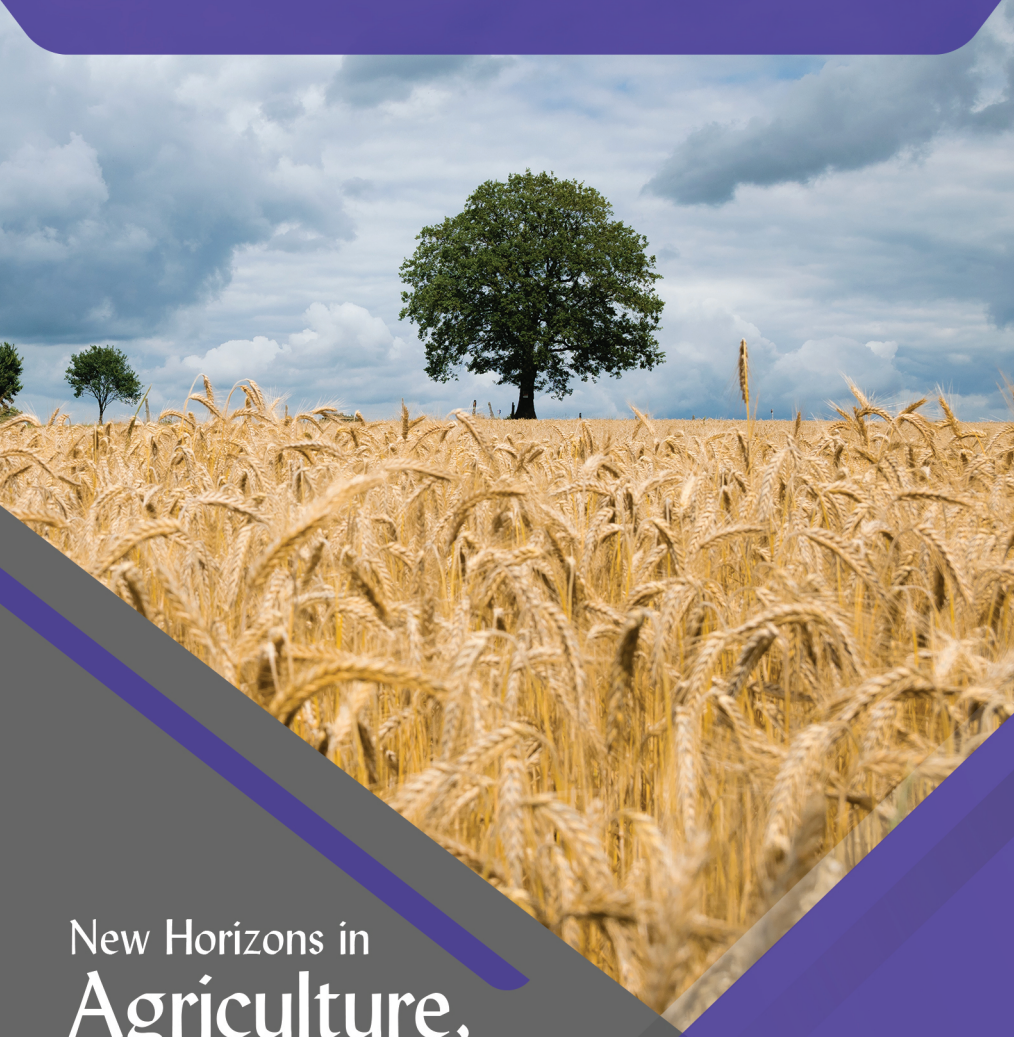


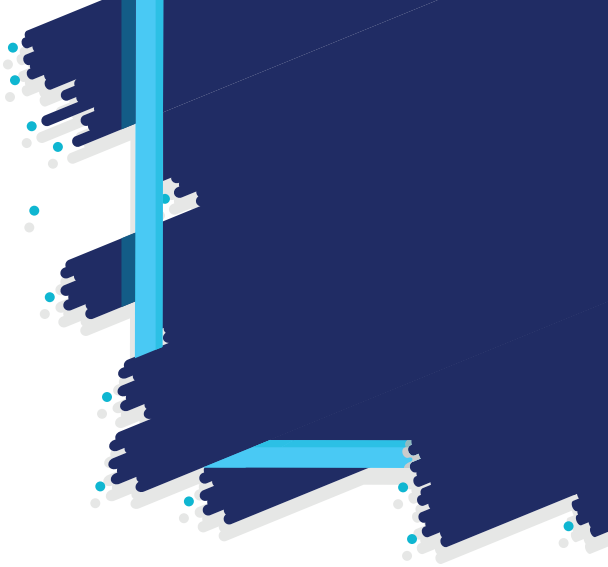
New Horizons in Agriculture, Forestry and Aquaculture Sciences

2019

Editors

Prof. Dr. Ali Musa BOZDOĞAN
Prof. Dr. Nigar YARPUZ-BOZDOĞAN

Gece Akademi



New Horizons in Agriculture, Forestry and Aquaculture Sciences

GECE AKADEMİ

İmtiyaz Sahibi / Publisher • Gece Kitaplığı
Genel Yayın Yönetmeni / Editor in Chief • Doç. Dr. Atilla ATİK
Editörler / Editors •
Prof. Dr. Ali Musa BOZDOĞAN
Prof. Dr. Nigar YARPUZ-BOZDOĞAN
Kapak & İç Tasarım / Cover & Interior Design • Didem S. KORKUT
Sosyal Medya / Social Media • Arzu Betül ÇUHACIOĞLU

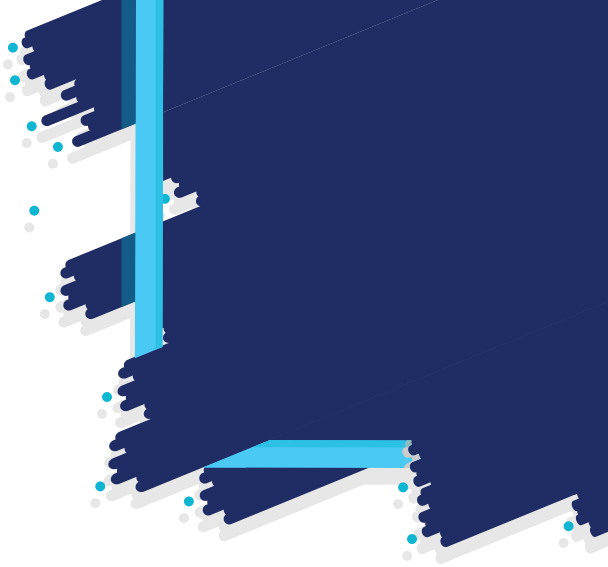
Birinci Basım / First Edition • ©EKİM 2019

