demand for irrigation water each year. However, the information gathered may be inaccurate or unrealistic because acreages have not been appraised, and mainly arises from poor information provided by the farmers to WUAs. Information on the efficient use of water by farmers is needed that is expected from WUAs. The collective answers of stakeholders to the question of whether they think that the WUA officials give enough information to the water users are presented in Table 4.

Table 4 Participation rate of stakeholders about given information by WUA officials

Actor	Strongly Agree	Agree	Fair	Disagree	Strongly disagree
Farmers	6%	17%	25%	25%	27%
Chairmen	0%	31%	39%	17%	13%
Managers	20%	20%	45%	15%	0%
DSI staffs	0%	7%	15%	40%	38%
Weighted Average	5.7%	16.7%	25.5%	25.9%	26.3%

Accordingly, the rate of having a positive opinion about given enough information to the water users are 22.37%, as oppose to this one 52.17% of stakeholders have negative opinion about the question which indicate that insufficient information is given to farmers about water related issues in the field. In fact, there is insufficient and inadequate information system in the field. The education levels of farmers are less. They need more and better information, therefore suitable information and extension activities are must in order to get better water management in the field. The collective answers of stakeholders to the question of providing technical support to the farmers on issues such as proper irrigation time, water amount and water needs of the product in the field is given in table 5.

Table 5. The answers of stakeholders to providing technical support by officials

Factor	Yes	No	Not much demand from farmers
Farmers	17%	83%	0%
Chairmen	26%	17%	57%
Managers	15%	15%	70%
DSI staffs	47%	8%	45%
Weighted Average	20.7%	68.3%	11%

Accordingly, the rate of having a positive opinion about given technical

support to the water users are 20.71%, as oppose to this one 68.27% of stakeholders have negative opinion and 11.02% expressed that there is not much demand from the farmers on these issues. This result is meaningful. The stakeholders, excluding farmers, are indicating that farmers are not aware on these issues. On the other hand, the farmers, who said no this question, were asked again to determine the reasons and 37% declared that they have enough information and experience while it is difficult to reach to the officials by 18%, and the disinterested public officials and/or inadequate public servants of 45%. Table 6 displays opinions about who should maintain irrigation systems.

Table 6. Respondents' opinion about who should maintain irrigation systems

Actors	Public	WUA	Farmer	WUA+Farmer	Not made
Farmers	6%	49%	7%	28%	10%
Chairmen	9%	78%	0%	9%	4%
Managers	5%	90%	0%	5%	0%
DSI staffs	45%	53%	0%	2%	0%
Weighted Average	10.5%	52.7%	5.6%	23.1%	8.1%

Results indicate that 52.73% of respondents believe that WUAs should maintain irrigation systems. It was observed numerous operation and maintenance problems during field visits. The transfer of irrigation systems from DSI to WUAs delegated responsibility for maintenance to WUAs, although DSI provides support. Maintenance of irrigation systems requires staff, machinery, and financial wherewithal, which WUAs lack. Table 7 indicates respondents' opinions about who should manage WUAs. Responses suggest further insights into issues of irrigation management.

Table 7. The answers of stakeholders to the question of who should manage the WUAs

Actors	WUA's Chairman	DSI	WUA's Manager	Governorate	Private Company
Farmers	25%	43%	7%	7%	18%
Chairmen	78%	13%	0%	0%	9%
Managers	25%	35%	15%	0%	25%
DSI staffs	15%	38%	2%	2%	43%
Weighted Average	24.81%	40.66%	6.48%	5.78%	20.73%

Respondents other than chairmen of WUAs do not want WUAs to be managed by the chairman. This result is meaningful and indicates shortcomings in the manner of electing the WUA chairmen plus their inability to manage large and complex irrigation systems funded by important public investments. Responses pertain not only to water management but also to management of soil and natural resources.

Among the respondents, 40.66% including 13% of WAU chairmen prefer that DSI manage WUAs. DSI has the experience, technical personnel, and machinery to assure efficient and timely water management. One striking result is that 20.73% of respondents want private companies to manage the water, even though it is known that prices will increase. Field interviews revealed that farmers believe price increases would be modest, resources will be used more economically, and favoritism would decline and also that private sector management would provide a more reliable irrigation. However, respondents expressing those views operate near the end of irrigation channels and belong to downstream WUAs. These farmers receive insufficient water during peak irrigation periods and thus suffer crop losses.

5. Respondents' Attitudes toward Pricing and Payment

Farmers pay 5.43% of their net income per acre for irrigation (Aydogdu et al., 2014c). Irrigation is the most important input in increased agricultural production and becomes more important as climate change presents greater potential for drought. Table 8 indicates the respondents' opinions about pricing irrigation water to assure its economic and efficient use.

Table 8. The answers of stakeholders to water charges

Factor	Strongly Agree	Agree	Fair	Disagree	Strongly disagree
Farmers	25%	30%	23%	15%	7%
Chairmen	48%	48%	4%	0%	0%
Managers	75%	10%	5%	0%	10%
DSI staffs	62%	24%	8%	4%	2%
Average	52.5%	28%	10%	4.75%	4.75%
Weighted Average	32.6%	22.2%	19.6%	12.4%	13.2%

Results indicate that 54.8% of respondents view current water charges favorably, whereas 25.6% view them negatively. These results indicate that they believe that charging for water is necessary for its economic and efficient use. Participants were asked their opinions of current water prices, and Table 9 displays the results.

Table 9. The answers of stakeholders to current water prices

Actor	High	Low	Fair
Farmers	41%	23%	36%
Chairmen	13%	70%	17%
Managers	5%	90%	5%
DSI staffs	20%	65%	15%
Average	19.75%	62%	18.25%
Weighted Average	35.6%	33.1%	31.3%

Except for farmers, respondents overwhelmingly believe water charges are low. Slightly more than one-third of respondents believe rates are high, and they are primarily located in pumping areas and pay 2.5 times more than respondents in gravity irrigation areas. To refine survey results, it was asked respondents what water charges should be. Table 10 reports responses.

Table 10. The answers of stakeholders to current water charges

Factor	Should be less	Should be more	Should be actual cost
Farmers	35%	16%	49%
Chairmen	4%	39%	57%
Managers	10%	15%	75%
DSI staffs	4%	22%	76%
Average	13.25%	23%	63.75%
Weighted Average	28.9%	17.7%	53.4%

Results indicate that about one-third of respondents specifically farmers believe water charges should be lower. All other groups believe they should be higher. These results are expected. Because lower water charges have positive effect on welfare of the farmers as opposed to this one have negative effect on income of the WUAs for service quality, operation, maintenance and management of WUAs. The vice versa is true for higher water charging, too. The remarkable result here is that a weighted average (53.4%) of respondents in all surveyed areas believes water should be priced at cost. This result is unexpected in regard to farmers and arises from detecting the actual value of the water that is quite different in the surveyed area and considered as mainly operation cost of the systems. The perceived cost of water differs significantly among the respondents. Farmers regard it as the relatively low expense of opening and closing gates to irrigation canals; they perceive operation, maintenance, renovation, and repair as public services that should be free. The WUA chairmen and DSI staff perceive the cost of water should correspond to the actual cost of supply, transmission, drainage, maintenance, and investment.

We asked respondents whether farmers would be more responsible and efficient in their use of water if its fee is set according to the number of field irrigation and the amount of used. Table 11 reveals their answers.

Table 11. The answers of stakeholders to charges depends on amount of water used

Actor	Strongly Agree	Agree	Fair	Disagree	Strongly disagree
Farmers	30%	33%	17%	12%	8%
Chairmen	44%	35%	4%	4%	13%
Managers	55%	15%	10%	10%	10%
DSI staffs	57%	30%	7%	4%	2%

Average	46.5%	28.3%	9.5%	7.5%	8.2%
Weighted Average	34.9%	31.9%	15%	10.6%	7.6%

Results indicate that 66.8% of respondents strongly agree or agree, whereas 18.2% disagree or strongly disagree. These results indicate that pricing based on furrow irrigation encourages farmers to waste water. It was also asked if raising fees would encourage less and more careful water consumption. Table 12 indicates that 40.1% of respondents strongly agree or agree that would be the case, whereas 38.9% disagree or strongly disagree.

Table 12. The answers of stakeholders to less water use in case of increased water fees

Actor	Strongly Agree	Agree	Fair	Disagree	Strongly disagree
Farmers	14%	20%	23%	21%	22%
Chairmen	13%	31%	22%	17%	17%
Managers	25%	30%	5%	15%	25%
DSI staffs	47%	28%	13%	6%	6%
Average	24.8%	27.3%	15.8%	14.8%	17.3%
Weighted Average	18.2%	21.9%	21%	18.8%	20.1%

Results in Table 12 reveal important differences among groups of respondents. Farmers can use water even they do not pay for it, as WUAs have no legal authority to withhold water for nonpayment of fees. Similarly, WUAs are reluctant to withhold water for non-payment because farmers elect their executives and interest rate of nonpayment money is less. What's more, collection procedures take a long time, and attorney and court costs consume a significant proportion of sums eventually collected. Further, the parties involved generally know each other and are often relatives. This situation feeds on itself. Lower quality of service by WUAs increases farmers' unwillingness to pay. To raise farmers' willingness to pay, WUAs need training, awareness, support, higher service quality and transparency, and attention to farmers outside election periods. If WUAs meet such conditions, farmers' willingness to pay rises from 36% to 85% (Aydogdu, 2012; Aydogdu et al., 2014d). Aydogdu (2016) showed that farmers are willing to pay 71.69% above the current price under certain conditions. Aydogdu et al., (2016) showed that average willingness to pay of farmers are more than 85.19%, means that 2.23 fold of current price at surveyed time in case of water shortages.

Another important issue is price differentials between gravity and pump irrigation in the same field. Gravity irrigation charges are lower even though farmers use the same quantity of water and receive the same subsidies and crop payments. By subsidizing energy consumed by WUAs engaged in pump

irrigation, farmers and WUAs may be provided equal opportunities. At present, WUAs engaged in pumping pay high electricity rates and are in debt to utilities. Even if they receive all the payments owed them for irrigation, they will be unable to discharge the obligation. Freezing their indebtedness would ease the problem. Debt amnesty or extended payment terms merit consideration, provided they avoid future repetition of the worst instances of this practice.

Structural problems plague water management, pricing, and collections in the GAP–Harran plain irrigations. Water pricing is a sensitive issue and should be set according to farmers' ability to pay. Mostly, farmers on the Harran plain are unwilling rather than unable to pay. If WUAs' collection problems cannot be solved, they have limited ability to operate optimally. A common price may be created in the GAP–Harran plain for both gravity and pumping irrigations. This price can be used by WUAs and farmers in terms of price stability for payments and collections.

The education levels of farmers in the Harran plain are low, as in many parts of the world (Aydogdu, 2012). Farmers' sense of ownership of irrigation systems is not developed, they perceive these services as public services and do not feel themselves to be largely responsible (Aydogdu, 2012). The farmers in the Harran plain are not homogeneous in many ways. There is a need to develop awareness, ownership and responsibility in farmers. This can happen with education. Before the training programs are planned, a detailed sociological research on the site is required. Based on the findings to be obtained from this, target groups should be identified and directed towards these groups. In particular, agricultural subsidies have a direct impact on farmer behavior. Farmers prefer to sow products that are within the scope of support, which can be used as an element in creating optimal policies. Problems in agricultural irrigation cannot be solved by reactive approaches. Detailed socio-economic analysis of the irrigation area is required. Proactive approaches involving structural changes are needed. This situation cannot be solved only by a public institution (DSI) or by law (6172 and 7139). The more active participation of the Ministry of Agriculture and Forestry is required, as well as the administrations providing water (DSİ, Special Provincial Administrations, Irrigation Unions, WUAs and Cooperatives, etc.).

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CHAPTER 7

EVALUATION OF CENTRAL ASIA APPLE GENETIC RESOURCES: SOME FRUIT AND TREE CHARACTERISTICS OF NATURALLY GROWING APPLE SPECIES IN KYRGYZSTAN

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INTRODUCTION

The mainlandregions of apples in the world were reported as East Asia, Central Asia, West Asia-Europe and North America (Janicket al., 1996).Central Asia has a considerable level of apple genetic resources, and it has been reported that wild apple genetic resources in particular have a crucial significance. The reason of this has been shown as a narrowing genetic diversity with the selections made for desired characteristics of commercial apple varieties. It has been reported that apple populations in Central Asia were an important gene pool that will contribute to overcome biotic and abiotic stress tolerance, quality parameters, growing form etc. (Forslineet al., 2010). In the Central Asian region, Kyrgyzstan is one of the major centers of apple origin. In different regions of Kyrgyzstan, there are some deciduous fruit species as well as significant apple populations and forests. However, it is reported that these materials were subjected to human-induced losses and these genetic resources may be lost completely in future time(Dzunusova, 2008). In Kyrgyzstan, besides M. domestica, three more apple species are naturally grown. These are the species Malus sieversii (Ledeb.) M. Roem, (Malus kirghisorum) and Malus niedzwetzkyana (Dieck) CK Schneid. For Malus sieversii, the arid mountainous regions of Kazakhstan, Kyrgyzstan, China, Tajikistan, Uzbekistan and Turkmenistan are natural distribution areas. Malus kirghisorum was reported to be genetically close to Malus sieversii but different in shape, color and other parameters. Malus niedzwetzkyana has pink-violet pigmentations on leaf, flower and fruit (Volk et al., 2009).

There are many plant species in the Central Asia region that are endangered and must be protected. In a study regarding the endangered species, M.

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sieversii and M. niedzwetzkyana were reported as endangered species and were included in the red list. These species are reported to be endangered due to loss of habitat and degradation, opening of agricultural fields and genetic erosion. It was emphasized that, in contrast to the narrow genetic basis of cultivated apples, these endangered species, which would enhance genetic diversity, must be preserved ex-situ and in-situ (Eastwood et al., 2009). On the other hand, it was evaluated that M. niedzwetzkyanawas also in the Red Book of Threatened Species of Kazakhstan (Omashevaet al., 2015).

In apple breeding studies, generally a few cultivars were used as genitor and the main purpose is to gain the resistance against the main diseases. Such a case then reduces genetic diversity and increases inbreeding depression. On the other hand, there are many species within the genus Malus. Wild species are of great importance in this regard, especially in the extension of the genetic base (Dan et al., 2015). At this point, wild apple species originating from Central Asia are very important resources for breeding studies. The identification of apple cultivars and genotypes are the basic operations to be carried out before the breeding works.

This study was carried out to determine the apple genetic diversity of Kyrgyzstan and to evaluate their some fruit and tree characteristics. The study revealed fruit and tree characteristics of apple varieties and genotypes belonging to Malus sieversii, Malus kirghisorum, Malus niedzwetzkyana and M. domestica species in different regions of Kyrgyzstan.

MATERIAL and METHODS

Fifty-nine cultivars and genotypes belonging to different apple species in different regions of Kyrgyzstan were used in this study. Of these species, 34 were M. domestica (9, 13-20, 30-47, 50, 51, 54-56, 58 in Table 1), 23 were M. sieversii (1-8, 11, 21-29, 48, 49, 53, 57), 1 belonging to M. kirghisorum (material 52 in Table 1) and 1 M. niedzwetzkyana (material 59 in Table 1). Most of the materials belonging to M. domestica were cultivars while the rest were genotypes.

In order to determine tree and fruit characteristics of these materials, the natural growth form of the tree and the fruit size (with digital calipers), fruit weight (with precise balance), fruit firmness (with penetrometer), total soluble solids (with refractometer), fruit shape and color (visually) were measured and observed. Measurements were generally carried out at the end of September when the fruits were full-ripe. Standard deviations were also calculated for the properties to be measured.

Data on fruit and tree characteristics were analyzed by using the NTSYS (NTSYS-pc version 2.1, Exeter Software, Setauket, N.Y., USA) software as described by Rohlf (2000). Similarity index was created in accordance with Dice's coefficient (Dice, 1945). Using the similarity index, a dendrogram was generated by UPGMA (Un-weighted Pair-Group Method with Arithmetic Mean) method and the groups formed by apple materials were determined. The principal components analysis (PCA) of the original binary data matrix was also perfor-

med using NTSYS-pc version 2.1.

RESULTS and DISCUSSIONS

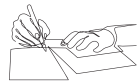
High-level variations were observed in tree and fruit characteristics of apple cultivars in this study (Table 1). Fruit diameters of the materials varied between 89.5-18.0 mm. "Rasida" had the largest fruit diameter. Fruit diameters were determined as between 26 - 76 mm in Iranian apple cultivars and genotypes (Damyaret al., 2007). On the other hand, Kaya et al. (2015) reported fruit diameters of local apple genotypes from Lake Vanregion of Turkey as between 46 - 95 mm. The presence of more variations in present study as compared to the other studies can be explained by the fact that four separate species were included in this study.

[8]**Table 1.** Fruit and tree characteristics of 59 apple cultivars and genotypes studied

Number	Cultivar/ Genotypes	Fruit Width (mm)	Fruit Length (mm)	Fruit Weight (g)	Firmness (g/cm²)	TSS (%)	Tree Shape[8]	Fruit Shape	Fruit Color
1	15-IKTA-01	64.5 ± 5.2	50.0 ± 4.8	102.2 ± 27.9	9.3 ± 0.8	13.7 ± 1.0	US	Flattened round	Pink skin over yellow background
2	15-IKTA-02	56.8 ± 2.8	45.0 ± 4.4	73.4 ± 16.3	8.6 ± 0.9	14.9 ± 0.4	S	Flattened	Mottled red over yellow background
3	15-IKTA-03	33.0± 0.8	25.5 ± 1.6	15.4 ± 1.9	8.4 ± 0.6	13.6 ± 0.8	US	Flattened	Solid red
4	15-IKTA-04	39.7 ± 1.4	31.6 ± 1.4	23.9 ± 2.4	10.5 ± 0.6	16.2 ± 1.2	US	Flattened	Mottled red over light green background
5	15-IKTA-05	51.4 ± 3.3	46.4 ± 3.8	60.1 ± 10.4	10.1± 0.7	13.9 ± 0.7	US	Round	Yellow
6	15-IKTA-06	35.8 ± 1.0	32.2 ± 1.8	22.6 ± 2.3	9.8 ± 0.4	17.1± 1.2	S	Round	Light red over yellow background
7	15-IKTA-07	57.1 ± 1.0	48.0 ± 1.3	77.3 ± 5.7	11.4 ± 0.8	12.8 ± 0.4	U	Round	Pink skin over light green background
8	15-IKTA-08	27.7 ± 1.2	25.3 ± 1.7	11.0 ± 1.2	10.5± 0.7	22.8 ± 1.5	F	Round	Dark red
9	15-IKTA-09	63.5± 1.7	48.5 ± 1.4	92.0 ± 6.5	12.2 ± 0.7	17.6 ± 1.8	US	Flattened	Red skin over light green background
10	15-IKTA-10	18.0 ± 0.7	14.9 ± 0.5	3.0 ± 0.3	9.6± 0.4	18.1 ± 2.4	US	Flattened round	Dark red
11	15-IKTA-11	42.2 ± 1.1	35.7 ± 1.8	33.9 ± 2.0	9.0 ± 1.0	15.0 ± 0.9	US	Flattened round	Yellow
12	Tomson	75.0 ± 2.8	68.9 ± 1.2	170.2 ± 5.9	9.1 ± 2.0	12.4 ± 0.3	S	Round	Mottled red over light green background
13	Rasida	89.5 ± 7.1	79.8 ± 7.5	316.8 ± 50.5	6.5 ± 0.5	11.9 ± 1.2	US	Flattened round	Red skin over light green background

8- D= Drooping, F= Fastigiate, S= Spreading, U= Upright, EU= Extremely upright, US= Upright/ Spreading