ISBN • 978-605-80229-7-3

Gece Kitaplığı / Gece Publishing
ABD Adres/ USA Address: 387 Park Avenue South, 5th Floor,
New York, 10016, USA
Telefon / Phone: +1 347 355 10 70
Türkiye Adres / Turkey Address: Kızılay Mah. Fevzi Çakmak 1. Sokak
Ümit Apt. No: 22/A Çankaya / Ankara / TR
Telefon / Phone: +90 312 384 80 40
+90 555 888 24 26
web: www.gecekitapligi.com
e-mail: geceakademi@gmail.com

GECE AKADEMİ

Baskı & Cilt / Printing & Volume
Sertifika / Certificate No:29377



New Horizons in Agriculture, Forestry and Aquaculture Sciences

GECE AKADEMİ

CONTENTS

A RESEARCH CONDUCTED ON YIELD AND YIELD CHARACTERISTICS OF CHICKPEA GENOTYPES (*Cicer Arietinum* L.) UNDER BAYBURT CONDITIONS

Ümit GİRGEL[1], Alihan ÇOKKIZGIN[2]

1 Bayburt University, Aydintepe Vocational School, Bayburt, Turkey, umitgirgel@bayburt.edu.tr

2 Gaziantep University, Nurdagi Vocational School, Gaziantep, Turkey, acokkizgin@gantep.edu.tr

A RESEARCH CONDUCTED ON YIELD AND YIELD CHARACTERISTICS OF CHICKPEA GENOTYPES (*Cicer Arietinum* L.) UNDER BAYBURT CONDITIONS

Ümit GİRGEL[1], Alihan ÇOKKIZGIN[2]

INTRODUCTION

There are 9 annual and 34 perennial wild species belonging to the genus *Cicer* (Singh *et al.*, 2008). All the species are diploid (2n=16), and are self-pollinated (Singh and Ocampo 1993:199, Singh and Ocampo 1997, Hancock, 2004).

Chickpea (*Cicer arietinum* L.), an annual plant of the family Leguminosae, its origin that the center of the south-eastern Anatolia (Auckland and Maesen, 1980) and it is located in central and western Asia (Maesen, 1987). Also Ladizinsky, (1975) reported that *Cicer arietinum* L. is an annual species that originated in south eastern Turkey.

The cultivated chickpea is in a group with *Cicer reticulatum* Davis and *Cicer echinospermum* Ladiz. These two diploid species closely resemble the cultivated chickpea, as they are annual and morphologically very similar and share many molecular markers and biochemical (Tayyar & Waines, 1996, Iruela *et al.*, 2002).

Legumes are good sources of plant based proteins (Lopez-Amoro's *et al.*, 2006). The chickpea, which is a edible legume plant, contains protein varying in the rate of 16.4

1 Bayburt University, Aydintepe Vocational School, Bayburt, Turkey, umitgirgel@bayburt.edu.tr

2 Gaziantep University, Nurdagi Vocational School, Gaziantep, Turkey, acokkizgin@gantep.edu.tr

to 31.2% according to the type and the conditions in which it is grown (Sehirali 1988).

Chickpea (*Cicer arietinum* L.) is the 3th most important legume crop after bean, and pea. In the world, chickpea cultivation was carried out in 14.6 million hectares of land and it had 14.7 million tons of production and 1014.6 kg/ha yield. The chickpea cultivation areas in Turkey, 392.6 thousand hectares and chickpea had a production value of 470 thousand tons and yield 1196.9 kg/ha in Turkey (FAO, 2017).

Chickpea production in Turkey is among the most cultivated legumes. As for the reason; chickpea plants can adapt to bad environmental conditions (Sahin & Gecit, 2006).

The aim of this study is to determine the convenient chickpea varieties and local genotypes. Another aim is to provide a gene source for future breeding studies.

Materials and Methods

This research; in order to determine the yield and yield characteristics of local chickpea genotypes and registered chickpea varieties were conducted in the province of Bayburt during the 2017-2018 growing season. The research area was the experimental area of Aydintepe Vocational School (40°24'05.7"N 40°08'31.3"E) and it was carried out with three replications according to the randomized complete block design.

In the study, 8 registered chickpea cultivars (Cakir, Aydin-98, Yasa-05, Isik-05, Menemen-92, Hisar, Azkan, Sari 98) and 3 local genotypes of Bayburt province were used.

According to soil analysis, cattle manure were given as per decare 2 ton in sowing time.

The study was conducted in rain dependent conditions without irrigation and chickpea harvesting was done in the June 2018.

There is a transition climate between the Eastern Black Sea climate and the Eastern Anatolian climate in the Bayburt province, Aydintepe district (40°24'05.7"N 40°08'31.3"E).

According to the average of many years (1960-2017) in the province of Bayburt; The average annual rainfall is 440.6 mm, the average annual temperature is 7.1 °C (Anonymous 2018).

The data obtained from study were analyzed according to one factor randomized complete block design (RCBD) using the SAS (Statistical Analysis System software v.9) package program (SAS, 2004). Duncan's multiple range test (DMRT) was used to compare the means (Duncan, 1955:1-42).

Results and Discussion

According to the obtained results, the differences between genotypes were found to be statistically significant for all parameters except the number of branches per plant and the seed number per pod (Table 1).

Table 1. *Summary of Variance Analysis*

Source	DF	Mean Square						
		Plant height	First pod height	Branch number per plant	Pod number per plant	Seed number per pod	Thousand seed weight	Seed yield
Replication	2	115.242**	17.911	2.125*	1.629	0.0385	752.818	52.364
Genotype	10	47.996*	28.314**	0.590	20.251*	0.0254	5852.455**	1278.491**
Error	20	18.305	7.358	0.396	9.065	0.0225	160.018	64.914
CV(%)		9.467	11.004	15.891	26.970	13.939	2.961	9.071

**p<0.01 and *p<0.05

Plant height (cm)

The highest value in terms of plant height was obtained from Aydin-98 cultivar (51.80 cm) while the lowest value was obtained from Bayburt local genotype-1 (38.33 cm) (Table 2).

Depending on plant genetics plant height values are different according to the cultivar or line. These results are in line with the findings of Toker & Canci, (2003), Mart & Anlarsal, (2007), Ashraf *et al.*, (2011), Ceyhan *et al.* (2013).

First pod height (cm)

In terms of the values of the first pod height, Azkan, Menemen-92 and Sari 98 standard varieties were taken in the same statistical group and the highest values (28.07, 27.87 and 27.47 cm respectively), while the lowest value was found in Bayburt Local Genotype-3 (19.20 cm) (Table 2).

The first pod height values have emerged as a result of the interaction between the genetic structure and the environmental conditions, and similar opinions are suggested by some researchers (Bakoglu, 2009, Ceran & Onder, 2016).

Branch number per plant

Although the difference between genotypes was statistically insignificant, the highest number of branches was obtained from Azkan variety (4.67 number/plant) and the lowest value was obtained from Bayburt Local Genotype-1 (3.2 number/plant) (Table 2).

Table 2. *Means of plant height (cm), first pod height (cm), branch number per plant and pod number per plant of chickpea genotypes*

Genotype	Plant height (cm)	First pod height (cm)	Branch number per plant	Pod number per plant
Aydin-98	51.80 A	26.33 AB	4.07	12.80 AB
Azkan	48.47 AB	28.07 A	4.67	11.67 B
Cakir	48.40 AB	24.80 ABC	3.80	10.47 B
Hisar	44.93 ABCD	25.87 AB	4.13	11.07 B
Isik-05	46.00 ABCD	24.60 ABC	4.20	11.40 B
Menemen-92	43.87 ABCD	27.87 A	3.53	8.33 B
Sari 98	47.27 ABC	27.47 A	3.67	9.73 B
Yasa-05	46.47 ABCD	25.27 AB	3.67	9.80 B
Bayburt/Incili Genotype	38.33 D	21.60 BCD	3.20	8.33 B
Bayburt/Yukari Kirzi Genotype	40.00 CD	20.10 CD	4.00	11.40 B
Bayburt/Catiksu Genotype	41.60 BCD	19.20 D	4.60	17.80 A
Mean	45.19	24.65	3.96	11.16

Means followed by the same letter are not statistically significant different

In other studies, it is reported that the differences between the genotypes in terms of the number of branches are statistically insignificant (Babagil, 2010, Mekuanint *et al.* 2018).

Pod number per plant (number/plant)

When the local and standard varieties were evaluated in terms of the number of pods per plant, Bayburt Local Genotype-3 (17.80 pod/plant) had the maximum pod number (Table 2).

When the situation is examined in terms of low value; although there was more than one value in the same statistical group, the Bayburt Local Genotype-1 with the Menemen-92 Cultivar had the lowest value (8.33 pod/plant).

The number of pods per plant is a characteristic that is controlled by genetic factors. Therefore, it can take different values according to the cultivars or lines. Similar ideas reported in literature (Erman *et al.* 1997, Bicer & Anlarsal, 2004, Peksen & Artik, 2004, Solanki, 2008, Ashraf *et al*., 2011, Ceyhan *et al.* 2013).

Seed number per pod (number/pod)

The differences between the values were statistically insignificant but the highest value was 1.2 number/pod and the lowest value was 1.0 number/pod (Table 3). Similar results gained by Togay *et al.* (2005), Ceyhan *et al.* (2013).

Table 3. *Means of seed number per pod, 1000 seed weight (g) and seed yield (kg/da) of chickpea genotypes*

Genotype	Seed number per pod	1000 Seed weight (g)	Seed Yield (kg/da)
Aydin-98	1.00	461.0 B	106.0 A
Azkan	1.00	410.0 E	116.0 A
Cakir	1.13	420.0 DE	110.0 A
Hisar	1.20	427.0 DE	80.0 B
Isik-05	1.00	437.0 CD	77.0 B
Menemen-92	1.20	384.0 F	69.0 BC
Sari 98	1.20	427.0 DE	111.0 A
Yasa-05	1.00	370.0 F	67.0 BC
Bayburt/Incili Genotype	1.00	457.0 BC	60.0 C
Bayburt/Yukari Kirzi Genotype	1.10	526.0 A	104.0 A
Bayburt/Catiksu Genotype	1.00	381.0 F	77.0 B
Mean	1.08	427.3	88.8

Means followed by the same letter are not statistically significant different

1000 Seed weight (g)

The highest value was obtained from Bayburt Local Genotype-2 with 526g, while the lowest values were found in Menemen-92 (384 g) and Bayburt Local Genotype-3 (381 g) genotypes (Table 3).

These results are in line with the findings of Ceyhan *et al.* (2013) Who reported that according to variance analysis for 1000 seed weight found statistically important. Similar results obtained by Babagil, (2010), Ashraf *et al.*, (2011), Ceran & Onder, (2013), Bicer *et al.* (2017), Lakić *et al.*, (2019).

Seed Yield (kg/da)

The highest value for seed yield was taken from Azkan variety (116 kg/da). Aydin-98, Cakir, Sari 98 and Bayburt Local Genotype-2 genotypes were included in the same statistical group (Table 3).

The lowest yield was obtained from Bayburt Local Genotype-1 (60 kg/da). Genetic factors and environmental conditions determine seed yield. Cultivars and lines may have different seed yield values due to their genetic features. It was reported by other researchers that different seed yield values were obtained according to varieties (Singh *et al.* 1984, Karadavut & Ozdemir 2001, Solanki, 2008, Bakoglu, 2009, Ceyhan *et al.* 2013, Yucel, 2013, Ojwang *et al.*, 2016, Bicer *et al.* 2017).

Conclusion

Aydin-98, Azkan, Cakir, Sari 98 cultivars can be recommended for use by local farmers. Also Bayburt Local Genotype-2, which has the statistically same yield level as the standard cultivars, was determined as promising. However, for more reliable results, it is appropriate to repeat this study for 2 more years.

REFERENCES

Anonymous, (2018). Republic Of Turkey Ministry Of Agriculture and Forestry, Meteorological Service. Bayburt Province Statistical Database, www.mgm.gov.tr

Ashraf, M.I., Pervez, M.A.,Amjad, M.,Ahmad, R. & Ayub, M. (2011). Qualitative and Quantitative Response of Pea (*Pisum sativum* L.) Cultivars to Judicious Applications of Irrigation with Phosphorus and Potassium. *Pak. j. life soc. Sci*. 9(2):159-164.

Auckland, L.J.G. & Maesen, V.D. (1980). *Hybridization of Crop Plants. Chickpea*. (Walter R. Fehr and Henry H. Hedley Editors): 249-259.

Babagil, G.E. (2010). A Study on Yield and Yield Characteristics of Some Chickpea (*Cicer arietinum* L.) Varieties in Erzincan Ecological Conditions. *Journal of Adnan Menderes University, Agricultural Faculty,* 7(1):7-10.

Bakoglu, A. (2009). A Study On Yield And Yield Components Of Some Chickpea (*Cicer arietinum* L.) Varieties In Elazig Ecological Conditions. *J.Agric.Fac.HR.U*.,13(1):1-6.

Bicer, B.T. & Anlarsal, A.E. (2004). Determination of Botanical and Agronomical Characteristics of Some Chickpea (*Cicer arietinum* L.) Landraces. *Journal of Agricultural Sciences*, (4):389-396.

Bicer, B.T., Albayrak, O. & Akinci, C. (2017). Effect of Different Sowing Dates on Yield and Yield Characters in Chickpea. *Journal of Adnan Menderes University, Agricultural Faculty*, 14(1):51-57.