14	**Kırgizskiyzimniy**	84.9 ± 4.6	71.9 ± 6.4	252.1 ± 32.8	6.7± 0.8	11.6 ± 1.3	S	Flattened round	Red
15	**Prevoshodniy**	61.8 ± 3.6	63.8 ± 3.0	125.7 ± 17.5	8.7 ± 0.5	10.9 ± 1.2	S	Elongated	Mottled red over light green background
16	**Issyk-Kul Aport**	75.7 ± 3.0	64.1 ± 3.6	168.0 ± 21.0	5.8 ± 0.4	9.9 ± 1.0	US	Flattened round	Red
17	**Velfilor**	64.5 ± 5.5	61.1 ± 5.8	118.2 ± 25.7	7.9 ± 0.5	11.4 ± 0.8	U	Elongated round	Yellow
18	**Bayken**	73.2 ± 2.5	62.7 ± 5.1	172.3 ± 23.8	10.1 ± 1.4	13.4 ± 1.1	U	Flattened	Pink skin over yellow background
19	**Zolotoy**	77.5 ± 2.1	64.8 ± 7.3	199.5 ± 31.4	10.1 ± 0.5	11.1 ± 0.2	U	Flattened	Red skin over light green backround
20	**Klon-Kitayka**	71.9 ± 1.7	53.8 ± 1.8	148.7 ± 4.4	9.4 ± 1.3	13.6 ± 1.0	US	Flattened	Mottled red over yellow background
21	**15-IKCT-01**	39.7 ± 1.6	34.7 ± 1.2	28.2 ± 3.4	7.7 ± 0.7	14.6 ± 1.0	U	Flattened round	Dark red
22	**15-IKCT-02**	49.8 ± 3.0	43.1 ± 2.8	52.2 ± 6.5	10.0 ± 0.7	12.9 ± 0.7	U	Flattened	Red
23	**15-IKCT-03**	48.1 ± 0.5	43.2 ± 2.3	47.5 ± 2.5	8.6 ± 0.3	10.8 ± 0.8	U	Flattened round	Mottled red over light green background
24	**15-IKCT-04**	47.7 ± 1.8	35.7 ± 1.2	45.4 ± 3.2	7.5 ± 0.4	13.6 ± 0.5	U	Wheel shaped	Red skin over light green background
25	**15-IKCT-05**	54.8 ± 3.2	49.2 ± 2.4	72.9 ± 9.6	10.8 ± 1.8	13.4 ± 1.0	U	Flattened	Pink skin over yellow background
26	**15-IKCT-06**	41.2 ± 2.3	33.9 ± 2.1	30.9 ± 4.9	7.0 ± 1.3	16.3 ± 1.0	US	Flattened	Dark red
27	**15-IKCT-07**	42.6 ± 2.0	34.5 ± 2.6	28.4 ± 3.9	5.0 ± 0.7	15.9 ± 0.4	U	Flattened	Yellow
28	**15-IKCT-08**	43.3 ± 2.4	37.8 ± 2.0	33.3 ± 6.2	8.0 ± 0.9	13.2 ± 0.2	U	Flattened round	Yellow
29	**15-IKCT-09**	48.8 ± 2.6	48.4 ± 4.3	50.0 ± 7.0	7.1 ± 0.5	10.2 ± 1.1	D	Oval round	Mottled red over green-yellow background
30	**15-IKOR-01**	82.7 ± 2.7	70.1 ± 6.1	241.8 ± 30.4	7.2 ± 0.8	11.2 ± 1.0	US	Flattened	Red
31	**Zolotoy-Ranet**	77.0 ± 0.8	68.7 ± 3.1	206.2 ± 11.4	9.7 ± 0.6	10.2 ± 0.4	US	Flattened round	Pink skin over green background
32	**Tomson 2**	70.7 ± 1.8	59.3 ± 2.4	141.2 ± 11.4	7.6 ± 0.5	12.7 ± 0.7	S	Flattened	Red
33	**Jupiter**	83.9 ± 10.8	70.2 ± 8.7	243.8 ± 60.0	5.5 ± 1.2	12.9 ± 1.5	US	Round	Mottled red over green background
34	**Tomkinsking**	74.4 ± 3.7	63.8 ± 4.8	171.4± 25.5	7.6 ± 0.6	15.8 ± 1.9	US	Flattened round	Striped to solid red
35	**15-IKBD-01**	64.0 ± 1.2	60.9 ± 2.4	134.3 ± 7.8	10.0 ± 0.7	12.1 ± 0.5	S	Round	Red



36	**Palmira**	63.3 ± 1.9	58.5 ± 1.9	125.4 ± 10.6	9.8 ± 0.8	10.8 ± 0.3	US	Round	Striped to solid red
37	**15-IKBD-02**	82.6 ± 4.4	71.2 ± 2.8	238.8 ± 21.5	6.6 ± 0.5	13.3 ± 1.1	S	Pyramid	Red skin over yellow background
38	**ZimniyLimonnay**	75.3 ± 3.1	69.7 ± 5.8	199.6 ± 27.6	7.6± 0.5	13.4 ± 0.4	S	Elongated pyramid	Pink skin over yellow background
39	**15-IKBD-03**	76.9 ± 4.8	66.8 ± 3.1	180.9± 24.5	6.9 ± 0.8	13.1 ± 0.9	D	Pyramid	Red skin over yellow background
40	**Saltanat**	73.3 ± 2.5	53.4 ± 3.9	157.1 ± 19.9	8.2 ± 0.5	12.8 ± 1.3	US	Flattened	Red
41	**Alamidinskoe**	73.4 ± 2.8	65.8 ± 3.7	173.1 ± 18.6	9.0 ± 1.0	10.6 ± 2.0	U	Flattened round	Red
42	**Tulpan**	65.3 ± 4.2	73.1 ± 4.4	161.1 ± 20.5	5.2 ± 1.1	13.9 ± 0.9	S	Elongated	Red
43	**Zailiyskoezimnoe**	75.5 ± 2.2	69.2 ± 4.4	197.8 ± 21.0	7.7 ± 0.7	11.0 ± 0.7	U	Round	Dark red
44	**Sinaptalgarskiy**	64.4 ± 1.8	71.0 ± 2.6	143.4 ± 11.6	9.2 ± 1.0	15.1 ± 1.1	U	Elongated	Red
45	**Aynur**	66.5 ± 1.7	59.3 ± 2.2	123.7 ± 6.6	6.5 ± 0.5	13.8 ± 0.6	U	Flattened round	Light yellow
46	**Melba**	69.3 ± 2.0	63.2 ± 1.3	149.1 ± 10.9	4.8 ± 0.3	12.5 ± 1.1	U	Flattened round	Red
47	**Almatinskoegrusovka**	62.3 ± 3.1	53.9 ± 2.9	105.0 ± 15.5	9.5 ± 0.5	13.6 ± 1.5	U	Flattened round	Red
48	**15-IKBD-05**	39.9 ± 1.0	31.3 ± 1.9	22.5 ± 1.9	6.1 ± 0.7	18.0 ± 0.7	U	Flattened	Yellow
49	**15-IKBD-06**	33.6 ± 1.5	29.3 ± 0.5	18.1 ± 1.5	7.8 ± 0.7	12.4± 1.5	U	Flattened	Red
50	**Borovinka**	64.7 ± 3.3	57.5 ± 3.6	109.0 ± 12.4	3.4 ± 0.4	11.4 ± 1.5	U	Flattened round	Mottled pink skin over yellow background
51	**Stolovka**	59.0 ± 3.6	47.8 ± 1.9	77.8 ± 14.3	2.9 ± 0.8	16.4 ± 0.4	U	Flattened	Mottled red over yellow background
52	**15-IKTK-01**	36.2 ± 0.9	35.0 ± 3.1	21.9 ± 2.6	7.1 ± 0.6	10.3 ± 0.6	U	Round	Light yellow
53	**15-IKTK-02**	28.1 ± 1.2	23.5 ± 3.3	10.6 ± 1.3	6.9 ± 0.5	14.6 ± 0.7	U	Flattened	Mottled pink skin over yellow background
54	**Akalmaz**	60.5 ± 1.9	48.8 ± 3.3	86.8 ± 12.0	9.0 ± 1.0	12.4 ± 2.3	U	Flattened	Light yellow
55	**Kasen**	58.2 ± 3.3	48.4 ± 1.7	73.6 ± 7.2	3.5 ± 0.6	12.2 ± 0.8	U	Flattened	Mottled pink skin over cream-yellow background
56	**15-IKTK-03**	89.1 ± 5.6	70.7 ± 7.7	274.0 ± 41.1	5.0 ± 1.1	13.8 ± 1.2	U	Flattened	Mottled red over yellow background
57	**15-IKTK-04**	43.0 ± 1.6	34.9 ± 1.5	34.3 ± 3.5	11.9 ± 0.9	14.6 ± 0.6	US	Flattened	Dark red

58	**Grusovka**	52.2 ± 0.8	42.6 ± 2.1	60.5 ± 4.2	5.6 ± 1.0	10.9 ± 1.2	US	Flattened	Yellow
59	**16-TACT-01**	43.7±2.5	40.3± 1.8	41.1± 2.5	9.1± 0.2	8.0± 0.1	EU	Round	Red

Fruit lengths of apple materials also showed significant differences. The material with the highest fruit length was also identified as "Rasida" (79.8 mm) and the minimum fruit length was determined for 15-IKTA-10 genotype (14.9 mm). Ozongunet al. (2014) found fruit lengths of some standard apple varieties as between 57 - 77mm.

Fruit weight was one of the features with the greatest variation. In general, M. sieversiigenotypes had lower values in terms of fruit size and weight. The fruit weights of the apples varied between 316.8 ("Rasida") and 3.0 g (15-IKTA-10). Erdogan and Bolat (2002) carried out a study in Çoruh valley of Turkey and reported fruit weights of apple genotypes as between 17.52 - 258.68g. These values werereported as between 9 - 165 g for Iranian apples (Damyaret al. 2007). Kaya et al. (2015) found the fruit weightsof apples as between 43.04 - 310.99g. Greater variations were observed in apples of the present study since there were M. sieversii genotypes with quite small fruit weights.

In terms of fruit firmness, apple materials showed differences from very hard to soft. Fruit firmness was determined as maximum for genotype 15-IKTA-9 (12.29 kg/cm2) and the least for "Stolovka" (2.93 kg / cm2). This value was reported as between 6.94 - 9.55 kg/cm2 in previous study carried out in Isparta, Turkey (Ozongunet al., 2014). Kaya et al. (2015) measured fruit firmness of apple genotypes grown in Vangolu region of Turkey as between 3.99 - 14.05 kg/cm2. On the other hand, there were significant differences in total soluble solids (TSS) content of apple cultivars and genotypes. This value ranged from 8.0 to 22.8%. In a study conducted in Artvin province of Turkey, the amount of TSS was between 8.5 - 13.7% (Serdar et al.2007). In previous studies carried out in Corum, Turkey, TSS value varied between 10.65 - 15.00% (Dogru, 2012) and in another study done in Giresun region, the values varied between 11.63 - 12.80% (Karadeniz et al., 2013). Greater variations on present TSS values can be explained by the fact that different species and a large number of materials existed in present study.

Fruit shape and fruit color also showed high-level variations (Table 1). Fruit-shape forms ranged from pyramidal shapes to wheel-shaped. Twenty-three of the apple cultivars and genotypes were flattened, 17 were flattened-round, 11 were round, 3 were elongated, 2 were pyramid and 1 was elongated pyramid, oval round and whell-type. Fruit colors ranged from light-yellow to dark-red. Fruit color is a quality criterion that determines consumer preferences at a significant level. The wide variety of color variations detected in the apple material in the present study indicated that they were an important genetic resource. Fruit variations seen in apple materials are presented in Figure 1.

When the materials were examined in terms of tree growth form (shape), it was generally seen that upright and upright/spreading forms were dominant. Twenty-six of materials were upright, 19 were upright/spreading, 10 were spreading, 2 were drooping, one of them was extremely upright and one of them was festigiate-shaped. Damyaret al. (2007) found that the tree form

in the Iranian apple genotypes was very similar to the present forms, ranging from extremely upright to drooping.

Figure 1. Fruit variations of apple materials studied

At the same time, fruit and tree characteristics data were analyzed using the NTSYS program. In the program, a dendrogram was created by the UPGMA method and the groups of apple materials were determined (Figure 2). The apple genotypes were separated as groups according to their morphological characteristics.

According to the dendrogram, although some apples were closely related, they had not been identified as exactly similar material. Apple materials were collected under two main groups (A and B). On the other hand, Damyaret al. (2007) analyzed Iranian apple genotypes based on morphological data and determined five separated groups. In present study, the genotypes of *M. domestica* and *M. sieversii* species, which make up the majority of the material, were separated with a few exceptions. Most of the cultivars and genotypes belonging to *M. domestica* were included in a large group. In group A, there were 30 *M. domestica*, 3 *M. sieversii*, 1 *M. kirghisorum* and 1 *M. niedzwetzkyana* genotypes. Within the group A, 4 sub-groups were formed. The first subgroup consisted of 10 *M. domestica* genotypes while the second one consisted of 9 *M. domestica* genotypes. In the third sub-group, 8 *M. domestica* genotypes and 1 M*. sieversii* genotype (15-IKCT-09) were placed. The last sub-group of the main group A was more complex than the others, with 3 *M. domestica*, 1 *M. sieversii*, 1 *M. kirghisorum* (15-IKTK-01) and 1 *M. niedzwetzkyana* genotypes (16 -TACT-01). In general, genotypes with similar fruit characteristics were grouped more closely.

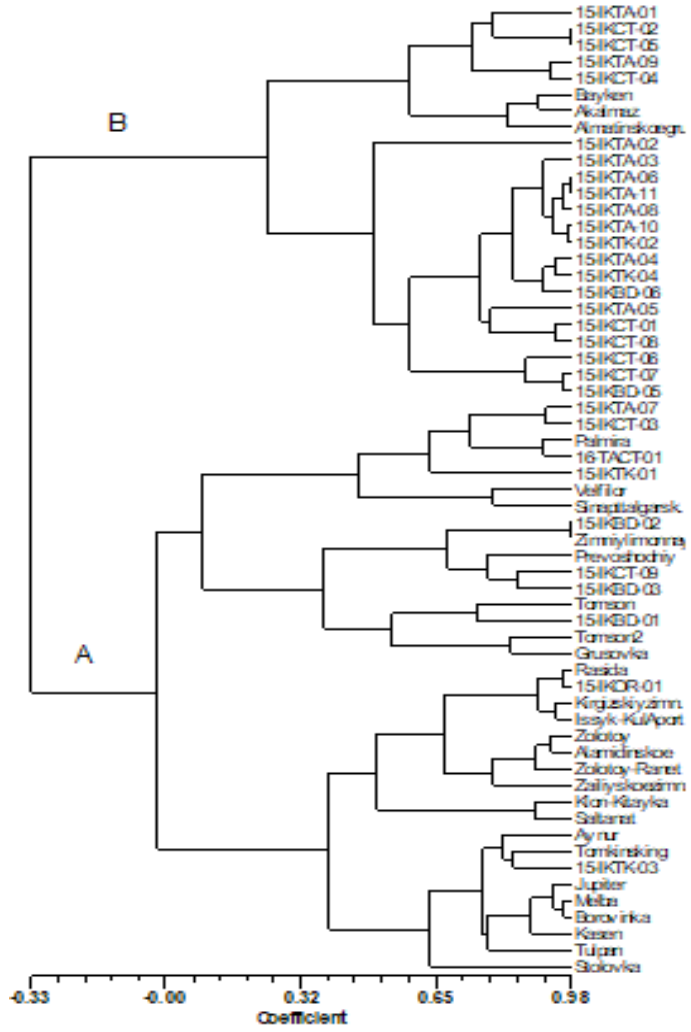


Figure 2. Classification of apple materials based on fruit and tree characteristics using UPGMA methods

In the dendrogram, materials in group B were divided into two sub-groups. In the first sub-group, there were 16 *M. sieversii* genotypes. In the second sub-group of the main group B, 4 *M. sieversii*, 3 *M. domestica*("Almatinskoegrusovka", "Akalmaz", "Bayken") and 1 *M. domestica* genotype were nested. The *M. domestica* cultivars were distinctly separated from each other.

Principal Component Analysis (PCA) was performed on the materials used in this study to better understand the diversity. Distribution of species and genotypes on two-dimensional graphic is shown in Figure 3. Principal components analysis is a data reduction method to explain the relationships between two or more characters and it represents the total variance with a

limited number of variants. In cases where the 'Eigen' values of the first two or three principal components explain a large part of the cumulative total variation, the analysis of the principal components is regarded as a suitable technique for grouping individuals on a graphic distribution (Mohammadi and Prasanna, 2003). According to the analysis of the principal components in present study, 85.1% of the total variation was explained by the first three eigenvalues. This shows that the variation was well-explained by the analysis of the principal components and the similarity/differences between the materials was well expressed with two-dimensional distribution. According to PCA analysis, the *M. domestica* and *M. sieversii* genotypes used in present study were grouped separately. Except for some *M. sieversii* genotypes, the materials were not very close to each other. The distribution on the graph showed the variation among the materials.

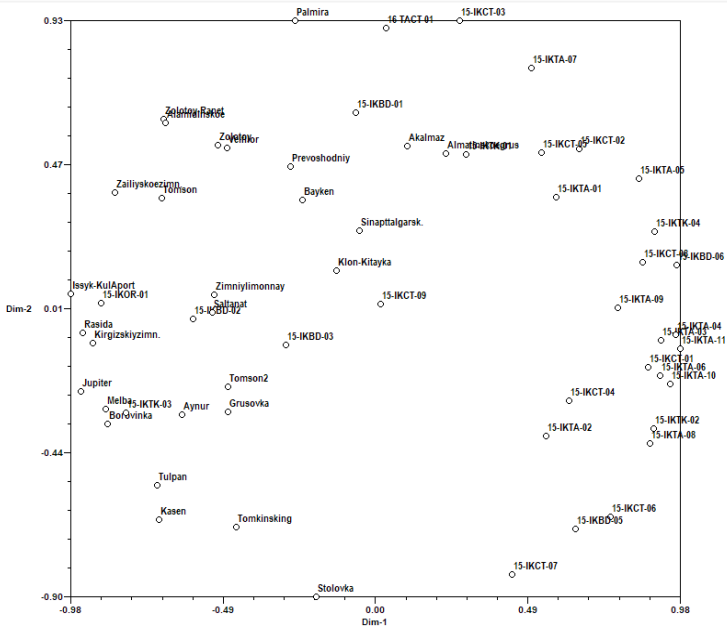


Figure 3.Principal component analysis diagram showing the relationships among 59 apple materials

In present study, some fruit and tree characteristics of 59 apple materials belonging to 4 apple species in Kyrgyzstan were evaluated. Significant variations were observed among the materials in terms of the characteristics examined. Some of the studied species were endangered through habitat loss and degradation, land clearing and genetic erosion, and grafting of commercial varieties and hybridization. Because of the narrow genetic bases of domesticated apples, these endangered species should be preserved ex-situ and in-situ levels. Also new protection strategies should be developed for these important species.

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CHAPTER 8

ENVIRONMENTAL IMPACT OF AGRICULTURAL MEDICINAL WASTE IN SANLIURFA AND RECYCLING BY FARMERS

Ayşe ÇALIK[1]

INTRODUCTION

Entries used in vegetal, animal production and agricultural activities in nature in the past years in natural environment conditions in harmony with the nature have not caused harm to the environment nor caused environmental problems (cevreonline, 2007). The problem of hunger has arisen with the increase of population in the world and the decrease of agricultural land. In order to solve this problem, we have sought ways to achieve more efficiency in shorter periods of time in agricultural activities. Because of the long, laborious and costly battles made by physical and biological routes for the harmful effects that lead to loss of productivity from these roads, chemical warfare has started to be used as a more effective way (Kıslalıoğlu and berkes, 1985). When pesticides used in chemical warfare, that is to say pesticides, are produced in quantities to meet human needs in the production process, they produce wastes that will harm the environment. Agrochemicals used in the production line of agricultural products increase the yields and are resistant to diseases and damages while damaging the environment and surrounding environment that the crop grows. The use of chemical drugs used in agricultural production is causing environmental problems by unconsciously throwing them around, spreading the environment and the drugs remaining in medicine boxes to other places by wind and rain. Some of them evaporate and cause permanent accumulation of toxins in the atmosphere, while others are broken down by photochemical processes into toxins and non-toxins. Another part is kept in the ground, polluting the land. Some of them threaten the life of the creatures by raining rivers, lakes and sea waters with rain, floods and snow waters (Yazgan, 1997)

Şanlıurfa is a city with good agricultural potential. Şanlıurfa garden plants, field plants, has an ecology suitable for vegetable and animal production. The agricultural activities carried out at this concentration of agricultural and animal activities bring environmental problems together. With this study, it is aimed to present the solution proposals by examining the environmental problems arising from agricultural production through Şanlıurfa province.

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Material and method

This study was completed by discussing the questionnaires prepared according to theses, articles and reports made by the farmers. Survey results and compiled data are evaluated according to Şanlıurfa province together with previous studies on environmental relations in agricultural production. The data obtained as a result of this valuation are interpreted and interpreted in the results of the research and findings.

Research Findings and Discussion

In recent years, developments in genetics have led to the development of high-yielding plant and animal breeds. Accordingly, the developments in agriculture, the spread of chemical fertilizer use, the prevention of losses caused by diseases and pests and the spreading of the most wasted irrigation system led to crop and animal increases, leading to increased production and productivity in developed countries (Anonymous, 2003).

1. Problems caused by crop production

1.1. Pesticide pollution

In crop production, pesticides are used in the fight against disease, harmful and foreign weeds. It is known that if pesticide is not used, the quality and yield are low at 60%. It is inevitable to use agrochemicals in order to control the harmful organisms causing the loss of crops (Turabi, 2007; Tiryaki et al., 2010). The use of pesticides adversely affects human health and the environment. When pesticides are used intensely and unconsciously, pesticide residues in the soil, water, and air can remain in the soil (Tiryaki et al., 2010). It has been found that the pesticides used by the farmers have lost their effect over time, and it is understood that this is caused by the excessive use of the indicated doses. In this context, institutions and organizations are provided training on pesticide use, pesticide use results, residue problems and environmental problems (anonymous, 2013). All of the pesticides applied in the plant are not taken up by the plant, 30% of the given medication is transported by the plant and 70% is transported to different ecological environments by wind, rain and irrigation (Aydın, 2002; In Sanliurfa, a number of precautions must be taken to prevent damage to human beings, animals and other living things. For this, it is necessary to find environmentally friendly methods of struggle in agricultural struggle. The use of predators, biotechnological herbal materials used in biological struggle is the first to come to mind. Besides, if the use of pesticides can not be prevented, it should be possible to use pesticides that will reduce the negative effects on the living things, leave no residue, and can be broken down in a short time. In addition, farmers should be informed about the use of medicines and damage to the environment after drug disposal, and practical training should be given about the solutions.

1.2. Chemical Fertilizer Pollution

While the fertilizers used in agricultural production increase the efficiency from one side, the other side also affects the yield negatively. While agricultural fertilizers increase yield and quality when applied adequately, when they are applied, nitrogen and phosphorus is washed and ground and surface waters are polluted, causing air pollution at the same time (Güler, 2004, Atılgan et al., 2007). For the fertilization in Şanlıurfa province in time and in sufficient quantity, soil analysis should be performed before planting and fertilization should be done according to the results of analysis. Periodic training seminars on how to make fertilizer and how waste will be recycled after fertilization should be given.

1.3. Irrigation problems

It is the most basic environmental problem that the irrigation water is raised, the salinity, fertilizer and chemical remnants are descended by irrigation water and then the salt concentration is increased and the underground and surface waters are mixed and the living beings benefiting from these diseases are damaged and diseased ; Taşkaya, 2004; Alper, 2010). Agricultural medicines are scattered to water sources in various ways. During the agricultural struggle, agricultural medicines are exposed to water by direct contact of the plants or insects in or around the water, the washing of medicinal plants and soil surfaces with rain water, the discharge of pharmaceutical industrial wastes into flowing and stagnant water, the washing of empty packaging containers in water sources. A pesticide that enters water sources affects water flora and fauna negatively. The amount of water to be irrigated by the GAP project in Şanlıurfa province has increased. Excess water usage poses a big problem as irrigation with irrigation is more commonly used in the region. This not only increases the cost but also causes salinization and soil water uptake in the soil (Anonymous, 2013). In order to prevent this problem, annual rainfall is not enough in Şanlıurfa province, proper irrigation methods should be chosen for the region and proper irrigation should be done at the right time to increase the efficiency.

Results and suggestions

In order to prevent environmental problems and foodborne diseases in the world, it is necessary to take some measures in agricultural production. To be able to prevent environmental problems and diseases, sustainable agriculture should be presented as a solution to good farming practices and organic agriculture environmental problems. If chemical use can not be prevented by farmers, it is necessary to use chemicals which will minimize the effect of negativity on living beings, do not leave residues and do not last long. Chemical fertilizers should be applied at appropriate doses according to the prepared programs based on the analysis results of experts in control, and high efficiency should be obtained by reducing the adverse effects on the environment. In Şanlıurfa province, trainings should be given to farmers about how fertilizers and waste should be converted after drug use. It is planned by

the Ministry of Food, Agriculture, and Livestock to provide a 'triple washing method' to prevent the packaging and waste of plant protection drugs used in agricultural struggle to be buried in the soil, burned open and to be thrown into random surroundings. Within the scope of this project, waste collection points will be established on triple washing, the waste should be recycled and disposed of by the farmers and the environmental pollution should be prevented.

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CHAPTER 9

FERTİLİZATİON OF N AND P IN FORAGE PLANTS, THE EFFECTS OF VETCH AND TRİTİCALE ON THE RELATİONSHİP BETWEEN TOTAL GREEN AND DRY GRASS YİELDS AND THEİR RATES

Ayşe ÇALIK[1]

INTRODUCTION

When the agricultural resources of our country are examined, it is observed that in the feed industry, the production area where raw cellulose content is more than 16-18% and all kinds of materials used in feed are obtained, the grass-pasture fields as animal feed are important and therefore our animal husbandry is mainly made based on natural pastures. our pastures covering 1/5 of the agricultural lands of our country, which meet a significant portion of the need for feed, have become corrupt and inefficient as a result of irregular and over-grazing for many years. Therefore, the need for Feed which became a problem in animal husbandry in our country was mostly met with extremely low values with grain straw, plant residues and stubble feed as well as fields of pasture. With the protection of pasture areas are improved and the plant cover should be grazing in the extent of their capacity. In addition, low feed value of hay used in animal feed and digested degree causes a significant loss of yield in animals. For this reason, while feed production is a prerequisite for increasing yield, even under farmer conditions, feeding of animals with high quality feed increases their yield twice as much.

In the cultivation of fodder crops, wheat and legume fodder crops can be grown as pure, and in the cultivation of these plants as a mixture, higher yield and quality products can be obtained. Mixtures to be formed, at least one wheat and legume should be arranged, suitable for the production of grass or seed mixtures, plant species in the mixture are close to each other, soil and climate requirements should be taken into account such as appropriate characteristics. Sayılgan (2002), triticale and ordinary vetch in mixed growing, in his experiment to determine the effects of mixture ratio and plant frequency on yield and yield components, he stated that 60% vetch + 40% triticale mixture can be preferred and that harvest should be done when the seed is started to be seen with sub-branches.

This study was carried out to determine the nitrogen (N) and phosphorus (p) fertilizer doses that are best suited to the common vetch and triticale mixtures at 60% and 40% in order to meet the quality feed requirement and obtain high yield with suitable fertilization.

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MATERIAL AND METHODS

Özveren common vetch and Tacettinbey triticale varieties were used as plant material in the experiment. Özveren vetch is a new variety that has been successfully grown for dry grass yield. The optimum harvesting time for weed is the start of formation of the lower fruits. Tacettinbey triticale variety resistant to winter, tilting and falling; the fertilizer reaction and the ability to adapt well is medium resistant and early varieties to cast the grain. When triticale is harvested as a green feed during the milk age, it contains 22-24% protein; yield is significantly higher than other cereals; dry matter production is high.

Ammonium sulphate containing 21% Nitrogen with physiological acid character and triple superphosphate containing 42% P2O5 as phosphorous fertilizer were used in consideration of regional soil. Sanliurfa is under the influence of the terrestrial climate, including in the Southeast Anatolia climate region. The summers are hot and the arid winters are a mild climate.

The experiment was carried out on 25 parcels with three replications according to the parcel trial design divided into random blocks with the phosphorus doses as the main parcel and the nitrogen doses as the sub parcels. In the lower parcels, the parcel size is set to 4 m, the parcel width is 2 m, and the distance between the blocks is 2.5 m.

Fertilizer doses; Ammonium sulphate fertilizer at 0-3-6-9-12 kg / da pure N and TSP fertilizer at 0-3-6-9-12 kg / da pure P were used in the future. The total amount of P in the fertilizer and half of the amount of N were planted together with planting, while the other half was given in early seedling stage after emergence. The sides of the parcels were removed from the sides and the sides by 20 cm, and the remaining 5.6 m^2 area was harvested during the full flowering period of the vetch.

Table 1. Average Climate Values of Şanlıurfa Province (2010-2012) (DMİ, 2013)

		OCTB	NOVEM	DECEMB	JANUA	FEBRUA	MARCH	APRIL	MAY
2010-2011	Ort. Temperature (° C)	21.0	16.5	10.4	7.3	7.6	12.3	15.4	21.3
	Top Load. Temperature (° C)	32.1	28.5	26.0	14.6	17.8	25.2	28.5	34.9
	Most Dream. Warm. (° C)	9.8	8.5	3.0	0.3	-0.9	2.3	4.3	11.3
	Lowest Humidity (%)	10.0	10.0	21.0	41.0	30.0	26.0	28.0	24.0
	Precipitation Topl.Kg / m²	2.3	0.0	72.1	58.0	28.2	42.0	133.7	39.2
2011-2012	Ort. Temperature (° C)	19.3	9.4	7.4	5.5	5.8	9.7	19.3	22.4
	Top Load. Temperature (° C)	32.7	21.4	16.0	14.8	16.2	21.3	32.6	33.2
	Most Worst (° C)	8.8	-0.4	0.8	-4.3	-1.9	-1.7	6.6	13.0
	Lowest Humidity (%)	25.0	25.0	29.0	54.0	35.0	25.0	11.0	10.0
	Precipitation Topl.Kg / m²	12.3	62.1	47.1	170.9	95.8	35.8	23.3	42.3

The vertical distance between the soil surface and the extreme point was measured and the averages were taken in 10 vetch and Tritikale plants that were randomly selected before planting (cm) in each plot (Anlarsal and Gülcan, 1988). Dry grass yield (kg / da), dry weed samples randomly taken from each plot were found in the drying cabinet until the weights were fixed at 70 C, then the dry grass weights were found as%. The annual yield of

each plot is calculated by multiplying dry hay yield by calculated hay yield (Anlarsal and Gülcan, 1989). The results obtained from the experiments were subjected to analysis of variance according to the split plot design of random blocks and the differences between the experimental subjects were checked by F and LSD tests.

RESULTS AND DISCUSSION

1. Green grass production(kg/da)

The results of variance analysis were applied to the total green grass yield values measured in the plots of vetch + triticale mixture applied to different nitrogen and phosphorus doses.

Table2. Analysis Of Variance Results On Green Grass Yield

Source Of Variation	Degree Of Freedom	Frames Average	F Value	chance
Block	4	201544.2	1.55	0.235
Year	1	470288.0	3.62	0.075
Phosphorus	4	651619.9	5.02	0.008**
Year*Phosphorus	4	136927.9	1.06	0.410
Error 1	16	129753.3		
Nitrogen	4	3103062.7	90.06	0.000**
Year*Nitrogen	4	28115.7	0.82	0.519
Nitrogen*Phosphorus	16	44738.8	1.30	0.219
Year *Nitrogen* Phosphorus	16	51692.8	1.50	0.120
Error 2	80	34454.1		

**%1 is statistically significant within error limits; * %5 is statistically significant within error limits.

Different nitrogen and phosphorus doses applied.The difference between the green grass yield values in the triticale mixture of vetch + 40 %at 60% was statistically significant in nitrogen and phosphorus applications.

Table 3. Avrage values and groups related to green grass yield

	Applications	P_0	P_3	P_6	P_9	P_{12}	Ort.
2 Years United	N_0	1763.8	1886.6	2039.4	1868.7	1829.4	1877.6 d
	N_3	2258.6	2574.0	2609.9	2355.6	2339.5	2427.5 bc
	N_6	2476.3	2782.4	2796.6	2646.2	2516.0	2643.5 ab
	N_9	2550.2	2823.9	2947.5	2572.1	2507.2	2680.2 a
	N_{12}	2382.2	2534.2	2525.5	2063.8	2182.2	2337.6 c
	Ort.	2286.2 c	2520.2 ab	2583.8 a	2301.3 bc	2274.8 c	2393.29

1) The mean with the same letter is not statistically different from the F and LSD test in terms of 5% error limits.

2. Dry grass yield (kg / da)

The results of variance analysis were given regarding the total dry weed yield values measured from the Vetch + triticale mixture plots where nitrogen and phosphorus fertilizers were applied at different doses.

Chart 4. Analysis Of Variance Results On Dry Weed Yield

Varyasyon Kaynağı	Serbestlik Derecesi	Kareler Ortalaması	F Değeri	Olasılık
Block	4	71034.8	1.86	0.168
Year	1	16.5	0.00	0.984
Phosphorus	4	197660.3	5.16	0.007 **
Year*Phosphorus	4	41183.6	1.08	0.401
Error 1	16	38284.9		
Nitrogen	4	992470.6	100.19	0.000 **
Year*Nitrogen	4	19454.2	1.96	0.108
Nitrogen*Phosphorus	16	13872.3	1.40	0.163
Year*Nitrogen*Phosphorus	16	18052.2	1.82	0.042 *
Error 2	80	9905.7		

** %1 is statistically significant within error limits; * %5 is statistically significant within error limits.

Different nitrogen and phosphorus doses applied to vetch + triticale dry matter yield in mixtures of phosphorus and nitrogen applications in terms of the difference between the values statistically at the level 0.01 and year*Nitrogen*phosphorus were determined to be significant at 0.05 level in terms of interaction.

Chart 5. Average values and groups related to dry weed yield

	Applications	P_0	P_3	P_6	P_9	P_{12}	Ort.
2 Years United	N_0	762.81	853.81	955.31	825.77	845.49	848.64
	N_3	1032.1	1213.5	1267.1	1064.4	1141.6	1143.7
	N_6	1205.1	1287.5	1389.1	1284.2	1223.2	1277.8
	N_9	1200.2	1350.9	1478.8	1217.8	1236.8	1296.9
	N_{12}	1120.3	1105.9	1195.3	940.8	1038.3	1080.1
	Ort.	1064.1	1162.3	1257.1	1066.6	1097.1	1129.5

1) The mean with similar letters is not statistically different from the F and LSD test in 5% error limits.

The total dry yield values in the average of two years were changed between 848.64-129.6 kg/da in nitrogen applications and between 1064.1-1257.1 kg/da in phosphorus applications. The highest total dry seed yield in the average of two years was obtained from N9P6 plots with nitrogen 1478,8 kg/da and phosphorus 9 kg/da, and the lowest total dry seed yield was 762,81 kg / da from n_0p_0 plots with nitrogen and phosphorus.

Aydın and Tosun (l99l) reported that the dry grass yield obtained as 221.0 kg/da from 80% vetch and 20% triticale mixture was low and the legume ratio in the mixture was high. In addition, Aydın and Tosun (1993) reported that the average dry weed yield was 245.4 kg and 271.5 kg from Decar and the effect of phosphorus on dry weed yield was realized in nitrogen presence in vetch and barley mixture with Decar 0 and 6 kg P2O5 fertilization.

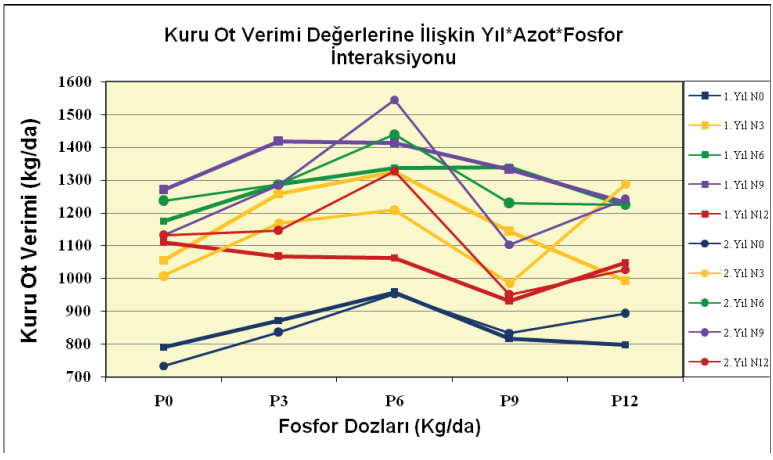

Figure 1. *Nitrogen*phosphorus doses interaction (kg/Da)

With the increase in nitrogen dose, phosphorus doses and differences occur according to years and cause significant changes in dry grass yield. As a matter of fact, stable results were obtained in P_0, P_3, P_6 and P_9 doses applied in N_3 doses, but differences were observed in P_{12} doses over the years. However, in N_6, N_9 and N_{12} doses, it is observed that the interaction occurred even in P6 dose and continued in higher phosphorus doses. Dry grass yield according to the years and fertilizer doses applied nitrogen*phosphorus doses of one year of different reactions caused interaction.

3. Triticale ratio of green grass (%)

The results of variance analysis were applied to the values of age triticale ratio measured in the Vetch + triticale mixture plots of different nitrogen and phosphorus doses.

Chart 6. results of variance analysis of green grass triticale ratio

Varyasyon Kaynağı	Serbestlik Derecesi	Kareler Ortalaması	F Değeri	Olasılık
Block	4	8.47	1.77	0.184
Year	1	177.47	37.05	0.000 **
Phosphorus	4	12.06	2.52	0.082
Year*Phosphorus	4	0.28	0.06	0.992
Error 1	16	4.79		
Nitrogen	4	7.82	8.88	0.000 **
Year*Nitrogen	4	0.06	0.07	0.991
Nitrogen*Phosphorus	16	1.36	1.54	0.104
Year *Nitrogen* Phosphorus	16	0.60	0.69	0.799
error 2	80	0.88		

** %1 is statistically significant within error limits; * %5 is statistically significant within error limits.

The difference in the values of green grass triticale ratio in the Vetch + triticale mixture applied to different nitrogen and phosphorus fertilizers was found to be statistically significant for nitrogen applications and years at 0.01 level.

Chart 7. average values and groups of green grass triticale ratio

	Applications	P_0	P_3	P_6	P_9	P_{12}	Ort.
2 Years United	N_0	89.02	87.63	89.68	88.70	89.38	88.88 a
	N_3	88.91	88.24	89.33	88.31	88.65	88.69 ab
	N_6	87.80	87.71	88.74	87.76	88.16	88.03 ab
	N_9	87.66	86.73	88.29	87.23	88.62	87.70 b
	N_{12}	87.17	87.74	89.57	88.61	89.79	88.58 ab
	Ort.	88.11	87.61	89.12	88.12	88.92	88.37

1) The mean with similar letters is not statistically different from the F and LSD test in 5% error limits.

Nitrogen and phosphorus fertilizer applied in the experiment, the average green grass triticale ratio is 89.79%, 12 kg/da nitrogen and 12 kg/da phosphorus fertilizer applied n1212, parcel obtained, while the lowest value is 87.17% and 12 kg/da nitrogen and phosphorus fertilizer applied $n_{12}p_0$ parcels are observed to be obtained.

4. Vetch ratio of green grass (%)

The results of variance analysis were obtained from the combination of the Vetch + triticale applied to different nitrogen and phosphorus doses and applied to the green vetch ratio values.

Chart 8. Analysis of variance results for green grass Vetch ratio

Varyasyon Kaynağı	Serbestlik Derecesi	Kareler Ortalaması	F Değeri	Olasılık
Block	4	8.47	1.77	0.184
Year	1	177.47	37.05	0.000 **
Phosphorus	4	12.06	2.52	0.082
Year*Phosphorus	4	0.28	0.06	0.992
Error 1	16	4.79		
Nitrogen	4	7.82	8.88	0.000 **
Year*Nitrogen	4	0.06	0.07	0.991
Nitrogen*Phosphorus	16	1.36	1.54	0.104
Year*Nitrogen*Phosphorus	16	0.60	0.69	0.799
Error 2	80	0.88		

** %1 is statistically significant within error limits; * %5 is statistically significant within error limits

The difference between the values of the Vetch ratio in the Vetch + triticale mixture of different nitrogen and phosphorus doses was statistically significant in terms of years and nitrogen applications, and it was observed that the other variance components were not statistically significant.