Ceran F. & Onder, M. (2016). Determination of some Agricultural Characteristics on Chickpea (*Cicer arietinum* L.) Cultivars That Are Sown at Different Periods. *Selcuk Journal of Agriculture and Food Sciences*, 3(1): 25-29.

Ceyhan, E., Kahraman, A. & Dalgic, H. (2013). Determination of Some Agricultural Characters of Chickpea (*Cicer arietinum* L.) Genotypes. World Academy of Science, Engineering and Technology *International Journal of Agricultural and Biosystems Engineering*, 7(11): 1092-1095.

Duncan, D.B. (1995). Multiple Range and Multiple F Tests. *Biometrics*, 11 (1):1-42.

Erman, M., Ciftci, V. & Gecit, H.H. (1997). A Research on Relations Among the Charecters and Path Coefficient Analysis in Chickpea (*Cicer arietinum* L.). Ankara University, Faculty of Agriculture, *Journal of Agricultural Science*, 3(3):43-46.

FAO, (2017). Food and Agriculture Organization of the United Nations, Statistical Database. www.fao.org

Hancock, J.F. (2004). *Plant Evolution and the Origin of Crop Species*. 2nd ed. CABI Publishing, 313p.

Iruela, M., Rubio, J., Cubero, J.I., Gil, J. & Millán, T. (2002) Phylogenetic analysis in the genus *Cicer* and cultivated chickpea using RAPD and ISSR markers. *Theoretical and Applied Genetics* 104, 643-651.

Karadavut, U. & Ozdemir, S. (2001). Effect Of *Rhizobium* Inoculation And Nitrogen Application On Yield And Yield Characters Of Chickpea. *Anadolu, J. of AARI*, 11(1):14-22.

Ladizinsky, G. (1975). *A new Cicer from Turkey*. Notes Roy. Bot. Gard. Edinb. 34: 201-202.

Lakić, Z., Stanković, S., Pavlović, S., Krnjajić, S. & Popović, V. (2019). Genetic variability in quantitative traits of field pea (*Pisum sativum* L.) genotypes. *Czech Journal of Genetics and Plant Breeding*, 55(1): 1-7.

Lopez-Amoro's , M.L., Hernandez , T. & Estrella, I. (2006) Effect of germination on legume phenolic compounds and their antioxidant activity. *Journal of Food Composition and Analysis*, 19:277-283.

Maesen, L.J.G. van der (1987). Origin, History and Taxonomy Of Chickpea. In: Saxena, M.C. and Singh, K.B. (eds) *The Chickpea*. CAB International, 11-34, Wallingford, UK.

Mart, D. & Anlarsal, A.E. (2007). A Study On To Determining The Genotype X Environment Interactions In Chickpea (*Cicer arietinum L.*) Under Cukurova Conditions. *Jour-*

nal Of Field Crops Central Research Institude, 16(1-2):51-60.

Mekuanint, T., Tsehaye Y. & Egziabher Y.G. (2018). Response of Two Chickpea (*Cicer arietinum* L.) Varieties to Rates of Blended Fertilizer and Row Spacing at Tselemti District, Northern Ethiopia. *Advances in Agriculture*, 1-8.

Ojwang, J.D., Nyankanga R.O., Olanya O.M., Ukuku D.O. & Imungi J. (2016). Yield components of vegetable pigeon pea cultivars. *Subtropical Agriculture and Environments* 67:1-12.

Peksen, E. & Artik, C. (2004). Comparison of Some Cowpea (*Vigna unguiculata* L. Walp) Genotypes from Turkey for Seed Yield and Yield Related Characters. *Journal of Agronomy,* 3(2): 137-140.

SAS (2004). SAS/STAT 9.1. *User's guide: Statistics*. SAS institute Inc., Carry, NC, USA, 5121pp.

Singh K.B. & Ocampo B. (1993). Interspecific Hybridization in Annual *Cicer* Species. *J. Genet. Breed*. 47: 199-204.

Singh K.B. & Ocampo B. (1997). Exploitation of Wild *Cicer* Species for Yield Improvement in Chickpea. *Theor. Appl. Genet*. 95: 418-423.

Singh, A., Ahlawat, I.P.S. & Sharaf, C.S. (1984). Response of Chickpea (*Cicer arietinum* L.) Cultivars to Seeding Rates and Phosphorus Level. *Indian J Agron*. 29 (3): 331-334.

Singh, R., Sharma, P., Varshney, R.K., Sharma, S.K. & Singh, N.K. (2008). Chickpea Improvement: Role of Wild Species and Genetic Markers. *Biotechnology & Genetic Engineering Reviews*, 25(1): 267-314.

Solanki, G.S. (2008). Performance of Chickpea (*Cicer arietinum* L.) Varieties to Varying Seed Rates Under Agro-climatic Conditions of Vindhyan Plateau. Jawaharlal Nehru Agricultural university, Msc Thesis, 64p.

Sahin, N. & Gecit, H.H. (2006). The Effects Of Different Fertilizing Methods On Yield And Yield Components In

Chickpea (*Cicer arietinum* L.). *Journal of Agricultural Sciences*, 12(3): 252-258.

Sehirali, S. (1988). *Legume Crops*, Ankara University Faculty of Agriculture Publications: 1089. Textbook: 314. 357 p., Ankara/Turkey.

Tayyar, R.I. & Waines, J.G. (1996) Genetic Relationships Among Annual Species of *Cicer* (*Fabaceae*) Using Isozyme Variation. *Theoretical and Applied Genetics* 92:245-254.

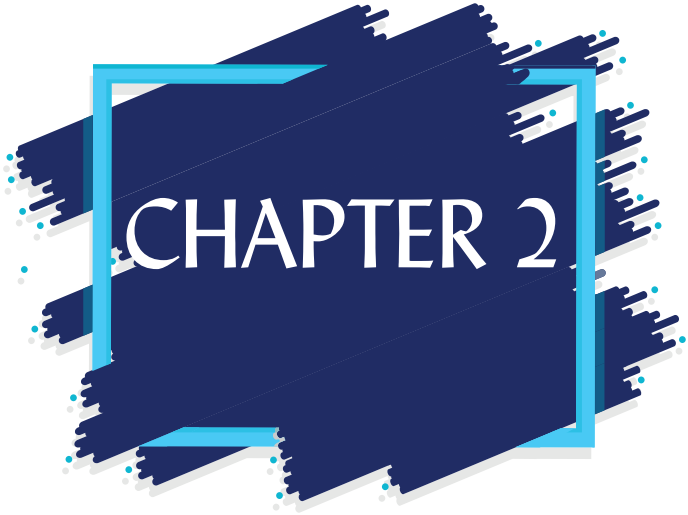
Togay, N., Togay, Y., Erman, M., Dogan, Y. & Cig, F. (2005). The Effects of Different Plant Densities on Yield and Yield Components in Some Chickpea (*Cicer arietinum* L.) Cultivars in Dry and Irrigated Conditions, *Journal of Agricultural Science*, 11(4):417-421.