Chart 9. average values and groups of green grass Vetch ratio

	Applications	P_0	P_3	P_6	P_9	P_{12}	Ort.
2 Years United	N_0	10.99	12.38	10.33	11.31	10.63	11.12 b
	N_3	11.10	11.76	10.68	11.69	11.35	11.31 ab
	N_6	12.21	12.29	11.27	12.24	11.85	11.97 ab
	N_9	12.35	13.28	11.71	12.78	11.39	12.30 a
	N_{12}	12.84	12.26	10.43	11.39	10.21	11.43 ab
	Ort.	11.89	12.39	10.88	11.88	11.08	11.63

1) The mean with similar letters is not statistically different from the F and LSD test in 5% error limits.

According to the average values of two years, the highest ratio was obtained from the N_9P_3 plots applied to nitrogen and phosphorus by 13.28% and 9 kg/DA, and the lowest ratio was obtained from the $n_{12}p_{12}$ plots applied to nitrogen and phosphorus by 10.21% and 12 kg/da.

5. Ratio of Triticale In Dry Grass (%)

The results of variance analysis were applied to the triticale ratio values of dry grass measured in the Vetch + triticale mixture plots of different nitrogen and phosphorus doses.

Table 10. Analysis Of Variance Of The Ratio Of Triticale In Dry Grass

Varyasyon Kaynağı	Serbestlik Derecesi	Kareler Ortalaması	F Değeri	Olasılık
Block	4	8.91	3.64	0.027 *
Year	1	55.12	22.55	0.000 **
Phosphorus	4	2.19	0.90	0.489
Year*Phosphorus	4	1.30	0.53	0.712
Error 1	16	2.44		
Nitrogen	4	1.27	2.05	0.095
Year*Nitrogen	4	0.28	0.46	0.761
Nitrogen*Phosphorus	16	0.52	0.84	0.632
Year *Nitrogen* Phosphorus	16	0.44	0.72	0.766
Error 2	80	0.62		

** %1 is statistically significant within error limits; * %5 is statistically significant within error limits.

The difference between the values of the tritikale ratio of dry grass in the Vetch + triticale mixture was observed statistically significant at 0.01 level for years. It was found that the other variance components did not have a statistically significant effect on the ratio of triticale in dry grass.

Chart 11. Average values and groups of triticale ratio in dry grass

	Applications	P_0	P_3	P_6	P_9	P_{12}	Ort.
2 Years United	N_0	94.07	94.64	94.83	94.34	94.60	94.49
	N_3	94.63	94.77	94.84	93.86	95.06	94.63
	N_6	94.12	94.60	94.77	94.49	94.86	94.56
	N_9	94.49	94.18	94.72	94.44	94.76	94.52
	N_{12}	94.59	94.28	95.44	95.22	95.43	94.99
	Ort.	94.38	94.49	94.92	94.47	94.94	94.64

1) The mean with similar letters is not statistically different from the F and LSD test in 5% error limits.

The average rate of dry grass triticale in two years was 93.86-95.44%, the highest rate of triticale was obtained from $N_{12}P_6$ Square and the lowest rate was obtained from N3P9 square.

6. Ratio of Vetch In Dry Grass (%)

The results of variance analysis were applied to the Vetch ratio values in dry grass measured from the plots planted in the Vetch + triticale mixture applied to different nitrogen and phosphorus fertilizer doses.

Chart 12. Analysis Of Variance Results For The Rate Of Vetch In Dry Grass

Varyasyon Kaynağı	Serbestlik Derecesi	Kareler Ortalaması	F Değeri	Olasılık
Block	4	8.91	3.64	0.027 *
Year	1	55.12	22.55	0.000 **
Phosphorus	4	2.18	0.90	0.480
Year*Phosphorus	4	1.31	0.53	0.712
Error 1	16	2.44		
Nitrogen	4	1.27	2.05	0.095
Year*Nitrogen	4	0.29	0.46	0.761
Nitrogen*Phosphorus	16	0.53	0.84	0.632
Year *Nitrogen* Phosphorus	16	0.44	0.72	0.760
Error 2	80	0.62		

** %1 is statistically significant within error limits; * %5 is statistically significant within error limits

The difference between the values of the Vetch ratio in the Vetch ratio in the Vetch + triticale mixture of different nitrogen and phosphorus doses was found to be statistically significant between 0.05 and 0.01 between the blocks.

Table 13. Average values and groups for the rate of Vetch in dry grass

	Applications	P_0	P_3	P_6	P_9	P_{12}	Ort.
2 Years United	N_0	5.94	5.36	5.17	5.67	5.41	5.51
	N_3	5.38	5.23	5.17	6.14	4.94	5.37
	N_6	5.89	5.40	5.24	5.52	5.15	5.44
	N_9	5.52	5.82	5.28	5.57	5.25	5.49
	N_{12}	5.41	5.72	4.56	4.78	4.57	5.01
	Ort.	5.62	5.51	5.08	5.53	5.06	5.36

1) The mean with similar letters is not statistically different from the F and LSD test in 5% error limits.

Depending on nitrogen and phosphorus fertilization, according to the two-year average, the highest rate of vetch in dry grass is 6.14% 3 kg/da nitrogen and 9 kg/da phosphorus applied n3p9 parcels, the lowest rate of vetch was obtained from 12 kg/da nitrogen and 6 kg/da phosphorus plots as 4.56%. Assefa and Ledin (2003) found that fertilization affected mixed sowing harmony and reduced the ratio of the Vetch in dry matter by 24%.

CONCLUSIONS

According to the results of our study, 60% vetch and 40% trichikale mixture applied the effect of nitrogen and phosphorus fertilizer doses on green grass yield, dry grass yield, triticale and vetch ratios in wet grass was found to be statistically significant. It was determined that the nitrogen doses applied to the plants included in the mixture increased the green herb yield up to 9 kg/da, phosphorus doses up to 6 kg/da and the highest yield was obtained from n9p6 parcels as 2947.5 kg/da. When the average values of two years in the study were examined, the highest value in dry weed yield was obtained from 147.8 kg/da and N9P6 fertilizer doses and the lowest value was obtained from the control plots with n0p0 fertilizer is not applied.

According to the results of the research, the most suitable fertilizer combination was 9 kg/da nitrogen (N) and 6 kg/da phosphorus (p) in mixed cultivation with 60% vetch and 40% triticale varieties. With the whole amount of phosphorus to be applied and half of the amount of nitrogen with planting, the other half of nitrogen fertilizer, the plant after the emergence of early seedling period is thought to be more appropriate.

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CHAPTER 10

DIATOM IN BIOTECHNOLOGY: VALUABLE PRODUCTS AND APPLICATIONS

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INTRODUCTION

Microalgae are microscopic unicellular, aquatic, prokaryotic and eukaryotic primary photosynthetic organisms. They are photosynthetic prokaryotic and eukaryotic microorganisms that grow rapidly and have the ability to exist in different environments owing to their unicellular or simple multicellular structure (Barsanti and Gualteri, 2006; Hamed, 2016).

Microalgae ecologically represent an important group that carry out primary production in marine or freshwater environment. Microalgae, which are mostly photoautotrophic organisms, have an active role by being the largest producers of organic matter in marine and freshwaters. Due to microalgae significant importance in primary production, it is thought that a study pioneering natural environment works is found vital to carry out a research in laboratory or outdoor conditions. In line with EU Blue Growth and OECD Green Growth Policy and bearing in mind that approximately 75% of the world is covered by seas, it has been thought that utilization of further marine resources should be diversified ad enhanced.

Our country is generally well suited for microalgae culture in terms of sunny days and mild climate. It is crucial to increase the number of studies on the utilization of algae and to transform the results obtained from these studies into products that will contribute the economy. However, our country's seas are extremely rich in microalgae diversity and there are many marine or freshwater species whose commercial importance is unknown yet. The microalgae culture studies in our country are carried out mostly with commercial species provided from abroad. The isolation of microalgae from the territorial waters from our region and determination of taxonomic locations of microalgae species in details by molecular phylogeny methods and in the future, cultivation of species under laboratory or outdoor conditions together with will provide resource for industrial production which will be the unique aspects of the researches. With reference to European Union's Blue Growth Policy which describes the further utilization of marine resources so the OECD's similar policy namely Green Growth nevertheless considering that four thirds of the world is covered with sea and oceans and our country remain as a peninsula, could provide sufficient reason for best utilization of

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marine resources.

Microalgae exist in almost every habitat in all over the world. Microalgae have the ability to use solar energy in combination with water and carbon dioxide to create biomass. Microalgae are able to double their weights daily, can easily be used in biotechnological processes, have low cost, contain many useful substances which have an economic value and their ability to resist against environmental factors are the reasons of their significance. Microalgae use sunlight and carbondioxide to produce oil as terrestrial plant, however they possess more productivity than terrestrial plants due to their fast reproduction which take only few hours and the fact that they can be harvested throughout the year (Rawat et al., 2013). The many advantages of using microalgae instead of terrestrial crops, lies in the fact that the growth of algae is faster and they need less water than terrestrial crops. Besides, microalgae can be cultivated in wastewater thus in addition of producing bioactive compounds they can also be a treatment for effluents.

Microalgae strain selection to successful microalgae cultivation and generation of these products are very important. Two important steps in determining a resistant and suitable microalgal species are biological and ecological investigate of target microalgae strain samples from diverse habitats, and strain selection, isolation, and purification using traditional and advanced microbiological methods (Grobbelaar, 2009; Mutanda et al., 2011). Despite the advances in microalgal biotechnology, there are some difficulties about in the microalgae culture. Basically, the main objective of the production of phototrophic organisms is to provide the continuous culture. It is known that the microalgae species are affected from changing environmental factors. The microalgae cells react to these changing factors, continuously. The important factors affecting microalgal growth conditions such as nutrient medium, temperature, salinity, CO_2 availability, pH and light (Cohen et al., 1988; Brown et al., 1989; Roessler, 1990; Sukenik, 1991;, Lourenço et al., 1998; Hu, 2004).

Diatoms are Bacillariophyceae classification within the division Heterokontophyta. Their most characteristic feature is the ability to generate external wall composed of silica [$(SiO_2)n(H_2O)$], known as the frustules. The well examined small-cell species (5–50 μm) inclined to be most abundant at the beginning of spring and autumn, when nutrients were not limiting and light intensity (Falciatore and Bowler, 2002). Day length is optimal for diatom photosynthesis.

Diatoms are generally contains two major groups, depending on the symmetry of their frustules (Van Den Hoek et al., 1997). Centric diatoms are radially symmetrical the frustules especially resembling a petri dish, whereas pennate diatoms are elongated and bilaterally symmetrical in valve view (Van Den Hoek et al., 1997; Falciatore and Bowler, 2002). Some of the pennate diatoms are able to glide along surfaces, owing to the raphe within one or both of the frustules through which mucilage is excreted to assist movement (Falciatore and Bowler, 2002).

One of the major primary producer in biomass production and the sinking of atmospheric greenhouse gas and biomass production are diatoms. Diatoms ecologically represent an important group of microalgae that carry out primary production in marine environment. Diatoms, which are mostly photoautotrophic organisms, have an active role by being the largest producers of organic matter in marine and fresh waters. Various studies have shown that these photosynthetically active organisms are responsible for 20–25% of total terrestrial primary production (Field et al. 1998) and approximately 40% of annual marine biomass production (Falkowski et al. 1998).

Due to diatoms significant importance in primary production, it is thought that a study pioneering natural environment works is found vital to carry out a research in laboratory conditions. In line with EU Blue Growth and OECD Green Growth Policy and bearing in mind that approximately 75% of the world is covered by seas, it has been thought that utilization of further marine resources should be diversified ad enhanced.

Diatoms are unicellular, sessile, photosynthetic algae which compose silica cell wall. They are found in diverse habitats like freshwater, marine and brackish. They are important tools for determining ecological conditions and play an important role of the primary production in these habitats. Also, they play a vital role on the photosynthesis in aquatic habitats.

Diatoms (Bacillariophyta) ecologically represent an important group of microalgae that carry out primary production in marine environment. Diatoms, which are mostly photoautotrophic organisms, have an active role by being the largest producers of organic matter in marine and fresh waters.

Nowadays, interest in microalgal biotechnology has mostly been focused on the efficient algae culture technologies to produce valuable metabolites commercially from algal biomass. In recent years, an increasing interest in microalgal biotechnology was noticed due to the accumulation of cells metabolites in large amounts. Microalgae are used for various purposes mainly as food supplement, fertilizer for improving soil structure, in animal feed due to protein, vitamins, fatty acids, carbohydrates, minerals and pigments, hydrocarbons, polysaccharides, antibiotics, and for other metabolites (Becker, 2007; Milledge 2011; Yaakob et al., 2014). Microalgae are a diverse group of microscopic organisms with the wide range of biochemical compounds and contain up to 50-70% protein, 30% lipids, 20-40% carbohydrates, over 40% glycerol, up to 8-14% carotene and high concentration of aminoacids, fatty acids and vitamins (B1, B2, B3, B6, B12, E, K, D, etc.), compared with other plants or animals (Avagyan, 2008). Despite the fact that more than 50000 microalgae species of them are known, only 30000 have been researched (Mata et al., 2010). The diatom numbers of their genera and species are approximately 250 and 100,000, respectively (Lebeau and Robert, 2003; Guiry, 2012).

Nowadays, there are numerous commercial applications of diatoms to produce valuable metabolites commercially from algal biomass. Microalgal

biomasses have been produced industrially for applications in different fields such as food, aquaculture, pharmaceutical, nutraceutical, cosmetic, and animal feed industries.

Diatoms naturally produce substances for foodstuffs, antibiotics, and pharmaceutically active substances. Industrial applications considered and pioneered for commercial use of diatoms consist of nitrogen-fixing biofertilizer, renewable energy, fluid fuel production, raw materials production, and naturally-occurring and industrial waste detoxification using biological refuse as substrate (Bozarth et. al., 2009). Besides these important aspects, which have been showed that reviewed recently (Kroth 2007), cell biological and molecular applications have been emphasized for diatoms in the last couple of years, revealing enthusiastic perspectives for new applications of diatom biotechnology.

In many countries, lipid productions from microalgal biomass studies are subject to research. With regard to the benefits of using microalgal biotechnology, the major areas of progress have been in the fields of biodiesel production using microalgae. Studies are underway seeking for the possibilities to utilize from renewable and non-toxic microalgal biodiesel as an energy source. In many countries they are researching the stress conditions which stimulate the increase of the current lipid content in the cell and they are making serious efforts to specify the high growth rate of microalgal species and their lipid content. Diatoms were investigated that have a higher lipid content than other algal species (Hildebrand et. al., 2012). The high production of lipids in many species of diatoms has attracted great notice to the potential use of diatoms as a source for biofuels (Daboussi et. al., 2014). Lipids are the major metabolites of diatoms, being consisting of neutral lipids, polar lipids and traces of sterols (Chen, 2007). Several studies have shown that neutral lipids are their main stored lipids, contains of triacylglycerol (TAG), diacylglycerol (DAG) and monoacylglycerol (MAG), with the TAG content typically accounting for more than 60% of total lipids (Chen, 2007). The fatty acids of diatoms consist of those from lauric acid (C12:0) to lignoceric acid (C24:0). The contents of myristic acid (C14:0), hexadecanoic acid (C16:0), 9-hexadecenoic acid (C16:1) and eicosapentaenoic acid (EPA, C20:5 n-3) are generally higher than those of other fatty acids (Ackman et.al., 1964; Chen et al., 2007; Chuecas and Riley, 1969; Kates and Volcani, 1966; Wen and Chen, 2002). In addition to, some diatoms ınclude docosahexaenoic acid (DHA, C22:6 n-3), which is important for many marine animals that appear to have a limited capacity for synthesising longchain polyunsaturated fatty acids, especially EPA and DHA, which are needed for good growth and survival (Reitan et. al.,1994; Renaud et al., 1991; Yongmanitchai and Ward, 1989). Several researches have been carried out concerning the effectiveness of different species of diatoms as a food source for culturing larvae of marine organisms. Therefore, alteration in the lipid composition of various diatom species under different environmental conditions is a topic worth investigating. Therefore, the number of studies on this issue can be increased.

Fucoxanthin, a carotenoid with potential to be used in pharmaceutical, food and cosmetics, not found in higher plants is an organic substance with known antioxidants and coloring properties is an important metabolite generated by diatoms within the cell. In many countries, lipid productions from microalgal biomass studies are subject to research and in this study oil production capacity of chosen local species will be determined and defined molecular species will be registered for our country. To produce microalgal metabolites of high-value products specifically, using microalgae is a large income-generating industry the potential for substantial in many parts of the world growth. Having three of the four covered with seas and oceans around the world and in our country is surrounded on three sides by the sea, it should be considered as important reasons that we need to make better use of our marine resources.

The most common traditional diatom species used for biotechnology, such as Chaetoceros calcitrans, Nitzschia closterium, Phaeodactylum tricornutum, Skeletonema costatum, Thalassiosira pseudonana.

Therefore, the present this review to emphasize the latest developments and recent research focusing specifically on the potential biotechnological application of diatom species. Algal biomass compounds and their methods of extraction are investigated. Information about diatom of industrial production and their promising as a source of renewable energy are also provided. Finally, strain selection, isolation and purification techniques for diatom species, molecular identification, growth characteristics, large scale cultivation, and harvesting are explained and the possibilities of their improvement have been discussed and evaluated. Additionally; this review is a brief summary of a concerned with diatom research project currently in progress. Within the scope of the project; the diatoms collected and isolated from the Yumurtalık Bay at Northeastern Mediterranean at Gulf of Iskenderun, and species were cultivated under laboratory conditions, identified using molecular techniques, and their growth and biochemical composition were investigated. The isolation of diatoms from the territorial waters from our region and determination of taxonomic locations of diatom species in details by molecular phylogeny methods and in the future, cultivation of species under laboratory conditions together with have provide resource for industrial production which will be the unique aspects of this project.

In conjunction with the determination of biochemical contents of local diatom species in the region, industrial use possibilities of these species have be revealed. Thus, by utilizing the advantage of more efficient cultivation of local species in regional climatic conditions, new types of candidates for commercial use have been explored. Moreover, the phylogenetic records of diatom species identified in the area have been done which will permit to collect data that have contribute to the diversity of the scientific literature.

Application of the preliminary experiment

Sampling was carried out using a plankton nets having 20 µm and 55 µm mesh size plankton nets for 10 minutes at different depths, horizontally

Salinity, temperature, pH measurements of each stations were made with a YSI model salinometer. Samples were placed in plastic jars and kept in ice in the dark plastic box and transferred to Algal Biotechnology Laboratory, Fisheries Faculty, Cukurova University within 2h.

The isolation of the required species were done by serial dilutions and applying agar plating methods. Isolated diatom species were cultured in different media.

-By agar-plating method: For preparing the agar-medium, 1.5% agar is added to 1 liter of suitable medium or even natural seawater and this agar solution is sterilized in an autoclave for 15 minutes under 150 lbs pressure and 120^{o}C temperature.

-Serial dilution: Label tubes 10^{-1} to 10^{-10} indicating dilution factor. Aseptically add 1 ml of enrichment sample to the first tube (10^{-1}) and mix gently. Take 1 ml of this dilution and add to the next tube (10-2), mix gently. Repeat this procedure for the remaining tubes (10^{-3} to 10^{-10}). Incubate test-tubes under controlled temperature and light conditions: Examine cultures microscopically after 2-4 weeks by withdrawing a small sample aseptically from each dilution tube. A unialgal culture may grow in one of the higher dilution tubes e.g. 10^{-6} to 10^{-10}.

To purify the samples, antibiotic (Ampicillin sodium and Kanamycin) media were prepared at 5 different rates (200 mg/L, 400 mg/L, 600 mg/L, 800 mg/L, 1000 mg/L) after sterilization of the agar medium in the autoclave. Proportions of antibiotics were prepared by adding the proportions. It was then poured separately into agar plates (about 15 mL) and waited for cooling. Algae transferred to new flask were continuously mixed and illuminated with shaker. As the number of cells increases were applicated acid/base treatment. Artificial seawater prepared 7 treatments including pH2, pH3, pH4, pH5, pH9, pH10 and pH11 for acid/base treatment. 1 ml of sample was taken from the flask. And eppendorf tubes were centrifugeted 3500 rpm, 5minute with mini scanspeed. Upper leaved the liquid. Eppendorf tubes were mixed artifical sea water (pH2, pH3, pH4, pH5, pH9, pH10 and pH11) taken 1 ml and rested for 5 min. Again eppendorf tubes were centrifugeted 3500 rpm, 5minute and upper leaved the liquid. This application was repeated 5 rounds. The algae sample that was deposited at the bottom of the eppendorf tube was again streaked with agar.

These pure cultures were maintained at room temperature (20±1°C) under 40 µmol photon m^2s^2 light intensity on a 12:12-h light/dark cycle and were aerated continuosly. The identification of the isolates was established under microscope based on the morphological characters following Tregouboff and Rose (1957), Cupp (1977), Richard (1987), Delgado and Fortuno

(1991), Hartley (1996) and Tomas (1997). Isolated diatom species were detected following morphological and molecular identification. Genomic DNA extractions were performed with a DNeasy Plant Mini Kit (Qiagen, Tokyo, Japan) following the manufacturer's protocol. Then DNA isolated from the cells was and amplified by PCR. Identifications of our samples were made with phylogenetic analyses depending on nucleotide sequences of small subunit of nuclear ribosomal DNA. Nucleotide sequencings were performed commercially by Macrogen Inc. (Korea) with the same primers used for PCR amplifications. To evaluate the phylogenetic relationships among isolates Neighbor-Joining (NJ), Maximum-Parsimony (MP) and Bayesian inference (BI) algorithms were used. Twenty diatom samples isolated from different stations at Bay of Yumurtalik were considered in this project. According to these results, a new record diatom species were identified in Turkey.

The diatoms collected and isolated from the Yumurtalık Bay at Northeastern Mediterranean at Gulf of Iskenderun, and these species of (Chaetoceros sp. and Nitzschia sp.) cultivated under laboratory conditions. Cultures were maintained at room temperature (20±1°C) under 40 μmol photon m^2s^2 light intensity on a 12:12-h light/dark cycle and were aerated continuosly. Experiments were carried out by cultivation of 10^4 cells mL-1 of Chaetoceros sp. and Nitzschia sp., in 1 L cylinder tubes containing sterilized F/2 medium with salinity of 30 ppt. Cultures were placed on the shelves and aerated by a compressor, continuously.

Analytical Methods

The growth rate of *Chaetoceros sp.* and *Nitzschia sp*. were characterized based on cell counts using a haemocytometer or via optical density measurements at 700nm.

The spesific growth rate (μ) and biomass productivity (Song et al., 2013) were calculated from and cell density was determined by Wood et al., 2005.

$\mu=(\ln Nt-\ln N0)/\Delta t$

Biomass productivity (mg L-1 day-1)= μ xBiomass

Chlorophyll *a* and total carotene contents of the algae were determined spectrophotometrically after extraction with acetone (Boussiba and Vonshak, 1992).

Microalgae at late log phase were harvested by centrifugation at 1520xg for 10 min. The pellet was dried at 60 0C for dry weight measurement. Lipid was extracted from the algae biomass according to the Bligh and Dyer (1959) method.

Total lipid content= (Total lipids/biomass)x100

Lipid productivity= Lipid contentxbiomass productivity

The fatty acid methyl esters (FAMEs) of algal lipids were prepared according to the method by Prevot and Mordret (1976). The resulting FAMEs were

analysed by GC-FID.

The carbohydrate content was determined as described by Liang et al. (2013). The total carbohydrate (CT) concentration was represented by the following equation: CT ¼ 0:9CR

Fucoxanthin content was analyzed by high performance liquid chromatography (HPLC), and purified fucoxanthin was determined by Terasaki et al., 2009.

Total protein was determined by Kjeldahl method (AOAC, 1998).

Preliminary experiment results

The specific growth rate and biomass and biomass productivity, cell density, chlorophyll *a*, total carotenoid, protein, carbohydrate, lipid and lipid productivity, fatty acid methyl esters (FAMEs) and fucoxanthin contents determined and showed significant differences ($p< 0.05$) between these species. The growth was continued to 8 days for *Chaetoceros* sp. and 10 days for the *Nitzschia* sp .The best growth and biochemical composition were obtained from the diatom *Chaetoceros* sp., while the highest amount of fucoxanthin was found in *Nitzschia* sp. These species growth and biochemical composition are summarized in Table 1.

Table1. Main parameters of growth rate and biomass and biomass productivity, cell density, chlorophyll *a*, total carotenoid, protein, carbohydrate, lipid contents of *Chaetoceros s*p. and *Nitzschia* sp

Parameters	***Chaetoceros* sp.**	***Nitzschia* sp**
Biomass (mgL^{-1})	1.014 ± 0.001^{a}	0.970 ± 0.007^{b}
Growth rate (day^{-1})	0.765 ± 0.009^{a}	0.626 ± 0.004^{b}
Biomass productivity ($mgL^{-1}day^{-1}$)	0.776 ± 0.007^{a}	0.607 ± 0.02^{b}
Chlorophyll *a* (μgL^{-1})	1.658 ± 0.025^{b}	1.780 ± 0.02^{a}
Total carotene(μgL^{-1})	2.181 ± 1^{b}	2.293 ± 2^{a}
Lipid (%)	19.74 ± 2^{a}	15.71 ± 3^{b}
Protein (%)	12.16 ± 0.001^{a}	11.65 ± 0.001^{b}
Carbohydrate (%)	37.48 ± 0.002^{a}	24.43 ± 0.001^{b}
Fucoxanthin (mg FX/g DW)	3.5 ± 0.3^{b}	4.8 ± 0.5^{a}

Means values, n=5; *Different letters between the columns indicate significant differences ($p<0.05$).

These species fatty acids are summarized in Table 2 and 3.

Table 2. Fatty acid content in *Chaetoceros* sp. (%)

C14:0	16.45 ± 0.2
C15:0	1.02 ± 0.5
C16:0	29.15 ± 0.7
C16:1	37.21 ± 0.12
C16:2	1.83 ± 0.9
C16:3	1.02 ± 0.2
C18:0	2.71 ± 0.3
C18:1	3.20 ± 0.1
C18:2	1.22 ± 0.1
C18:3	0.99 ± 0.4
C20:4	2.16 ± 0.5
C20:5	3.04 ± 0.6
C22:6	n.d. ± 0.7
SFA	49.33 ± 0.9
UFA	50.67 ± 0.11
MUFA	40.41 ± 0.12
PUFA	10.26 ± 0.13

Table 3. Fatty acid Content in *Nitzschia* sp (%)

C14:0	7.0 ± 0.2
C16:0	38.9 ± 1.2
C16:1	40.2 ± 0.2
C18:1	1.7 ± 0.2
C18:2	0.9±0.1
C18:3(n-3)	5.4 ± 0.2
C20:4(n-6)	1.3 ± 0.3
C20:5(n-3)	4.3 ± 0.3

The major fatty acids of the *Nitzschia* species were 14:0, 16:0, 16:1(n-7), 16:3(n-4) and 20:5(n-3). The major fatty acids of *Chaetoceros sp.* were 14:0, 16:0, 16:1.

The lipid and lipid productivity of *Chaetoceros sp*. was 19.74±2% and 15.32±1.35 $mgL^{-1}day^{-1}$ determined, respectively. The lipid and lipid productivity of *Nitzschia sp.* was 15.71±3% and 9.54±1 $mgL^{-1}day^{-1}$ determined, respectively. The highest spesific growth rate, biomass and lipid productivity values were found for *Chaetoceros sp.* The best growth and biochemical composition were obtained from the diatom *Chaetoceros sp.,* while the highest amount of fucoxanthin was found in *Nitzschia sp.*

Commercial Applications of Diatom Bioactive Compounds

The various mentioned microalgal bioactive compounds could be largely used in different industrial sectors (food colorant, feed, cosmetics, biofuel,

biofertilizer pharmaceutical, nutraceutical, etc).

Many microalgae biochemical composition, particularly the relative amounts of protein, lipid, and carbohydrate, when grown rapidly under favorable culture conditions. Microalgae have been utilized by humans for hundreds of years as food, feed, remedies, and fertilizers (Barsanti and Gualtieri, 2006).

Microalgae are also added and enriched to pasta, bread, snack foods or drinks either as nutritional supplements or natural food colourants (Becker, 2004).

One of the most important metabolite obtained from microalgae is the carotenoid pigment has a high value of biotechnological importance with applications in the aquaculture (salmon, trout, sea bream, shrimp, crustaceans), nutraceutical, immunomodulation, cancer presevention, pharmaceutical, cosmetics, food and feed industries (Guerin et al., 2003; Aflalo et al., 2007).

Fucoxanthin, a carotenoid with potential to be used in pharmaceutical, food and cosmetics, not found in higher plants is an organic substance with known antioxidants and coloring properties is an important metabolite generated by diatoms within the cell. Diatoms (Bacillariophyta) are one of the largest groups in the marine microalgae (Mann, 1996). Many studies have been investigated on pigment and lipid production from diatoms in different countries (Kim et al., 2012; Xia et al., 2013; D'Ippolito et al., 2015; Stonik and Stonik, 2015; Wang et al., 2011). Pigments are the most important metabolites in recent years (Wijffels 2007; Del Campo et al., 2007). The fucoxanthin producing diotoms were determined in the species such as Cylindrotheca closterium, Chaetoceros gracilis, Odentalla aurita Phaeodactylum tricornutum and Nitzschia sp. etc (Pasquet et al., 2011; Kim et al., 2012; Xia et al., 2013).

Diatomite is used mainly in the food industry as natural filtration material and in medicine, toothpaste, paint, cosmetic industries. Diatomite is also used as a valuable agricultural land and usually remove natural raw materials from nature (Neu and Alciartore, 1977; Parkinson and Gordon 1999; Cai et. al., 2005).

Biodiesel production from microalgal lipid and especially diatoms is the field of research in many countries (Levitan, 2014; Hassan et. al., 2013; Hildebrand, 2012; Demirbas and Demirbas, 2011; Samantray, 2010; Mata et. al., 2009; Griffiths et. al., 2009). Recently in many countries, different studies have been carried out on microalgae lipid as renewable fuel sources (Chisti, 2007). Many researchers so far have reported many advantages of using microalgae for biodiesel production (Demirbas, 2009; Mata et al., 2010; Singh et al., 2010; Huang et al., 2010). As a source of renewable energy, opportunities to benefit from non-toxic microalgae are underway for a biodiesel fuel source. Many microalgae strains capable of producing high amount of lipids have been identified and their lipid production metabolisms have been determined and reported (Sheehan et al., 1998)

Extracts from microalgae are rich sources of valuable metabolites commercially from algal biomass proteins, vitamins, minerals, and carotenoid pigments such as astaxanthin, fucoxanthin, zeaxanthin and beta-carotene etc. Components of microalgae are mostly used in cosmetics as thickening agents, water-binding agents, antioxidants, include facial and body skin care (anti-aging, moisturizing, and regenerant products), shower gels, body lotions, sun screen cream, and hair-care products (Spolaore et al., 2006; Priyadarshani and Rath, 2012).

Microalgae are rich source of novel and biologically active primary and secondary metabolites. These metabolites can be potential biomass compounds of interest in the pharmaceutical industry (Rania and Hala, 2008; Krishnakumar et al., 2013; Pradhan et al., 2014).

Microalgae feeds are currently used mainly for the cultivation of larvae and juvenile shelland finfish, and raising the zooplankton (rotifers, cladocerans, brine shrimp, or copepods) required for feeding of juvenile animals and used in this domain for many types of animals such as cats, dogs, aquarium fish, ornamental birds, horses, poultry, cows and breeding bulls (Chen, 2003; Spolaore et al., 2006). In aquaculture the most used species are from the microalgae, Phaeodactylum, Chaetoceros, Skeletonema and Thalassiosira. Diatom species can utilization by readily produced and must be non-toxic for aquaculture feed.

Studies are underway seeking for the possibilities to utilize from renewable and non-toxic microalgal biodiesel as an energy source. In many countries they are researching the stress conditions which stimulate the increase of the current lipid content in the cell and they are making serious efforts to specify the high growth rate of microalgal species and their lipid content. Recently in many countries, different studies have been carried out on microalgae lipid as renewable fuel sources (Chisti, 2007). Many microalgae strains capable of producing high amount of lipids have been identified and their lipid production metabolisms have been determined and reported (Sheehan et al., 1998). As a source of renewable energy, opportunities to benefit from nontoxic microalgae are underway for a biodiesel fuel source. For this purpose, high lipid content and better growth rate of microalgae species, besides stress conditions that stimulate content of lipid are being researched in many countries (Bulut Mutlu et al., 2011). Many studies have shown that, the quantity and quality of lipids within the cell can vary as a result of changes in growth conditions such as temperature and light intensity, or nutrients, especially concentrations of nitrogen, phosphates and iron (Illman et al., 2000; Liu et al., 2008; Xin et al., 2010). Different nitrogen (N) sources and concentrations can affect the growth and biochemical composition of algae and change the amount of carotene and fatty acid (Fidalgo et al., 1998). While N limitation decreases, the cell density of the cultures, amount of biomass and amount of chlorophyll a, increase the organic carbon compounds such as the lipid in the biochemical structure of microalgae (Kilham et al., 1997; Pruvost et al., 2009). It was known that decreasing of N or completely removing it from the culture

media, caused an increase in lipid content of the cell, thus, N limitation is suggested as the stress factor (Sukenik, 1991). Nitrogen limiting conditions were in fact reported to significantly increase the lipid content of many microalgae (Illman et al., 2000). It is known that different N sources and concentrations can affect the growth and biochemical composition of microalgae (Fidalgo et al., 1995). When the N deficiency was applied to the culture, the microalgae biomass decreased and lipid content increased (Xin et al., 2010). Microalgae are accumulate lipids in the range of 20% to 50% dry weight of biomass (Demirbas and Demirbas, 2010). These amounts can be increased more in the stress conditions of the algal cells.

Microalgae biomass can be source of biodiesel as a renewable energy. The studies about microalgae lipid production are mostly conducted at the full-controlled conditions in the laboratories. However, it is important that to achieve the mass production of microalgae for industrial production. And also it is important that decreasing of the cost of culture to produce lipid. To determine the microalgae species contained high lipid and to obtained high biomass are studied in many countries. In our country, also we have to study about isolation of the microalgae contained high lipid in our seas. Our country has planty of sunlight and subtropic climate, and the photosynthetic microalgae biomass can produce easily (Ak et al., 2015). The most important microalgae species that are used for biofuels are Chaetoceros calcitrans, Nitzschia closterium, Phaeodactylum tricornutum, Skeletonema costatum, Thalassiosira pseudonana etc.

Microalgae are used in agriculture as biofertilizers and in the soil ecosystem by improving its quality and fertility. The majority of Cyanobacteria such as Anabaena and Nostoc are capable of fixing atmospheric nitrogen and are effectively used as biofertilizers (Mandal et al., 1999). Microalgae can also be a source of biomass compounds that could be employed as plant-protecting substances against diseases caused by viruses or bacteria (Hannon et al., 2010; Abd El Baky and El-Baroty, 2013). The algal production technology developed and reported to provide an additional income from the sale of algal biofertilizer.

In conclusion, the microalgae have an enormous biodiversity and they can be a source of bioamass compounds (proteins, lipids, pigments, and vitamins) with numerous biological activities (antioxidant, antibacterial, antiviral, and anti-inflammatory). The interest in microalgae has increased as a result of the need for additional food supplies, energy resources and various raw materials, pharmateuticals, feed, biofertilizer etc. The cultivation of diatom is known to be the most profitable business in the biotechnological industry. It is a wasteless, ecologically pure, energy and resource saving process. Despite of their many advantages, the use of microalgae is still limited due to their high costs processing. More funds have to be made available for the study of microalgae. Of the 50000 existent species, only a few thousand are now kept in collections and are investigated for their chemical content, and even fewer are cultivated in industrial quantities. The studies about lipid produc-

tion from microalgae are mostly conducted in the controlled conditions in the laboratory environment whereas, the success is able to transfer of the results to the practice. It means the achievement is the high production volume economically. Finally, it is considered that the results obtained from this study showed that high lipid content of diatom contribute to biodiesel industry and the supply facilities. In addition to this expected to these types of biodiesel production in the Mediterranean Region with the aim of achieving a high level of lipid will supplemented for large commercial companies. However, it is important that to achieve the mass production of microalgae for industrial production. And also it is important that decreasing of the cost of culture to produce lipid.To determine the microalgae species contained high lipid and to obtained high biomass are studied in many countries. In our country, also we have to study about isolation of the microalgae contained high lipid in our seas. Our country has planty of sunlight and subtropic climate, and the photosynthetic microalgae biomass can produce easily.

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CHAPTER 11

THE EFFECTS OF NITROGEN DEFICIENCIES ON THE GROWTH, LIPID AND FATTY ACID COMPOSITION OF *Spirulina platensis*

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1. INTRODUCTION

Microalgae are used for various purposes mainly food supplement, as fertilizer for improving soil structure, in animal feed due to protein, vitamins, fatty acids, carbohydrates, minerals and pigments, hydrocarbons, polysaccharides, and for more many metabolites in the cell. Microalgae are able to double their weights daily, can easily be used in biotechnological processes, have low cost, contain many useful substances which have an economic value and their ability to resist against environmental factors are the reasons of their significance. Microalgae have the ability to use solar energy in combination with water and carbon dioxide to create biomass. Microalgae use sunlight and carbondioxide to produce oil as terrestrial plants, however they possess more productivity than terrestrial plants due to their fast reproduction which take only few hours and the fact that they can be harvested throughout the year.

Microalgae could be utilized for the production of several which are either unique to the algae or found at comparatively high concentrations, valuable metabolites in the cell and owner a high market value. In this regard, Spirulina is one of the promising microalgae. Because of this, one of the most important microalgae types cultured today is Spirulina platensis. Spirulina is cultivation, being both thermophilic and alkalophilic, with optimum growth conditions temperatures are 35-37 ^{0}C and pH of about 9-11. The high pH value in the medium is because of the CO_2 from in the bicarbonate and carbonate (Richmond 1988). These properties facilitate the maintenance Spirulina platensis productivity of monoalgal cultures in the laboratory and outdoor conditions. The general purpose of Spirulina production is to provide protein resource for people and also to benefit from the richness of its biochemical structure. The biochemical composition of Spirulina indicates that it has high nutritional value due to its content of a wide range of essential nutrients, such as vitamins, minerals, proteins, pigments (especially phycocyanin) and polyunsaturated fatty acids such as gamma-linolenic acid (Miranda et al., 1998). Spirulina contains 50-70% protein, 20% carbohydrate, 5% lipid, 7% minerals and 3 to 6% moisture (Ak et al., 2016).

Recently in many countries, different studies have been carried out on

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microalgae lipid as renewable fuel sources (Chisti, 2007). Many researchers so far have reported many advantages of using microalgae for biodiesel production (Demirbas, 2009; Mata et al., 2010; Singh et al., 2010; Huang et al., 2010). As a source of renewable energy, opportunities to benefit from non-toxic microalgae are underway for a biodiesel fuel source. Many microalgae strains capable of producing high amount of lipids have been identified and their lipid production metabolisms have been determined and reported (Sheehan et al., 1998). Numerous studies indicate that the biosynthesis and accumulation of lipids is increased in nitrogen-deficiencies cultures of various microalgae species (Sukenik and Wahnon, 1991; Reitan et al., 1994; Fidalgo et al., 1995; Colla et al., 2007; Pruvost et al., 2009; Bulut Mutlu et al., 2011; Uslu et al., 2011; Mostafa and Gendy, 2017; Ak et al., 2015; Deschoenmaeker et al. 2017; Esteves-Ferreira et. al., 2018) As a source of renewable energy, opportunities to benefit from non-toxic microalgae are underway for a biodiesel fuel source. For this purpose, high lipid content and better growth rate of microalgae species, easy to cultivate, besides stress conditions that stimulate content of lipid are being researched in many countries (Bulut Mutlu et al., 2011). Many studies have shown that, the quantity and quality of lipids within the cell can vary as a result of changes in growth conditions such as temperature and light intensity, or nutrients, especially concentrations of nitrogen, phosphates and iron (Illman et al., 2000; Liu et al., 2008; Xin et al., 2010). Different nitrogen (N) sources and concentrations can affect the growth and biochemical composition of algae and change the amount of carotene and fatty acid rates of the cells (Fidalgo et al., 1998). While N limitation decreases, the cell density of the cultures, amount of biomass and amount of chlorophyll a, increase the organic carbon compounds such as the lipid in the biochemical structure of microalgae (Kilham et al., 1997; Pruvost et al., 2009). It was known that decreasing of N or completely removing it from the culture media, caused an increase in lipid content of the cell, thus, N limitation is suggested as the stress factor (Sukenik, 1991).

In this study, the effects of nitrogen deficiencies were studied in Spirulina platensis (Cyanophyceae) with the aim of determining the effects of the 50% and 100% deficient nitrogen on growth, lipid and fatty acid composition of the cell under laboratory conditions.