Toker, C. & Canci, H. (2003). Selection of Chickpea (*Cicer arietinum* L.) Genotypes for Resistance to Ascochyta Blight [*Ascochyta rabiei* (Pass.) Labr.],Yield and Yield Criteria. *Turk J Agric For*, 27:277-283.

Yucel, D.O. (2013). Impact Of Plant Density On Yield And Yield Components Of Pea (*Pisum sativum* ssp. *sativum* L.) Cultivars. *ARPN Journal of Agricultural and Biological Science*, 8(2):169-174.

COMPARISON OF FINANCIAL PERFORMANCE IN DAIRY FARMS SUPPORTED AND NON-SUPPORTED BY IPARD PROGRAM: A CASE STUDY OF KONYA PROVINCE, TURKEY

Aykut ÖRS[1], Cennet OĞUZ[2]



1 Dr., Agriculture and Rural Development Support Institution, Konya, Turkey
2 Prof. Dr., Selcuk University, Faculty of Agriculture, Department of Agricultural Economics, Konya, Turkey

COMPARISON OF FINANCIAL PERFORMANCE IN DAIRY FARMS SUPPORTED AND NON-SUPPORTED BY IPARD PROGRAM: A CASE STUDY OF KONYA PROVINCE, TURKEY

Aykut ÖRS[1], Cennet OĞUZ[2]

INTRODUCTION

The rapid and multifaceted structural changes in the world in the process of transition to globalization and information society have made the concept of "competition" the most important phenomenon observed in the global economy. The concept of "competitiveness", which means that all economic units, starting from company level and at the level of the country and the region, can exist in the market conditions created by the global environment and at least protect their positions, has been accepted as a performance indicator for these units (Kara 2008). Competitiveness, in other words, competitive capacity, is defined by the World Economic Form as the entrepreneurs obtaining superiority over their competitors in designing, producing, pricing products and services (Özdemir 2015). Although competitive capacity is accepted as a national concept, competing institutions in the markets are also enterprises. The fact that businesses are private or public enterprises does not change the situation. Active or passive government policies have, undoubtedly, a major impact on the competitiveness of enterprises. However, investment, price policies and organizational structure are determined by the manager/s of each company. In short, businesses compete in the markets (Luehrman and Kester 1989).

1 Dr., Agriculture and Rural Development Support Institution, Konya, Turkey

2 Prof. Dr., Selcuk University, Faculty of Agriculture, Department of Agricultural Economics, Konya, Turkey

The competitive capacity of a business is the ability of the company to ensure the continuity of being preferred against the alternatives of the goods and services it provides to its customers. Company-level competitive capacity is, on the other hand, being in a superior condition equivalently to or less than any of its competitors in terms of product quality, low cost production (price and cost competitiveness), product quality, service offered and product attractiveness (quality competitive capacity), also the ability to innovate and invent (Baraz and Besler 2010). As in every sector, the competitive capacity is important for cow dairying at local, regional and international level. Especially in our country maintaining its efforts towards EU membership, it is thought that when the membership comes true, expected increases in production and income of producer in terms of agriculture in Turkey, owing to competitiveness and disparities amongst costs, will not be provided, but even decreases may occur. It is also foreseen that Turkey will become dependent on foreign in many agricultural and animal products (Murat 2011).

The growth and survival of dairy enterprises depend on their competitive capacity. A healthy determination of the competitive capacity of the business requires the measurement and analysis of the financial performance of the enterprise in question. In order to make a healthy decision in business, to carry out planning, control, and inspection, management functions effectively, financial analysis is becomes inevitable. Accordingly, one of the most important responsibilities of business managers is the measurement and analysis of financial performance. Capital, consisting of all elements of wealth allocated to production, is a pivotal production factor besides land, labour force and entrepreneur (Oğuz and Yener 2017).

Since agricultural enterprises in Turkey do not generally keep record of their accounting, they are far from

the thoughts of financial performance analysis. However, livestock enterprises are supported by huge financial investments and financial performance of investments in this area should be analysed, and it is useful to determine the competitive capacity of the enterprise in a healthy way. Konya dairy farming is also very significant in this respect, and constitutes Turkey's 24.5% of the total number of animals, 5.48% of milk production (Oğuz and Yener 2017). Financial performance measurement and analysis are important for an agricultural enterprise to review its own situation and compare it with other enterprises as well as demonstrating its competitiveness. The main data required to assess the financial position of an agricultural enterprise can be aggregated as total active capital, total passive capital, equity capital, total income, total expenses and net profit.

MATERIALS AND METHODS

The main material of the study consists of the data obtained from the surveys of dairy cow breeding operations, which benefited or not benefited from IPARD support in Konya province. In addition to these data: publications and web sites of relevant public institutions in the research area and previous research findings and published secondary data were used. In this study, $1 = 3.58 Turkish Liras calculated that was the average exchange rate of the dates of the field study was done.

In the study in which financial performances of supported and non-supported IPARD companies are reviewed, Konya was selected as a research area according to "Purposive Sampling Method" since Konya province produces approximately 6% of Turkey's milk production (TSI 2014), having 5% of cattle population and is one of three most supported area by IPARD. At the period of the sampling, 50 dairy cattle breeding companies, which are

active in Konya province and took IPARD support and the fact that the population is small and it is easy to reach the desired information, the "complete inventory" method was used as the sampling method in the selection of the enterprises. Simple random sampling method was used in the selection of enterprises that did not receive support. The sample volume was determined by the number of cows milked, and the calculations were made at a 95% reliability limit with a 5% margin of error. According to this, the number of enterprises, which have not received IPARD support in the research area, is 100. Total number of enterprises surveyed is 150.

Neyman method was used in stratified sampling methods for the sample volume. The basis of this method is to determine a single sample volume for all of the layers, taking into account the weight of each layer and its variance (Oğuz and Kararkayacı 2017). In agricultural enterprises, if there are significant differences in volume and variation between layers, using the Neyman Method, increase the efficiency of sampling. According to the Neyman method, the equation that determines the sample volume was formulated as follows (Yamane 1967).

$$n = \frac{[\sum(N_h S_h)]^2}{N^2 D^2 + \sum[N_h (S_h)^2]} n = \frac{[\sum(N_h S_h)]^2}{N^2 D^2 + \sum[N_h (S_h)^2]}$$

In formula; n = sample volume, N = total unit number belonging to the sampling frame, D = d / t, d = derivation from the average, t = standard normal distribution value.