2. MATERIAL AND METHOD

Microalgae Spirulina (Arthrospira) platensis was used in this study (Ben-Gruionuniv, Israel). The starter culture was obtained from Ben Gurion University of the Negev, The Jacob Blaustein Institute for Desert Research, Israel. Spirulina platensis cultures were kept at a constant room temperature of 26±2°C and illuminated with fluorescent lamps at an irradiance level of 80 μmol m^{-2} s^{-1} with photoperiod 16:8 (light:darkness, L:D) and were aerated continuously. In the laboratory, Spirulina platensis was cultured in 500 ml glass erlenmeyer flasks firstly, and then increased to the 2l glass flasks, later on the cultures were increased to the 6 l volume in balloons, in a continuous culture system. Cultures were placed on the shelves and aerated by

a compressor, continuously. Spirulina platensis were grown in 8 l glass jar in a batch culture system with an initial biomass concentration of 0.52 gl^{-1}. The irradiance was measured by a Radiation Sensor LI-COR (LI-250). The cultures were grown in Spirulina medium. The content of the medium consists of the following composition (gl^{-1}): 18.6 $NaHCO_3$, 8.06 Na_2CO_3, 1.00 K_2HPO_4 5.00 $NaNO_3$, 2.00 K_2SO_4, 2.00 NaCI, 0.40 $MgSO_4.7H_2O$, 0.02 $CaCI_2.2H_2O$, 0.02 $FeSO_4.7H_2O$, 0.16 $EDTANa_2$ and micronutrient elements (0.001 $ZnSO_4.7H_2O$, 0.002 $MnSO_4.7H_2O$, 0.01 H_3BO_3, 0.001 $Na_2MoO_4.2H_2O$, 0.001 $Co(NO_3)_2.6H_2O$, 0.00005 $CuSO_4.5H_2O$, 0.7 $FeSO_4.7H_2O$, 0.8 $EDTANa_2$) were added 10 mL to 1 L, (Zarrouk 1966). The sources of nitrogen of the medium is NaNO3. In the experiment, N was added 50% ($2.5gl^{-1}$) and 100% ($0gl^{-1}$) missing according to amounts in Spirulina medium. In the control culture, original Spirulina medium was used.

2.1. Analytical Methods

Samples were taken daily for analyses of the specific growth rate, cell density, biomass and biomass productivity, chlorophyll a, total carotenoid.

The specific growth rate (μ) was calculated from the slope of the linear regression of time (days) and cell density (cell ml^{-1}) according to eq. (1) (Wood et al. 2005):

$$\mu=(\ln_{Nt}-\ln_{N0})/\Delta t\mu=(\ln_{Nt}-\ln_{N0})/\Delta t \quad (1)$$

where μ (day^{-1}) is the specific growth rate in log phase, N_0 is the cell density at the beginning of log phase and N_t is the cell density at late log phase.

Spirulina platensis cell concentration was recorded daily by optical density measurement at 680nm (Costa et al. 2003) by a UV-visible spectrophotometer (Optima SP-3000nano).

Biomass was determined according to the method developed by Boussiba et al. (1992) with 10 mL of microalgae culture through glass fiber filter (Whatman GF/C, 1.2 μm, UK). Algal biomass on the filter was dried at 105 °C for two hours and weighed (Boussiba et al., 1992). The biomass productivity was calculated according to eq. (2) (Song et al. 2013).

$$\text{Biomass productivity } mgL^{-1}day^{-1}= \mu X\text{biomass} \quad (2)$$

For pigment analyses, 10 mL samples were centrifuged at 3500 rpm for 10 min, and the pellet extracted with 5 mL acetone (Parsons and Strickland, 1963). The extracts were centrifuged again and chlorophyll a and total carotene were measured spectrophotometrically, recording the absorption at 665, 645, 630 and 480 nm and using the equations of Parsons and Strickland (1963). All measurements were repeated in five replicates.

For lipid and lipid productivity, fatty acid methyl esters and protein analyses, samples of microalgae were collected at the stationary phase of the growth. Spirulina platensis cells were separated from the medium by centrifugation at 7500 rpm for 10 min, using the centrifuge model of Hereaus Sup-

ragufe 22. However, biomass was dried at 55°C for 2 h, pulverized in a mortar and stored at -20°C for later analysis. Dry extraction procedure according to Zhu et al. (2002) with a modification of the wet extraction method developed by Bligh and Dyer (1959) was used to extract the lipid from microalgae cells. Cells were harvested by centrifugation at 7500 rpm for 10 min. After drying, the samples were pulverized in a mortar and extracted using a mixture of chloroform: methanol (2:1, v/v), overnight. About 120 mL of solvents were used for every gram of dried sample in each extraction step. The solid phase was separated carefully using filter paper (Advantec filter paper, no. 1, Japan) in which two pieces of filter papers were applied twice to provide complete separation. The solvent phase was evaporated in a rotary evaporator by vacuum at 60°C. Total lipids and lipid productivity were calculated according to eqs. (3–4) (Song et al. 2013).

Total lipid content= (Total Lipids/biomass)x100 (3)

Lipid productivity=Lipid contentxBiomass productivity (4)

The amount of total protein (Nx6.25) was determined by Kjeldahl method (AOAC, 1995). FAMEs of algal lipids were prepared following the method of Prevot and Mordret (1976). Briefly, an aliquot of lipid (~9– 12 mg) was added to 2 ml of 0.5 M CH_3ONa and was incubated at 55 °C for 30 min. Then, 2 ml of distilled water and nhexane were added and gently mixed to recover the upper nhexane layer containing FAMEs, which was neutralized by washing with distilled water many times and was finally purified by silica gel column chromatography using a 5% mixture of diethyl ether in hexane. The resulting FAMEs were analysed by GC-FID (7890 A, Agilent Technologies, USA) equipped with a DB-Wax column (127-2012, Agilent Technologies, USA). The oven temperature was set at and held at 170 °C for 2 min, then was raised 5 °C min^{-1} to 240 °C where it was held for 14 min. The injector and detector temperatures were set at 250 °C. FAME components were identified by comparisons with retention times of FAME standards (37 FAME standards C4-C24, Supelco, USA).

The results were expressed as the mean values ± standard deviation. Comparisons of the means were conducted by oneway analysis of variance (ANOVA), followed by a Duncan's multiple range test to determine significance. In all cases, comparisons that showed a p value < 0.05 were considered significant. SPSS statistical package programme was used to compare means (Version 12.0, SPSS, Chicago, IL) (Zar, 1999).

3. RESULTS AND DISCUSSION

In this study, the effects of N deficiencies (50% and 100%) on the specific growth rate, biomass and biomass productivity, cell density, chlorophyll a, total carotenoid, protein, lipid and lipid productivity, fatty acid methyl esters (FAMEs) contents were determined and showed significant differences ($p < 0.05$) between the Spirulina platensis.

Nitrogen (N) limiting conditions were in fact reported to significantly increase the lipid fraction of many microalgae (Illman et al. 2000). The stress caused by nitrogen deficiency slows the cell division and growth in the cultures. The effects of N deficiencies (50% and 100%) growth is summarized in Table 1.

Table 1. Main parameters of growth rate, cell density, biomass and biomass productivity, chlorophyll *a* and total carotene contents of *Spirulina platensis* for control group and N deficiencies (50% and 100%) deficiency

Parameters	Control	50% N(-)	100% N(-)
OD $_{680nm}$	1.181±0.01^{a}	1.024±0.01^{b}	0.990±0.01^{c}
Biomass (gL^{-1})	1.250±0.01^{a}	1.150±0.09^{b}	1.050±0.02^{c}
Growth rate (day^{-1})	0.981±0.06^{a}	0.951±0.05^{b}	0.935±0.03^{c}
Biomass productivity (gL^{-1} day^{-1})	1.226±0.05^{a}	1.093±0006^{b}	0.981±0.08^{c}
Chlorophyll *a* (μgL^{-1})	455±0.05^{a}	235±0.05^{b}	195±0.05^{c}
Total carotene (μgL^{-1})	0.780±0.04^{a}	0.455±0.03^{b}	0.235±0.01^{c}

Means values, n=5; *Different letters between the columns indicate significant differences ($p<0.05$).

Table 2. Main parameters of lipid and lipid productivity and protein content of *Spirulina platensis* for control group and N deficiencies

Parameters	Control	50% N(-)	100% N(-)
Protein	69.21±0.07^{a}	52.75±0.04^{b}	34.56±0.06^{c}
Lipid (%)	5.43±0.06^{c}	13.14±0.02^{b}	16.85±0.01^{a}
Lipid productivity (gL^{-1} day^{-1})	6.66±0.01^{c}	14.36±0.7^{b}	16.53±0.9^{a}

Means values, n=5; *Different letters between the columns indicate significant differences ($p<0.05$).

Spirulina platensis is one of the most encouraging microalgae, relative to other sources especially rich of protein, polyunsaturated fatty acid (PUFA), GLA and the pigments such as phycocyanin and carotenoids (Narayan et al., 2005; Choopani et al., 2017). It is important to know the fatty acid profile *Spirulina* preparations, the results reported that the fatty acid profile of the *Spirulina* palmitic acid is the most abundant followed by gamma –linolenic, linolenic and linoleic acid. Algal fatty acid composition is affected by growth conditions such as temperature, nutrient availability and nitrogen deficiencies (Stansell et al., 2011; Tedesco and Duerr, 1989; Colla et al., 2007). The effects of N deficiencies (50% and 100%) fatty acids are summarized in Table 3.

Table 3. Fatty acid composition of *Spirulina platensis* for control group and N deficiencies

Fatty acids	Control	50% N (-)	100% N (-)
C14:0	0.9±0.1	2.4±0.3	2.6±0.2
C14:1	1.5±0.5	5.3±0.6	5.1±0.3
C16:0	53.9±0.4	30.9±0.2	29.8±0.3
C16:1	3.9±0.7	5.9±0.3	6.1±0.4
C18:0	6.55±0.1	3.5±0.2	3.1±0.3
C18:1	6.5±0.9	2.1±0.2	2.3±0.3
C18:2	25.01±1.6	42.8±0.9	48.56±0.7
C18:3	2.6±1.3	1.6±0.1	1.2±0.1
Total saturated (%)	61,35	36.8	35.5
Total monounsaturated (%)	11.9	13.3	13.5
Total polysaturated(%)	27.61	44.4	49.76

Biomass of Spirulina platensis were harvested at the stationary phase and 5.43%, 13.14%, 16.85% lipids were recorded for the groups of control, 50% N(-) and 100% N(-), respectively. The highest lipid content and biomass (1.05 g l^{-1}) were recorded from the culture treated with 100% N(-).

The percentage ratio of gamma-linolenic acid (GLA) to total fatty acids (TFA), unsaturated fatty acids, oleic and linoleic acid in the ratios determined is shown in Table 3. Spirulina platensis contains high levels of gamma-linolenic acid, an essential polyunsaturated fatty acid (Choopani et al., 2017). The fatty acid composition of the Spirulina platensis cultured show that (in order of abundance) palmitic, linolenic and linoleic acids were most prevalent. Nitrogen deficiencies increased total lipid content whereas decreased fatty acid content as a percentage of biomass. On the other hand, composition of the fatty acids was unaffected, but Spirulina platensis showed an increase in C14:1 and C18:2 under nitrogen deficit conditions. According to the research, under nitrogen deficiencies, many algal species were determined to accumulate lipids (Shifrin and Chisholm 1981), which especially contain saturated and monounsaturated fatty acids (FA) (Piorreck et al. 1984; Cohen 1986).

The biochemical composition of biomass depends on growth conditions such as nutrient medium, temperature, salinity, pH, and light (Sukenik, 1991; Cohen et al., 1987; Brown et al., 1989; Roessler, 1990, Lourenço et al., 1998; Rafiqul et al., 2003; Hu, 2004; Hifney et al., 2013).

Algae cultures require the nutrients, mainly nitrogen, phosphorus and potassium for growth (Slade and Bauen, 2013). The stress caused by nitrogen deficiency slows the cell division and growth in the cultures. Nitrogen limiting conditions were in fact reported to significantly increase the lipid content of many microalgae (Illman et al., 2000). It is known that different N sources and concentrations can affect the growth and biochemical composition of microalgae (Fidalgo et al., 1995; Colla et al., 2007). When the N deficiencies was applied to the culture, the microalgae biomass decreased and lipid content increased (Xin et al., 2010). A decrease in the concentration of N in the medium resulted in a significant change in cell composition, supporting the ac-

cumulation of lipid components and decrease protein content in S. platensis during the batch growth. While lipid content increased in the cell, the protein content decreased with lack of N (Table 2). In similar studies, it was reported that the N deficiency decreased optical density, biomass, growth rate, biomass productivity, chlorophyll a and total carotene (Tedesco and Duerr, 1989; Costa et al., 2003; Uslu et al., 2011; Kilham et al., 1997; Pruvost et al., 2009). In this study, N concentration was reduced to fifty and hundred percent rate in Spirulina media described in method. In this study, N deficiency caused the diminution of optical density, biomass, growth rate, biomass productivity, chlorophyll a and total carotene while the lipid content increased (Table 1 and 2). Nitrogen limitation caused the increasing of lipid and lipid productivity in Spirulina platensis cells (Table 2).

The reduction of the concentration of nitrate in the growth medium increased the lipid fraction in S. platensis, the deficiency of $NaNO_3$ limited the protein biosynthesis (Guillard, 1973). In this study, N deficiency (50% N (-) and 100% N (-)) in Spirulina culture medium increased lipid amount 13.14% and 16.85% and caused a reduction protein 52.75% and 34.56%. The highest lipid content and biomass (1.05 gl^{-1}) were recorded from the culture treated with 100% N(-).

Tedesco and Duerr (1989) indicated that, deficiency of N in S. platensis culture medium increased total lipid ratio and decreased fatty acid content as a percentage of biomass. In this study; nitrogen deficiencies increased total lipid content whereas decreased fatty acid content as a percentage of biomass. According to the results, composition of the fatty acids was unaffected, but S. platensis showed an increase in C14:1 and C18:2 under nitrogen deficit conditions. In another study; similar results have been found by Colla et al. (2004). Olguin et al. (2001) cultured S. platensis to determine the lipid amount in two different culture mediums (Zarrouk and complex mediums) and different light intensities (66 and 144 µmol photon m^{-2} s^{-1}). They found that, 28.6% lipid ratio in complex medium which contained 10 times less of N and at the low light intensity. They have determined an increase in the concentration of linoleic acid in Spirulina growing in N deficiency medium compared to Spirulina growing in Zarrouk's medium. Piorreck et al. (1984) investigated that two green algae (Chlorella vulgaris and Scenedesmus obliquus) and four blue green algae (Anacystis nidulans, Microcystis aeruginosa, Oscillatoria rubescens and Spirulina platensis) were grown in 81 batch cultures at different N ratios. In all the algae increasing N ratios caused to an increase in the biomass (from 8 to 450 mgL^{-1}), in protein content (from 8 to 54%) and in chlorophyll. At low N levels, the green algae contained a high percentage of total lipids (45% of the biomass). They have observed such reserve compound accumulation occurs mainly in gren algae metabolism, while in the Spirulina the fatty acids of the lipid polar fraction remain constant for potassium nitrate concentrations. Brahmdutt et al. (2014), investigated three Spirulina strains and obtained that nitrogen limitation was more effective in increasing total lipid content, but phosphorus limitation had more effect on the fatty acid profile. The fatty acid content and nitrogen source were investigated in the Spirulina culture

medium by Rijn and Shilo (1986). They reported that reserve compounds were accumulated during nitrogen depletion.

Nitrogen deficiency increased the amount of lipid, in different microalgae species such as Isochrysis affinis galbana, Nannochloropsis sp., Phaeodactylum tricornutum, Neochloris oleoabundas, Chlorella vulgaris, Spirulina platensis (Sukenik and Wahnon, 1991; Reitan et al., 1994; Fidalgo et al., 1995; Colla et al., 2003; Pruvost et al., 2009; Bulut Mutlu et al., 2011; Madkour et al. 2012; Ajayan et al. 2012; Uslu et al., 2011; Ak et al., 2015; Deschoenmaeker et al. 2017). Similarly, Griffiths and Harrison (2009) reported that when N deficiency was applied to the culture at laboratory conditions, lipid content might be increased. Similar studies indicated that while N is deficient, protein decreases in general (Shifrin and Chisholm, 1981). Uslu et al. (2011) investigated the effect of N deficiencies (50 and 100%) on the lipid, protein and biomass of Spirulina platensis in at laboratory conditions. They reported that, 67.4%, 53.5%, 5.6% protein and 5.78%, 13.66%, 17.05% lipid were found for the control group, 50% N(-) and 100% N(-), respectively. The highest lipid, 17.05% and 1.00 gL^{-1} biomass were recorded from the culture with 100% N deficiency.

Spirulina platensis can be cultured throughout the year. Spirulina large-scale culture and harvesting are easy. The species is resistant to contamination, although, the lipid content is low, biomass is very well productive. However, the amount of lipid can be increased with stress factor. Nutrient studies have focused on the effects of nitrogen concentration and deficiency on lipid content. Several researchers obtain a lipid content of 5–19% of dry weight in S. platensis by different extraction systems (Ramadan et al., 2008; Afify et al., 2010; Shalaby et al., 2010; Verma et al.,2010; Uslu et al., 2011; Mostafa et al., 2012; Mostafa and Gendy, 2017). In this study carried out, it was determined that the stress of N deficiency increased the lipid content 5.43%, 13.14%, 16.85% lipids were recorded for the groups of control, 50% N(-) and 100% N(-), respectively.

An important characteristic for any biodiesel feedstock is the suitability of the fatty acid profile for biodiesel production. Few studies have investigated the quality of microalgal biodiesel. Algal fatty acid composotion is influenced by growth conditions such as temperature, nutrient availability and deficiency. One of the main targets in microalgae culture is to obtain high cell densities, rapid growth rates and high lipid content and biomass productivity. The studies about lipid production from microalgae are mostly conducted in the controlled conditions in the laboratory environment whereas, the success is able to transfer of the results to the practice. However, it is important that to achieve the mass production of microalgae for industrial production. And also it is important that decreasing of the cost of culture to produce lipid. In conclusion, microalgae biomass can be source of biodiesel as a renewable energy. To determine the microalgae species contained high lipid and to obtained high biomass are studied in many countries. Our country has planty of sunlight and subtropic climate, and the photosynthetic microalgae biomass

can produce easily.

Finally, the results obtained from this study showed that lipid and fatty acids content of microalgae can be considered as a contribution to biodiesel industry and the supply facilities. It means the achievement is the high production volume economically. There are some microalgae species having more lipid but their low biomass productivity will restrict large-scale culture for biodiesel.

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CHAPTER 12

THE IMPORTANCE OF BIOMASS ENERGY AND ENVIRONMENT

Gül Ebru ORHUN[1]

INTRODUCTION

Scientists have been warning the world for many years about that the fossil fuels all people depend on so heavily for energy are a finite resource. So we have to find the other energy resources as alternative. Energy from biomass is defined as a good renewable energy that is promising options for obtaining biomass energyplants. Bio-energy is manufactured from biomass. It is easy and efficient. Biomass energy plants such as maize are important renewable energy for ethanol production in the world due to its plentifulness and easiness of its conversion to ethyl alcohol (ethanol). Converting maize and other high-starch grains (wheat and all cereals) into ethanol has a long tradition. Conversion involves the processes of grinding, cooking with enzymes, fermentation with yeast, and final distillation to detach the water. The production and consumption of increasingly large amounts of energy are required to keep the todays' standard of across the globe. Bio-energy is a broad classification of energy production methods which employ the physical and chemical attributes of biomass renewable plant-originated organic matter. As maize cobs are used on a small scale as a fuel for direct ignition to cook and warm up, their use as feedstock for broad energy obtainment is a recent development.

Energy prices have always affected the agricultural prices. Increasing energy prices and devel-oped bio-energy conversion technologies are also pushing the agricultural output prices up. Where the demand from the energy sector is large, a floor price effect for agricultural products realizes. The output price effect pushes people to produce more and more (Schmidhuber, 2006)

The use of biomass energy can lead to higher economic growth across the world. Biomass energy is promising for sustainable energy. Because biomass is one of the important sources of energy that is estimated to contribute between 10% and 14% of the world's energy supply (Liu et. al., 2014). Therefore, this paper is drawing attention to importance of biomass energy for the future of the world.

BIOMASS ENERGY AND PLANTS

Biomass energy from plants are a popular feedstock for ethanol production in the world due to its abundance and relative ease of conversion to ethyl alcohol (ethanol) such as maize.Crops grown for energy could be producedin everywhere. While maize is currently the mostwidely used energy

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cereals, oil seeds andgrasses are likely to become the most popularin the near future.These plants require less maintenance and fewer inputsthan the others so they arecheaper and more sustainable to produce. Maize and other high- starch grains have been converted into ethanol for thousands of years. Conversion includes grinding, cooking with enzymes, fermentation with yeast, and distillation to remove water. Biomass from plants are important for energy. Energy is a broad classification of energy production methods which utilize the physical and chemical properties of biomass-renewable plant-derived organic matter. For example, while maize cobs have been used on a small scale as a fuel for direct combustion in cooking and heating, their use as feedstock for large-scale energy production is a more modern concept. At the same time this industry is important for economic growth.The production biomass energy involves a range of technologies that include solid combustion, gasification, and fermentation.These technologies produce liquid and gas fuels from traditional crops (sugarcane, maize,oilseeds), crop residues and waste (maize stover, wheat straw, ricehulls, cotton waste), energy-dedicated crops (grasses and trees).

Brazil produce bio-ethanol by using sugarcane fermentation techniques since the 1980s.

Wealthier countries such as Sweden, Austria and Finland, aware of the benefits of biomass and are already using it widely to displace fossil fuels.As it is seen Table 1. Finland, Denmark, Sweden and Austria have the highest rate. In 2014, Table: 1. shows that the importance ofbiomass use differs considerably across countries . Energy from biomass is a moreimportant contributor to energy supplies in developing countries where it accountedfor nearly 30 % (Table :1.).

According to IEA (2016) report, EU countries between 1998 and 2002 around 100 projects were supported under Framework ProgramFP5 with a total budget of EUR 140 million.Thefollowing Framework Program FP6, running from 2002 to 2006 funded 40 projects with a total amount of around EUR 150 million.In this respect, biofuels seven projects with a clear focus on 2nd generation biofuel technologies were supported (IEA, 2016).

Amount (%)	Country
25-30	Finland
20	Denmark and Sweden
15-20	Austria
10-15	South Africa
5-10	France, Germany,Italy, New Zeland, Switzerland
5	Canada and Belgium
1-5	Australia, Netherland, USA, UK, Norvay Ireland, Japan, Korea

Source: World Energy Balances, OECD/IEA 2015

Why is Biomass Energy?

Biomass is a particularly attractive alternative for a many reasons:

- 1- Biomass is renewable and sustainable.
- 2- Thanks to biomass, electricity can be produce as a low carbon source .
- 3- It is widespread, diverse and contributing both to the security of energy supply and to the diversification of energy sources.
- 4- Biomass can produce a low-carbon source of electricity. 5- Modern biomass conversion technologies can reducegreen gas emissions.
- 6- Biomass production can provide an alternative market for agricultural production, contributing to agricultural diversification and rural development.
- 7- Biomass energy is beneficial for environment (Feehan and Petersen, 2004)

Use of Biomass Energy

Biomass energyproducts provide multiple energy services: cooking fuels, heat,electricity, and transportation fuels. The conversion of bioenergy plants to ethanol takes place by the process of fermentation (Hazell and Pachauri, 2006).

Biomass can also be converted into liquidsor gases to produce electricity or transportationfuels.Most electric generators and businesses burn biomass by itself or with other fuels in conventional oil plants.

Biomass can be converted into a gas byheating it under pressure and withoutoxygen. This biogas canthen be burned to produce heat,steamorelectricity.

Ethanol is typically producedthrough fermentation and distillation. Plant (maize, soybean, palm, canola etc.) oils can be chemicallyconverted into a liquid fuel.These biofuels can be used in machines or in power plants.

For example, the yield of ethanol from a large production plant can range from 1 L to 2.69 kg. Due to high production costs of maize to be used as a feedstock, the best option is maize stover. It refers to the remaining parts on the surface of soil after harvesting the maize grains. The con-stituents of stover are cob, husks, leaves and stalk fractions. Stover makes up the co-product of the high-value maize grain fraction, which is the reason of its plentifulness. This widespread physical availability could eventually turn corn stover into a widely available bioenergy item (Zych, 2008; Klingenfeld, 2008).

Maize stover potential applications differ from an input in biochemical or thermochemical conversion processes for the production of liquid fuels to a direct energy source in biomass co-firing applications. As a cellulosic or

second-generation feedstock, maize stover can be used in bioenergy applications without directly affecting feed production (Zych, 2008). Thanks to the presence of all these qualifications and availability of resources, maize can be considered as the best crop for biomass quality in the field of research (Weng at.al. 2008). Many agricultural residues and manure are available at large quantities in the world. In particular, perennial crops take an important role as part of an integrated system that enhances soil and water quality and decreases the use of chemicals. UCS has an idea for the future of agriculture that plans to have a better balance among healthy food crops, fewer and less-concentrated livestock, soil-improving cover crops and low-impact perennial crops to produce energy (UCS 2013).

Maize use for biogas production should provide high dry matter yield and high methane output per area unit. Maize is well liked for energy production as it is one of the C4 type plants that has less need for plant nutrients (nitrogen, phosphorus, potassium) uptake per unit of dry matter produced compared to C3 type plants (Joci and Sari, 1983). The advantage of maize plant is its less water need (El- Sharkawy, 2009). Maize is used to produce heat and power energy. The periods of fresh raw material supply to biogas plants can be extended by introduction of early ripe and late ripe kinds in the crop rotations, and by harvesting at different times. The purpose of the investigation is to obtain biogas yield by employing anaerobic digestion process from fresh maize biomass harvested in different plant vegetation periods.

An innovative experiment is conducted in Missouri - USA. Maize isused to obtain ethanoland the wastefrom the process is used to fed the cows for dairy production. Cow manure fertilizes the maize and is also run through a digester toproduce biogas.A fuel cell successfully converts the biogas into electricity to run theoperation.The end products are ethanol,electricity,and milk.All the waste productsare used within the project to lower costs (Anonymous, 2003).

You can see the data about popular bioenergy plants in Table 2. As you can see, high- starch plants is important for ethanol production.

Plant	Plant Yield (Ton/ha)	Ethanol Yield (L/ Ton)	Ethanol Production (L/ha)
Sugar Cane	**50-100**	**60-80**	**3500-7000**
Sugar Beat	**40-50**	**90-100**	**3800-4800**
Maize	**4-8**	**360-400**	**1500-3000**
Sorghum	**4-15**	**330-370**	**1480-6300**
Wheat	**2-9**	**370-420**	**740-3800**

Table:2. Some Biomass Plants and Production Resource: World Energy Council, Survey of Energy Resources, 2007.

Biomass Energy and Environment

As it is known ,climate change is an important issue to scientists around the world .The effort toreduce net emissions of greenhouse gas emissionsacross the world could have majorimplications for agriculture. Renewable energy production especially biomass energy has the potential to contribute to greenhouse gas emissionreductions by displacing greenhouse gas emissions intensive sources of biomass. According to results previous studies,the largest potential for agriculture to contribute to reduced greenhouse gas emissionsare to provideenergy feedstocks that would substitute for fossil fuels. However, the use of biomass forrenewable energy can have unintended consequences, such as land use change, which couldincrease greenhouse gas emissions from agriculture. Furthermore, the use of biomass for renewal energy hasimplications for food availability (Liu et.al., 2011) The use of biomass energy has become an important subject in the world of clean energy generation. Biomass products (waste products from the agriculture and forestry industries) can be uses as solid, liquid, or gas fuels. Biomass energy takes care of environmental and ecological issues. Biomass and biogas technologies don't pollute to nature. This technology removes waste material that would be a potential source of pollution and converts it into usable energy. This system can be utilize on farms, it also takes them off the primary energy grid or places them in a position of supplying power to the local electric utility. For example, according to (Liu et.al 2014) study results: GHG emissions reductions associated with the production anduse of biomass-based ethanol appear to be lower than the emissions reductions from substituting coal by biomass for electricitygeneration. Overall, the use of biomass for electricity generationhad far greater greenhouse emissions offset potential than the production of biomass for vehicle fuel (Liu et.al.2014).

Biomass energy provides a source of renewable energy associated with low carbon dioxide emission levels compared to the use of fossil fuels. In addition, biomass technology help to improve the quality of our ecosystem by eliminating agricultural wastes. Because these wastes accumulate and lead toenvironmental pollution.

Clean, renewable energy biomass for transportation and electricity are an importantpart of the solution to the climate, economic, environmental, and securitychallenges posed by our fossil fuel use.

However, there is an negative view that biofuelscannot provide a solution to our energy needs. According to this view, as land resources for arablesubstitution of transport fuels on the scale required are not available without furtherextensive deforestation, which would cause massive carbon dioxide emissions anddemand for forest land to provide biomass for burning or gasification would need to beon a similarly large scale to meet emissions reductions targets, it is becomingincreasingly clear that the risks associated with these land-use changes may out-weighanybenefits (Righelato and Spracklen, 2007).

CONCLUSION

Energy from biomass is considered to be an alternative potential solution to mitigate fossil fuel use and to reduce greenhouse gas emissions. Biomass energy allows many benefits to both people and nature. Production of biofuels from biomass provides a new product market for farmers and can increase farming revenues substantially. Bioenergy from biomass is very economic.The major environmental benefit from using biomass energy to displace fossil fuels is the reduction of greenhouse gas emissions . Furthermore, it improves biodiversityand protects the natural habitat (including indigenous forests) and landscape.

Biomass isone of several elements of a comprehensive climate strategy that can clean the world and help protect the habitat by providing renewable source of hydrogen. New crops may be grown specifically forbiofuel and ethanol productionas well as new high-yielding varietiesof oil-seed crops. In time, these new energy cropsmay be planted in a lot of places surpassing even maize and wheat stover as an energy resource.

Biomass from plants can be considered sustainable because it is efficient and profitable as economic. It can conserve environmental performance and improve rural development. At the same time biofuels contribute to greenhouse gas emissions mitigation strategies in the transport sector. Biomass is an important source of energy today and will have greater importance in the future.

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CHAPTER 13

LAND SURFACE TEMPERATURE RETRIEVAL FROM LANDSAT 8 IMAGERY: A CASE STUDY OF ISTANBUL – TURKEY

Hakan OGUZ[1]

1. INTRODUCTION

Land Surface Temperature (LST) is described as the temperature of the earth's surface. LST is one of the important parameters in climate change, evapotranspiration, urban climate, vegetation monitoring and environmental studies from local to global scales. It is now possible to retrieve land surface temperature especially for large areas at sufficient temporal and spatial resolution rather than point data with the help of remote sensing technology [1]. Up to now, several methods have been developed to calculate LST from satellite imageries but single-channel (SC), split-window (SW) and radiative transfer equation (RTE) are the most popular ones among them. In the last couple of decades, many studies have been carried out on thermal analysis using MODIS, ASTER, Landsat TM, Landsat ETM, and Landsat 8 data [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13].

In this study, LST Calculator tool developed by Oguz (2016a) was used to retrieve land surface temperature using Landsat 8 satellite imagery of Istanbul. This tool requires band4, band5, and band10 of Landsat 8 imagery to retrieve the LST.

2. MATERIALS AND METHODS

2.1. Input Data

In this study, Landsat 8 satellite imagery acquired on April 23rd 2018 (with path/row: 180/31) was used as input data. Landsat 8 captures images of the earth every 16 day and can be downloaded free of change from USGS webpage [14]. Landsat 8 has two sensors on board: the operational land imager sensor (OLI) and thermal infrared sensor (TIRS). OLI has 9 bands with 30m spatial resolution (except for panchromatic band) while the TIRS has two thermal bands with 100m spatial resolution as illustrated in Table 1 below [9]. Having two thermal bands in Landsat 8 is the main improvement compare to previous versions of Landsat.

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Table 1 Landsat 8 OLI and TIRS bands

Band Number	Band Width	Description	Resolution (m)
Band 1	0.435 - 0.451	Coastal/Aerosol	30
Band 2	0.452 - 0.512	Blue	30
Band 3	0.533 - 0.590	Green	30
Band 4	0.636 - 0.673	Red	30
Band 5	0.851 - 0.879	NIR	30
Band 6	1.566 - 1.651	SWIR-1	30
Band 7	2.107 - 2.294	SWIR-2	30
Band 8	0.503 - 0.676	Pan	15
Band 9	1.363 - 1.384	Cirrus	30
Band 10	10.60 - 11.19	TIR-1	100
Band 11	11.50 - 12.51	TIR-2	100

2.2. Study Area

The study area, Istanbul, historically known as Constantinople, is the most populous city in Turkey and the country's economic, cultural, and historic center. Istanbul is a transcontinental city in Eurasia, straddling the Bosporus strait (which separates Europe and Asia) between the Sea of Marmara and the Black Sea (See Figure 1). Istanbul is one of the world's most populous cities and ranks as the world's fourth-largest city and the largest European city with the population of 15 million. Istanbul is viewed as a bridge between the East and West. Istanbul was named a European Capital of Culture in 2010 and is also the world's fifth most popular tourist destination. The city's biggest attraction is its historic center, partially listed as a UNESCO World Heritage Site, and its cultural and entertainment hub can be found across the city's natural harbor, the Golden Horn, in the Beyoğlu district [15].

In the Köppen–Geiger classification system, Istanbul has a borderline Mediterranean climate (Csa), humid subtropical climate (Cfa) and oceanic climate (Cfb), due to its location in a transitional climatic zone. Since precipitation in summer months ranges from 20 to 65 mm, depending on location, the city cannot be classified as solely Mediterranean or humid subtropical. Due to its size, diverse topography, maritime location and most importantly having a coastline to two different bodies of water to the north and south, Istanbul exhibits microclimates. The northern half of the city, as well as the Bosporus coastline, express characteristics of oceanic and humid subtropical climates, because of humidity from the Black Sea and the relatively high concentration of vegetation. The climate in the populated areas of the city to the south, located on the Sea of Marmara, is warmer, drier and less affected by humidity. The

annual precipitation in the northern half can be twice as much (Bahçeköy, 1166.6 mm), than it is in the southern, Marmara coast (Florya 635.0 mm). There is a significant difference between annual mean temperatures on the north and south coasts as well, Bahçeköy 12.8 °C, Kartal 15.03 °C [15].

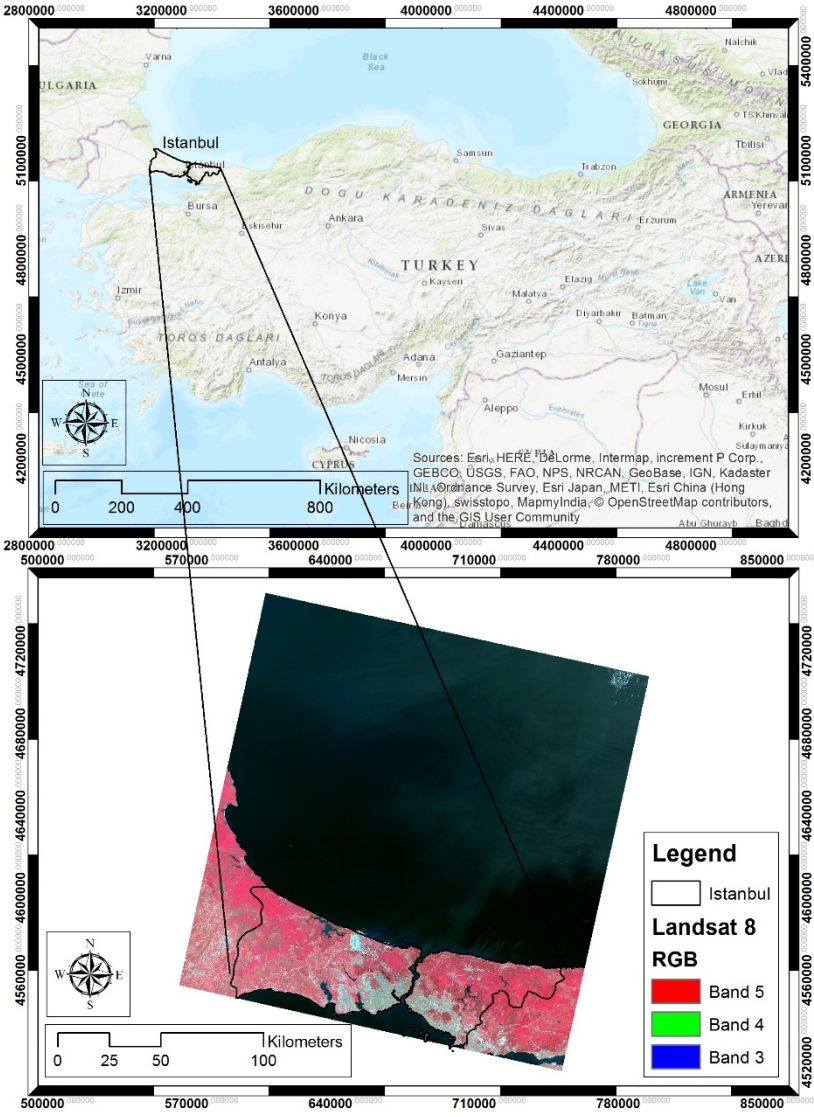

Figure 1: Location map of the study area

The flow diagram of this study is illustrated in Figure 2 below.

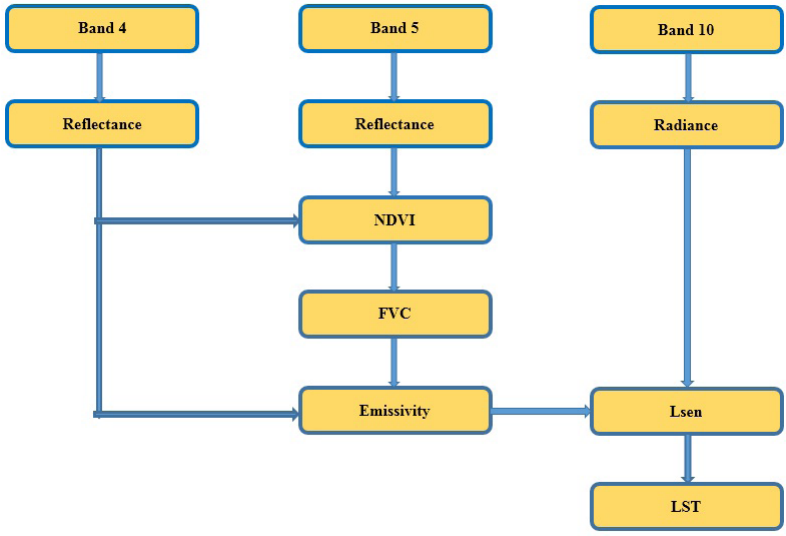

Figure 2: Flow diagram of the study

Detailed information on the methodology that this paper followed can be found in the article published by Oguz [8]. In this study, LST Calculator tool developed using Model Builder in ArcGIS to calculate land surface temperature from Landsat 8 imagery was used as shown in Figure 3 below.

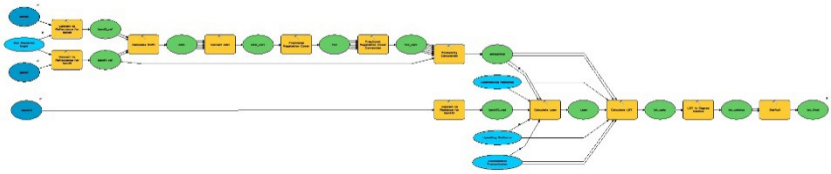

Figure 3: The model layout designed in Model Builder

3. RESULTS

After inputting required bands into the LST Calculator tool, the final LST map for the whole scene is calculated automatically as seen in Figure 4 below.