The sample volume was determined by using the number of milking cows. The sample size was calculated as 100 for a confidence interval of 95% and an error margin of 5%. As a result, 150 dairy farms were determined as total sample volume. Table 1 shows the total sample size.

Table 1: *Number of dairy cattle breeding enterprise surveys*

Farm Size Group (Head)	Non-supported by IPARD	IPARD supported	Total Sample size (n)
	Number of Surveys	Number of Surveys	Number of Surveys
1-25	63	2	65
26 - 50	20	2	22
51 - +	17	46	63
Total	**100**	**50**	**150**

To evaluate the survey data, data entries were put in survey cast table prepared in Microsoft Excel software. Two separate casting tables were prepared for the companies that are and are not supported by IPARD. In the research area, the capital structures of the enterprises are classified according to their liquidity (Erkuş *et al.* 1995).

RESULTS AND DISCUSSION

Active and Passive Capital Structure of Surveyed Enterprises

The capital in agricultural enterprises directly helps to increase the avail. In Konya province, it is allocated as active and passive capital according to the Capital Liquidity in dairy farms, which are supported and not supported by IPARD. Active capital is divided into three according to the ease of being converted into assets, whether it is revolved within itself (current or short-term assets), medium-term assets and stable (fixed or long-term) assets, while passive capital is divided into two as debts and equity capital. The debts are also classified into three as short-term (current) debts, medium-term debts and long-term debts, taking into account their maturities. For this purpose, passive capital indicating the active values and the resources of the capital that the entrepreneurs invested in their enterprises has been put forward for the purpose of production (Açıl and

Demirci 1984; İnan 1994; Oğuz and Bayramoğlu 2015). The distribution of the capital elements constituting the active capital is important for the effective management of the enterprise. For this reason, it is important to examine the active capital giving the working capital according to its components. In a rationally operating enterprise, the distribution of active capital is expected to be 25% for land capital, 25% for building capital, 25% for animal capital, 10% for instrument machinery capital, 10% for material ammunition capital and 5% for capital (Erkuş *et al.* 1995). However, limited agricultural arable land, spiritual commitment to land, rapid population growth, and increase in non-agricultural land demand all increase land prices. Thus, the share of agricultural land in active capital is high. Similar results have been achieved in previous studies (Bayramoğlu 2003; Altıntaş and Akçay 2007). Another item of capital that is calculated above the expected level in the research area is the instrument-machinery capital. Milk processing unit, cooling tank, feed mixer, tractor and other machine tools used in plant production, have formed this capital group in the enterprises analysed. Table 2 below shows the distribution of active capital in dairy enterprises.

Table 2: *Distribution of Active Capital ($) and Rates (%) in the enterprises*

Capital Groups			Farm Size Group (Head)							
			10-25		26-50		51-+		Business average	
			$	%	$	%	$	%	$	%
Non-supported by IPARD	Stable (Fixed) assets	Land Capital	175,056.31	71.52	337,774.05	76.46	433,866.99	69.06	251,597.67	72.01
		Land Reclamation Capital	12,688.90	5.18	20,120.81	4.55	46,861.65	7.46	19,984.65	5.72
		Building Capital	56,982.25	23.26	83,114.53	18.81	147,551.76	23.49	77,574.02	22.20
		Plant Capital	97.93	0.04	754.19	0.17	-	-	212.54	0.06
		Total	244,775.39	100.00	441,763.58	100.00	628,280.40	100.00	349,368.88	100 58,39
	Medium-term assets	Animal Capital	70,252.55	66.44	139,636.87	66.93	322,568.19	64.52	127,010.47	65.70
		Instrument Machine Capital	35,481.82	33.56	68,993.72	33.07	177,361.98	35.48	66,303.82	34.30
		Total	105,734.37	100.00	208,630.59	100.00	499,930.17	100.00	193,314.30	100 32,31
	Revolving (current) assets	Material and Ammunition Capital	3,835.98	9.95	3,019.90	5.06	10,026.95	8.79	4,725.23	8.49
		Money Capital	6,624.10	17.17	2,290.50	3.84	20,423.92	17.90	8,103.35	14.57
		Growing Plant Capital	28,109.28	72.88	54,341.46	91.10	83,661.58	73.32	42,799.61	76.94
		Total	38,569.37	100.00	59,651.86	100.00	114,112.46	100.00	55,628.19	100 9,30
	Total Active Capital		389,059.13		710,046.02		1,242,323.02		598,311.37	
IPARD supported	Stable (Fixed) assets	Land Capital	274,162.01	57.51	273,184.36	42.25	772,679.48	57.85	732,758.98	57.53
		Land Reclamation Capital	3,491.62	0.73	-	-	38,064.54	2.85	35,159.04	2.76
		Building Capital	199,097.77	41.76	373,384.08	57.75	515,550.62	38.60	497,205.84	39.04
		Plant Capital	-	-	-	-	9,302.06	0.70	8,557.89	0.67
		Total	476,751.40	100.00	646,568.44	100.00	1,335,596.70	100.00	1,273,681.76	100 56,23
	Medium-term assets	Animal Capital	89,944.13	41.64	121,229.05	38.06	428,585.74	61.49	402,745.81	60.78
		Instrument Machine Capital	126,036.17	58.36	197,294.41	61.94	268,460.70	38.51	259,917.07	39.22
		Total	215,980.31	100.00	318,523.46	100.00	697,046.44	100.00	662,662.88	100 29,26
	Revolving (current) assets	Material and Ammunition Capital	49,231.84	29.11	58,624.30	48.94	132,026.05	38.30	125,778.21	38.26
		Money Capital	84,517.04	49.98	2,653.65	2.22	76,337.09	22.14	73,716.95	22.43
		Growing Plant Capital	35,357.54	20.91	58,519.55	48.85	136,386.87	39.56	129,231.01	39.31
		Total	169,106.42	100.00	119,797.49	100.00	344,750.01	100.00	328,726.17	100 14.51
	Total Active Capital		861,838.13		1,084,889.39		2,377,393.16		2,265,070.80	

Considering the active capital distribution rates in enterprises not receiving IPARD support; fixed assets consist of 58,39%, medium-term assets constitute 32,31%, while

revolving (current) assets comprise 9,30%. In enterprises receiving IPARD support, the active capital distribution consists of fixed assets (56.23%), medium term assets 29.26%, and revolving (current) assets constitute 14.51% (Figure 1).

Erkuş (1995) stated that the distribution of active capital in a rationally operating business is expected to be 25% for land capital, 25% for building capital, 25% for animal capital, 10% for instrument machinery capital, 10% for material ammunition capital and 5% for money capital. When we adapt these values to the active capital classification in the study, we expect that fixed assets will be 50%, medium term assets 35% and current assets 15%. The distribution of enterprises with and without IPARD support is close to each other and near to the expected distribution rates.

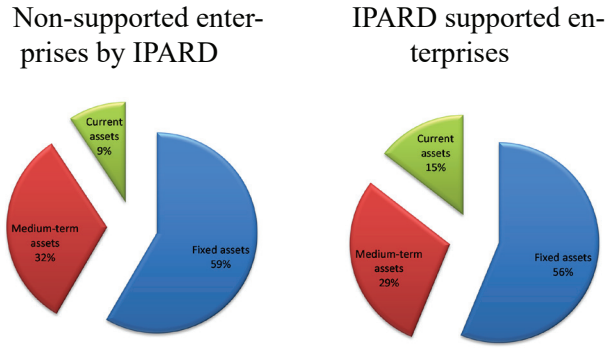


Figure 1: *Active capital distribution in IPARD supported and non-IPARD supported enterprises*

Passive capital consists of total foreign capital and equity capital used in the enterprise. Leased land values included in the active capital are included in the passive capital as inducted Debts. Equity capital is the value of the enterprise owners' personal shares in total assets. The equity capital of the enterprises examined is calculated by subtracting the total foreign resources from the active

capital (Table 3). While the average of equity capital in enterprises not receiving IPARD support is $ 513,094.75, the average equity capital in IPARD supported enterprises is $ 2,093,785.33. The total passive capital of enterprises not supported by IPARD is $ 598,311.37 and the passive capital of IPARD supported enterprises is $ 2,265,070.80.

Table 3: *Distribution of Passive Capital ($) and Rates (%) in the enterprises*

Capital Groups		Farm Size Group (Head)							
		10-25		26-50		51-+		Business average	
		$	%	$	%	$	%	$	%
Non-supported by IPARD	Short Term Debts	9,745.50	2.50	20,244.41	2.85	3,062.77	0.25	10,709.22	1.79
	Medium Term Debts	18,528.86	4.76	11,731.84	1.65	9,464.34	0.76	15,628.49	2.61
	Long Term Debts	3,904.41	1.00	2,402.23	0.34	4,600.72	0.37	3,722.35	0.62
	Total Dated Debts	32,178.77	8.27	34,378.49	4.84	17,127.84	1.38	30,060.06	5.02
	Inducted Debts	62,756.27	16.13	39,273.74	5.53	45,678.61	3.68	55,156.56	9.22
	Total Foreign Capital	94,935.04	24.40	73,652.23	10.37	62,806.44	5.06	85,216.62	14.24
	Equity Capital	294,124.09	75.60	636,393.79	89.63	1,179,516.58	94.94	513,094.75	85.76
	Total Passive Capital	389,059.13	100.00	710,046.02	100.00	1,242,323.02	100.00	598,311.37	100.00
IPARD supported	Short Term Debts	5,307.26	0.62	1,396.65	0.13	7,317.22	0.31	7,000.00	0.31
	Medium Term Debts	-	-	3,491.62	0.32	72,322.08	3.04	66,675.98	2.94
	Long Term Debts	-	-	8,379.89	0.77	23,317.95	0.98	21,787.71	0.96
	Total Dated Debts	5,307.26	0.62	13,268.16	1.22	102,957.25	4.33	95,463.69	4.21
	Inducted Debts	55,865.92	6.48	-	-	79,986.03	3.36	75,821.79	3.35
	Total Foreign Capital	61,173.18	7.10	13,268.16	1.22	182,943.28	7.70	171,285.47	7.56
	Equity Capital	800,664.94	92.90	1,071,621.23	98.78	2,194,449.87	92.30	2,093,785.33	92.44
	Total Passive Capital	861,838.13	100.00	1,084,889.39	100.00	2,377,393.16	100.00	2,265,070.80	100.00

The assets of an enterprise can be financed by two types of resources: foreign resources and equity capital. Foreign resources are short-term, medium and long-term debts that are borrowed from outside persons or entities other than business owners. The equity capital, on the other hand, is the resources that the owners of the business provide by their own means. Hence, equity capital refers to the financial interest of the owners in the enterprise or the size of the risk they have on the enterprise (Acar 2003). The passive capital distribution of enterprises not receiving support from IPARD is 86% equity capital and 14% foreign source while in enterprises receiving IPARD support, the equity capital ratio is 92% and foreign source rate is 8% (Figure 2). This shows that business owners are mainly using their own resources rather than foreign sources as a source of finance.

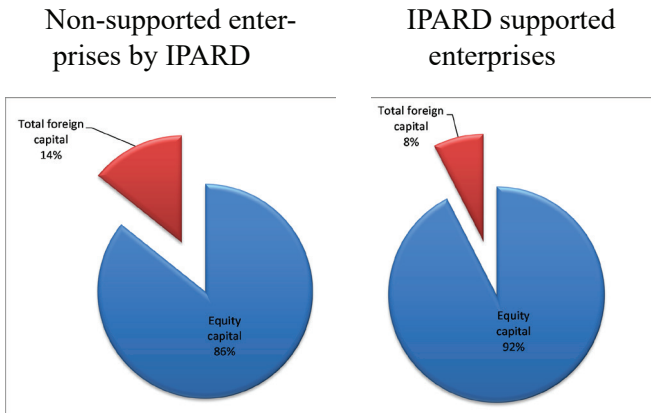


Figure 2: *Passive capital distribution in IPARD supported and non-IPARD supported enterprises*

Net Profit in Enterprises analysed

Net profit is calculated by deducting the production costs from the gross product. This is the main indicator that measures the profitability of business activity. For agricultural family businesses, net profit represents the amount

of resources that the family can use to cover costs such as living expenses, taxes and capital investments (Oğuz and Bayramoğlu 2018). Naturally, to be able to talk about an improvement in the financial situation of the business, the profit must be positive. If the profit is greater than zero, revenue from operating activity can be used for investment and growth. Production costs are estimated first to calculate net profit (Table 4). Production costs are the sum of the total business costs and the interest of the active capital. While the average production cost of enterprises not receiving IPARD support is $ 141,230.94, the value of IPARD supported enterprises is $ 494,888.90.

Table 4: *Production costs by business groups ($, %)*

Costs		Farm Size Group (Head)							
		10-25		26-50		51-+		Business Average	
		$	%	$	%	$	%	$	%
Non-supported by IPARD	Interest Rate of Active Capital	12,519.93	14.88	21,856.80	13.47	36,041.17	10.99	18,385.92	13.02
	Business Costs	71,634.77	85.12	140,415.05	86.53	291,953.58	89.01	122,845.03	86.98
	Production Costs	84,154.70	100.00	162,271.85	100.00	327,994.75	100.00	141,230.94	100.00
Supported by IPARD	Interest Rate of Active Capital	23,424.44	20.97	29,898.07	12.98	65,204.45	12.47	62,120.99	12.55
	Business Costs	88,281.64	79.03	200,443.28	87.02	457,846.64	87.53	432,767.90	87.45
	Production Costs	111,706.09	100.00	230,341.36	100.00	523,051.08	100.00	494,888.90	100.00

The net profit calculation is presented in Table 5. The net profit of enterprises not receiving support from IPARD is $ 30,682.14, while in IPARD supported enterprises it is $ 174,628.92.