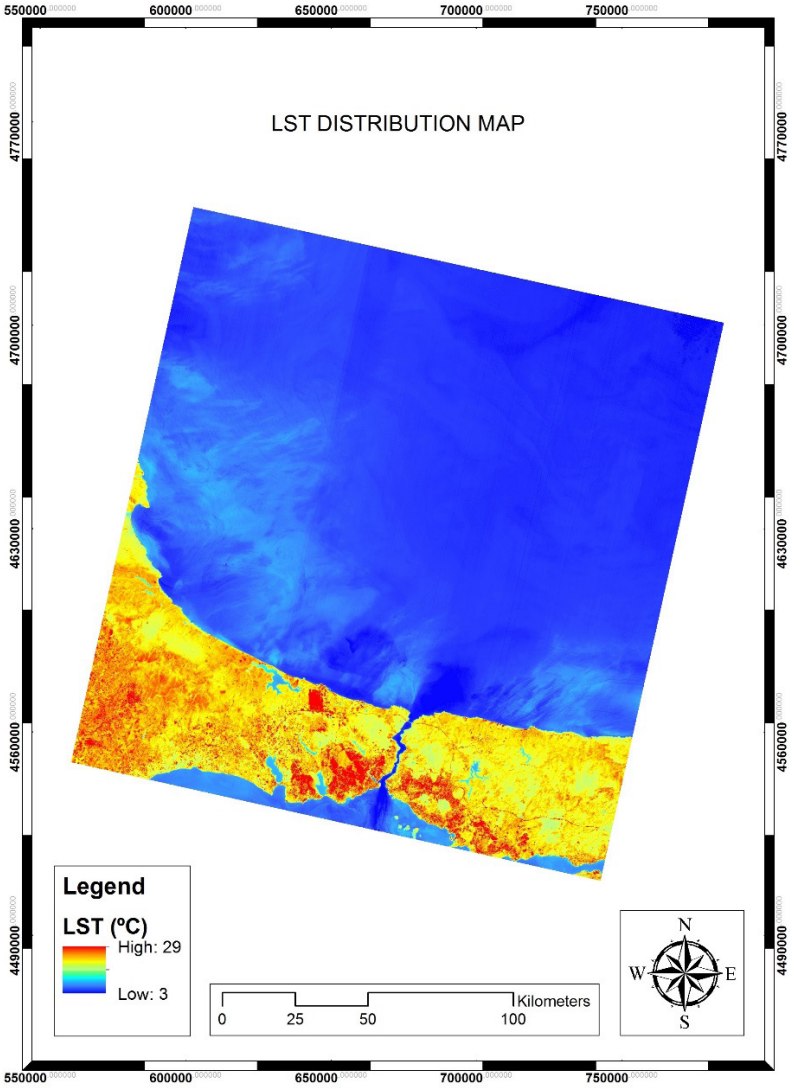

Figure 4: LST distribution map for the whole scene

The highest LST values was found in the urbanized areas ranging from 22 to 29 ºC. Black Sea, Marmara Sea and Bosporus Strait was found to be the coolest area with between 3 and 10 ºC. Forested areas in the study area has temperature range of 11 – 17 ºC.

In order to see the temperature variations in Istanbul, the city was extracted from the whole scene as illustrated in Figure 5 below.

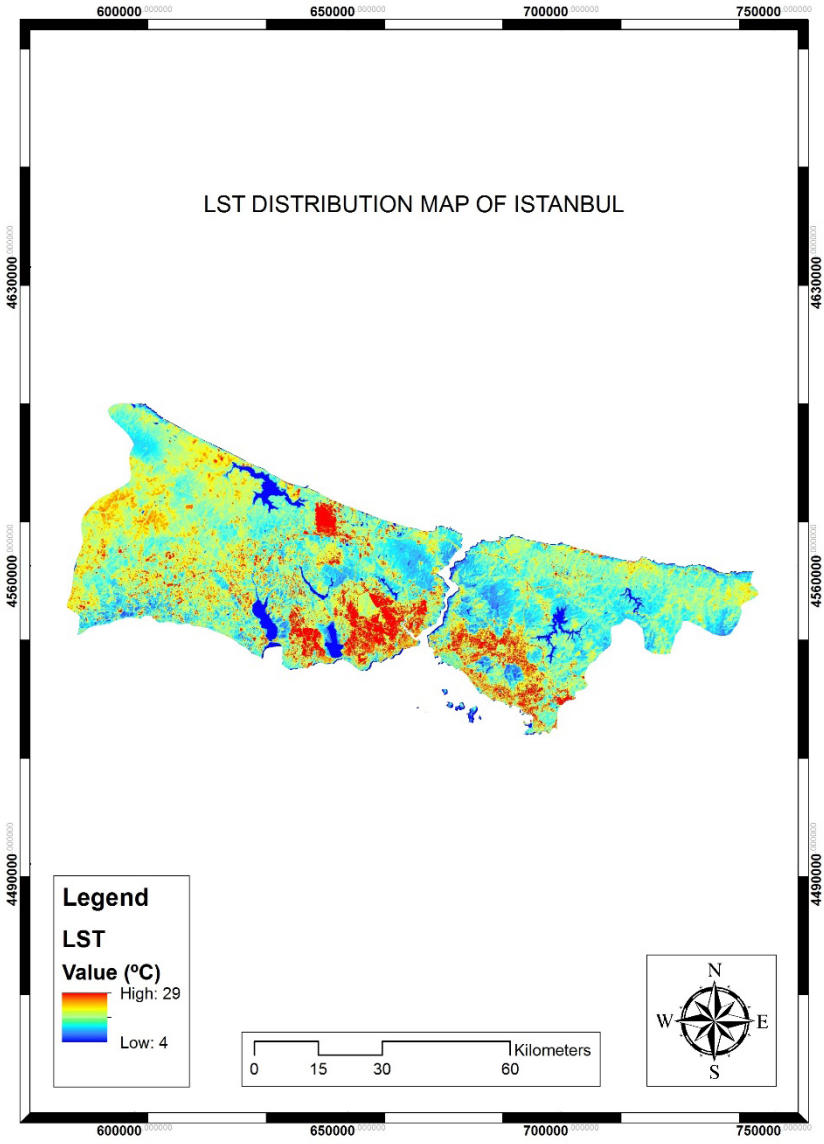

Figure 5: LST distribution map of Istanbul

Istanbul Airport and urbanized areas were found to be hottest regions, while lakes and reservoirs were found to be the coolest areas in the province as expected.

4. CONCLUSION

Land surface temperature is one of the key parameters in thermal analysis studies. The popularity of LST is being increasing for thermal analysis. Accurate calculations of this parameter is an essential and challenging topic for

the global change research. Therefore, the RTE method has been used in this study because of the accuracy of the model compare to single channel and split window algorithms.

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CHAPTER 14

STABILIZATION AND PLANTATION OF SAND DUNES

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Natural resources of the world have been under threat for years. Therefore, ecosystems facing the danger of destruction need to be protected. One of these ecosystems to be protected is sand dunes. The sand dunes are defined in many ways by many authors. For example, Acatay (1959) has defined sand dunes as very fine-grained sands with a little amount of bonding material as hummus and clay. According to the author, if sand dunes are dry and do not have any protective ground cover on the surface, they move from one place to another by means of the wind (Uslu, 1985). Another author, Tavşanoğlu (1954) defined sand dunes as sand masses thrown into the shores by waves from the seas and carried into the land by the dominant winds. Sand dunes are moving or stable sand hills of various sizes and heights, which are collected in an obstacle by dragging the sand particles with the winds. As can be seen in these definitions, the sand dunes, whose main elements are sand, are sand masses which are suitable to be transported by wind thanks to the fine-grained structure. Sand dunes, which are devoid of bonding agents such as clay, are loose, and they can move in the direction of the wind and form hills. Sand dunes have high wind erodobility, high water infiltration, low moisture capacity and very low hydraulic conductivity (Tsoar, 1997).

Formation of sand dunes:

The main sources that feed the coastal sands are sea currents, calcareous organic matter crumbs, and streams (Ertek, 2011). Coast winds and waves take the sand from the rivers and accumulate them to coastal beaches and coves. After a while, they dry out as a result of the evaporation caused by the strong wind and sands are carried to the inland with winds. Thus, the sand dunes are formed. Sand dune widths expand with wind effect, and this expansion causes various significant losses in the direction of the wind. Sand dunes without vegetation can be moved by the effect of winds. These sand movements are often dangerous to the surrounding cultural areas, agricultural lands, forests, residential areas, and roads. These sands completely turn everything into a sand desert (Daşdemir and Sayın, 2017).

Classification of dunes:

Sand dunes do not only exist in deserts. In addition to inland sand dunes

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seen in arid and semi-arid regions, coastal dunes are found in coastal areas. Therefore, the primary transporter factor is wind, according to the source of the sand forming the sand dunes can be divided into two categories. If the source of the dune is the sea, it is called coastal sand dune. If the source of the dune is the rocks that are decomposed inland, it is called the inland sand dune (Atmaca and Yılmaz, 2006). Coastal sand dunes are devoid of humus and clay content, but salty and strongly permeable. Inland sand dunes have high clay and dust content, and they are salt-free and less permeable.

Sand dune ecosystems:

Coastal sand dunes are complex and characterized by close interaction between biotic and abiotic components (Fenu et al., 2012). Since coastal sand dunes show variable characteristics as they move from coast to inland, different types of vegetation are developed structurally (Carranza et al., 2008). Since there are almost no clay and silt in the coastal sand dunes, the permeability of the dunes is high and their water-holding capacity is low (Uslu, 1977). Sand has low wilting point and low capillarity, and drains easily. As a result of surface evaporation, the top layers of sand dunes are usually dry, depending upon local climatic conditions.

The coastal areas, which are determined to cover only 4% of the earth serve to about 1/3 of the world's population. Although the importance of coastal ecosystems in terms of human activities is known, various human impacts such as agricultural activities, urbanization, and tourism change these areas greatly (Avcı, 2017). Sand dunes are considered as important ecosystems that with their special flora. Degradation of sand dunes causes damage to populations of rare sand dune plants which have limited distribution areas. Therefore, protection of the sand dunes is important for the natural ecosystem. Sand dunes are extremely valuable habitats and have a unique vegetation. Most of these plants cannot survive other than the coasts and sand dunes anywhere (Byfield and Özhatay, 1996). Plants grown in coastal sand dunes are few in number. However, these plants are morphologically and physiologically specialized plants with edaphic factors as salt, drought, pH, the amount of organic matter, mineral substances and electrical conductivity and unstable substrate (Acosta et al., 2009). The other most important factor affecting biodiversity in sand dunes is the degree of salinity. Because of the frequent floods occurring in coastal dunes, the salinity level of these areas is very high especially in the coastal area (Kunza and Pennings, 2008).

Factors such as the low amount of plant nutrients and organic matter, high permeability rate, direct sunlight exposure, high temperatures, highly effective wind, the mobility of the surface, exposure to salt are limiting the development of vegetation in sand dunes. The closest areas to the sea are places where there is high stress for plants. The wind bursting in the sand during strong storms makes the life of plants more difficult (Haslett, 2009; Davidson-Arnott, 2010).

Most of the sand dune plants are short in height. However, it has very long

roots to reach the water. Some of them are woody, and their leaves are smaller and thicker, and their stomata are in deep. The development of vegetation on sand dunes is caused by rhizomes in the sand, vegetative reproduction of plants or the emergence of a new plant from the seed. Plants that are most open to the sea effect in coastal areas are ephemeral (short-lived) plants (Archibold, 1995; Davidson-Arnott, 2010). Most of the plants grown in coastal dunes are xerophytes. They have long roots, thick leaves and rhizomes to survive with as little water as possible. These common features enable them to maintain the existing water while at the same time allowing them to access the least available water. These characteristics disappear from the coast towards the inland (Haslett, 2009).

The importance of sand dunes:

Sand dunes are as valuable and unique as the other ecosystems in sustaining natural balance. They are quite variable and mobile structures. Coastal sand dunes, one of the most dynamic structures in nature, are very sensitive and the transition regions between land and water ecosystems (Acosta et al., 2005; Carboni et al., 2009). Sand dunes have a very inefficient habitat and due to their extraordinary characteristics, such as dry sand in the summertime, special flora has developed on the beaches. Most of the plant species grown in beaches cannot grow in other places due to their ecological requirements (Byfield and Özhatay, 1996). Because plants develop adaptation strategies according to metabolic reactions and the environment and water (Kearney and Shantz, 1912).

Sand dunes are necessary for the existence of stream deltas, lagoons, and estuaries. They play a vital role for rare and endangered species of animals, such as sea turtles, seals, and many other species of birds (Ongan, 1997). Besides this, millions of people live in coastal areas. For this reason, coastal areas are very important in terms of ecological, economic and nature protection. Due to the different habitat characteristics they have, sand dunes are important areas that must be protected due to their biological richness and living species. Not only in terms of biodiversity, but also in terms of geographical locations and characteristics, they are very valuable and important areas. The sand dunes are also extremely valuable for nature conservation because they have little on earth. But the coastal ecosystems, including habitats and many plant and animal species, are now faced with many threatening factors. Some of these threatening factors are tourism, construction, and erosion (Özhatay ve Byfield, 1996). Damages in sand dune areas cause damage to people living on the coast, especially in agricultural activities in coastal areas. As a result; coastal dune ecosystems are degraded, irreversible, or even completely destroyed (Martinez et al., 2004; Monserrat et al., 2012).

Coastal sand dunes also protect the inland areas as a natural barrier against the spread of salt water and wind erosion. The plantation of sand dunes plays an important role in dune stabilization. Therefore, the loss of plant species in sand dune flora makes the sand dunes permeable to wind and wave erosion (De Lillis et al., 2004).

The opportunities offered by the coasts cause rapid population growth and environmental problems. The progress of coastal dunes is slowing down, with many anthropogenic effects such as global climate change and the construction of coastal areas. Human destructions either slow the natural cover of coastal ecosystems or completely destroy them (Stancheva et al., 2011).

The disadvantages of sand dunes:

Sand dunes have been seen on earth as an important problem for people for centuries. The fine sand, the main substance of coastal sand dunes, is carried by wind and grows over time, and it causes the formation of sand hills that cannot be compensated. Sand dunes can invade agricultural lands, forests, railroads, highways, residential areas, lakes, harbors, riverbeds, and wells. Because of these damages, the sand dunes need to be reclaimed, stopped and passivated. If the progression of sand dunes is not stopped, they expand more and more every day and cause serious dangers. Since the sand layer constituting the ground of sand dunes is constantly in motion, it is very difficult to prevent the movement of the dune before the moving ground is stabilized.

Combating with sand dunes:

The increasing population has forced people to prevent damages of the dunes and utilize these areas and thus protect these areas. For this purpose, it is necessary to stop and slow sand movements with mechanical approaches and to cover these areas with vegetation. The common practice of stabilizing sand dunes consists of two steps;

a- Temporary stabilization: The first stage of temporary stabilization is to form the front dune to control the source of the sand. The front sand dunes are stacks of sand that form perpendicular to the direction of the dominant wind from the sea along the coast. It usually consists of one or two rows behind the shore. Bushes, wood or stakes are used in the formation of the front dune. If these are single-row, the sand is deposited behind and in front of the fence, if two-rows, the sand is deposited between the two fences. Some grassland plants are planted in order to stabilize the front sand. The second stage of temporary stabilization is to stop sand movements. For this purpose, living (plantation, vegetation) or non-living (branch, clay or gravel, etc.) materials are used. As non-living material, the sand dune surface should be covered with branches, or the area should be divided into small squares. The most commonly used plant to disable sand dune movements is *Ammophila areneria* (L) Lin.. Beach wheat (*Triticum junceun* Pal.), beach oat (*Calamogrostis arenarium* Roth.) and beach rye (*Hordeum arenarium* A.) can also be planted. Plants should be produced vegetatively. The purpose of forming the front sand dune is to form a sand hill to prevent the sands from moving into inland areas, thus cutting the connection between the dune and the source.

b- Permanent stabilization: This is the stage of afforestation. The most effective and permanent approach of sand dune stabilization is the afforesta-

tion. Success in these areas can be achieved by using the right planting technique and selecting suitable species. Usually, the use of coniferous species is essential. Deep planting method is used. Deep planting encourages root development. Live hedges are preferred because it protects against wind action.

Reforestation of sand dunes:

Sand dunes are one of the most degraded lands where vegetation is typically absent, ecologically unstable and create various environmental problems and need immediate afforestation. Herbaceous plants which are successful in the first stages of the plantation, lose their activities in the following years and then die. Herbaceous plants are important in the movement of the sand dunes. The second stage after planting herbaceous plants is planting bushes. *Vitex sp., Myrtus sp., Tamarix sp.* etc. are suitable bushes for this purpose (Anonymous, 2013). The planting stage of the bushes follows the planting of trees. First studies are carried out for preparing the environment for permanent stabilization. If the field is covered with vegetation and the continuity cannot be achieved, the created barriers cannot perform over time and dune movements start again. Wind and salt resistant plants should be planted in areas which are close to the sea. The seedlings to be used in the sand dune plantation should be potted. The soil in the pot should be rich in terms of humus and organic matter and have high water-holding capacity. *Pinus pinaster, Pinus nigra, Pinus pinea, Pinus brutia, Pinus halepensis, Cupressus sempervirens* L.*, Eucalyptus camaldulensis, Elaeagnus angustifolia, Ulmus glabra, Platanus orientalis, Fraxinus americana, Robinia pseudoacacia* L., *Parkinsonia spp., Ailanthus excelsa., Tamarix sp., Spartium junceum* L. and *Acacia cyanophylla* are among the most used species in sand dunes.

Human activities in the coastal sand dunes are characterized by activities such as tourism, settlement, agriculture, and grazing and continue with coastal sand dune plantations. Afforestation studies in coastal sand dunes are another human impact used to stop the sand dune movements in coastal areas as a result of degenerating these areas with human impact. The natural sand dunes are formed by afforestation. In this way, the original sand dune relief is disrupted. During the planting phase of the saplings, the people and the work machines working in the field cause the dune to be pressed. This causes the deformation of sand dune vegetation. As a result of the wrong species selection, the afforestation area is occupied by invader species (Anonymous, 2013). With these species growing over time and forming the top structures, the plants of the dune vegetation are faced with an extreme shadowing which they are not accustomed to (Yılmaz, 2006). The progress of the sand dune can be stopped with the plants planted on the dunes. However, although the trees were planted close to each other and formed a barrier against the progress of the dune; the life of all the dune plants under these trees may end. In addition, the dune ecosystem is affected negatively by the afforestation works. The most important reason for this negative effect is the use of exotic species instead of sand dune-specific plant species. These species change the soil characteristics, geomorphological and hydrological structure of the sand dune ecosystems. As a result, the sand dune vegetation disappears (Ehrenfel, 2003).

Planting technique:

The purpose of afforestation in arid and semi-arid regions is the improvement of soil. Since soil moisture increases with the depth it is, important that planting should be done as deep as possible depending of course upon the tolerance of the species to be planted. In order to ensure a higher survival rate, the planting of seedlings in summer rainfall regions should be done after the onset of the rainy season, when the sand is wet. In regions receiving winter rainfall, it is advisable to plant late in the winter after the severe wind storms (FAO, 1985).

Selection of suitable species:

The purpose of afforestation in arid and semi-arid areas should be clearly defined. The purpose determines the choice of species. First of all, plant species should be drought and salt resistant. Plants should have a deep root system, thick, small and narrow leaves. Species should have low-maintenance requirements, and they should have the ability to reproduce vegetatively. It is especially important to use healthy, well-rooted seedlings in coastal sand dunes. Seedlings should planted in places that do not be exposed to wind. The soil of the nursery should not be very fertile, it should be light and it should give abundant rooting to the saplings.

Suggestions

It is very important to protect the sand dunes and transfer them to future generations, in order to prevent the extinction of endemic and rare plant species on sand dunes. The increase in human population as a result of new facilities established on the coastal areas has a negative effect on natural resources. As a result of this pressure, natural vegetation is destroyed. Various reasons such as the construction of various superstructure elements such as port and shelter, sand extraction from beaches, industrial facilities and mining activities lead to the change of these areas. One of the most important problems leading to the change of the flora of the sand dunes is invasive species (Avcı et al., 2015).

The extension of afforestation to even larger areas will do much to confirm the predicted ecological and economic benefits, and help to increase our capacity to successfully re-establish tree cover in such inhospitable environments. Considering the floristic characteristics of the vegetation on the coastal sand dunes, it is clear that these sand dunes have a large number of endemic and rare plants. Sand dunes where a large number of endemic and rare plants grow are part of the floristic diversity and their protection is important. It is necessary to raise the awareness of the local governments, tourism sector, local people and visitors in order to eliminate the problems. Sand dunes should be protected in order to prevent problems. Sand dunes which are sensitive, are very important areas for nature conservation. Over the last 20-30 years, increasing attention has been paid to sand dune afforestation. This has resulted in the development of techniques, whose use can give a greater probability of success in the future program.

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