Table 5: *Net profit by business groups ($, %)*

		Farm Size Group (Head)			
		10-25	26-50	51-+	Business Average
		$	$	$	$
Non-supported by IPARD	GP	97,109.49	199,972.87	416,114.86	171,913.08
	Production Costs	84,154.70	162,271.85	327,994.75	141,230.94
	Net Profit	12,954.79	37,701.02	88,120.11	30,682.14
Supported by IPARD	GP	129,457.54	273,824.59	710,202.75	669,517.81
	Production Costs	111,706.09	230,341.36	523,051.08	494,888.90
	Net Profit	17,751.46	43,483.24	187,151.66	174,628.92

Net profit per business is calculated by subtracting the production costs from the gross product (GP) value. Net profit per operation was determined to be $ 30,682.14 in enterprises not receiving support from IPARD and $ 174,628.92 in enterprises with support.

Comparison of financial performance analysis of the enterprises

In order to measure the financial performance of a business, it is necessary to find performance data and to calculate reference (standard) values. As reference values, rates (ratios) are often used rather than absolute financial indicators. Ratios are indicators that *estimate* a financial magnitude to another that establishes a relative relationship between two absolute performance indicators. The advantageous aspect of the proportional (relative) values is that the size of the business eliminates the deflecting effect on the indicator. That way, ratios enable a more meaningful and direct comparison between enterprises of different sizes compared to absolute indicators, thus making it possible to compare the financial performances of different enterprises better. The main ratios used in financial performance measurement are examined in four

main categories: liquidity, operation (activity), solvency, (lever), and profitability (Oğuz and Bayramoğlu 2018).

Liquidity Ratios

Liquidity ratios are inherently used to measure the extent to which an enterprise is able to meet its short-term debts and to determine whether the enterprise capital is sufficient or not. These ratios are the current ratio and capital transfer rate. Current ratio indicates the capacity of the enterprise to be able to pay its short-term debts. Generally, when the current rate exceeds one, it indicates that businesses can pay their short-term debts on time. Capital transfer ratio is calculated within the operation (activity) ratios. It is calculated by dividing the gross production value by the total business capital. It shows how effectively the assets of the business can produce the revenue. The higher the rate, the better. In the research area, the capital transfer rate of dairy farms is calculated as 67.89% in enterprises that do not receive support from IPARD and 67.33% in enterprises receiving support.

Table 6: *Current Ratio and Capital Transfer Ratio (%)*

		Farm Size Group (Head)			
		10-25	26-50	51-+	Business Average
		$	$	$	$
Non-supported by IPARD	Short-term debts	28,274.36	31,976.26	12,527.11	26,337.71
	Revolving enterprises capital	38,569.37	59,651.86	114,112.46	55,628.19
	Gross production value	94,266.09	196,963.09	413,095.64	169,006.52
	Total farm capital	144,283.74	268,282.45	614,042.62	248,942.49
	Current rate (%)	1.37	1.86	9.11	2.11
	Capital turnover rate (%)	65.3	73.42	67.27	67.89

Supported by IPARD	Short-term debts	5,307.26	4,888.27	79,639.30	73,675.98
	Revolving enterprises capital	169,106.42	119,797.49	344,750.01	328,726.17
	Gross production value	127,711.73	271,380.46	708,212.53	667,519.21
	Total farm capital	385,086.73	438,320.95	1,738,842.90	991,389.05
	Current rate (%)	31.86	24.51	4.33	4.46
	Capital turnover rate (%)	36.52	33.16	40.73	67.33

The debt solvency ratio is calculated by dividing the total liabilities to active capital. The enterprise's mobility demonstrates how much of the business financial debts can be covered if all of the assets are sold. In other words, this ratio is a rate that indicates how much of the assets of an enterprise owe to the person or institutions that provide him/her the credit. This rate is calculated as 7.56% in the research area.

Financial profitability

Financial profitability is the ratio between the total profit obtained as a result of business activities within a certain period of time and the equity capital determined in the same time part. In the scope of the study, the sum of the net profit and the equity capital rent is calculated by proportioning to the equity capital (Table 7). The financial profitability of the enterprises, which do not receive support from IPARD, is 8,59%, while for the enterprises receiving IPARD support, this value is 10,84%. If the financial profitability ratio is higher than the current interest rate, this means that the business makes profit. In the opposite case, the business equity capital is eroding (Çetin 2013). In the scope of the study, 9.97% (TUIK 2017), the current interest rate of May 2017, was used. According to this rate, IPARD supported enterprises are working in a profitable manner, while enterprises not receiving IPARD support are working a fair amount of below this rate.

Table 7: *Financial profitability by business groups ($, %)*

		Farm Size Group (Head)			
		10-25	26-50	51-+	Business Average
		$	$	$	$
Non-supported by IPARD	Net Profit	12,954.79	37,701.02	88,120.11	30,682.14
	Equity Capital Benefit	9,379.35	17,687.11	29,689.71	14,493.67
	Equity Capital	313,098.84	669,422.11	1,144,062.34	525,627.29
	Financial Profitability	7.13	8.27	10.3	8.59
Supported by IPARD	Net Profit	17,751.46	43,483.24	187,151.66	174,628.92
	Equity Capital Benefit	21,413.27	26,790.53	58,066.36	55,349.21
	Equity Capital	854,465.22	1,047,179.89	2,222,822.80	2,121,062.78
	Financial Profitability	4.58	6.71	11.03	10.84

Economic Profitability

Economic profitability shows how profitable the enterprise is using its resources. Within the scope of the study, the ratio of the avail to active capital is calculated (Table 8). While the average economic profitability of enterprises not receiving IPARD support is 23,80%, this value is 27,46% in enterprises receiving IPARD support. Accordingly, both business groups work profitably and use the resources of the enterprise well.

Table 8: *Economic profitability by business groups ($, %)*

		Farm Size Group (Head)			
		10-25	26-50	51-+	Business Average
		$	$	$	$
Non-supported by IPARD	Avail	25,474.72	59,557.82	124,161.28	49,068.06
	Active Capital	116,174.46	213,940.99	530,381.04	206,142.88
	Economic profitability	21.93	27.84	23.41	23.80
Supported by IPARD	Avail	41,175.90	73,381.31	252,356.11	236,749.91
	Active Capital	349,729.19	379,801.40	905,409.58	862,158.04
	Economic profitability	11.77	19.32	27.87	27.46

While the financial profitability (FP) measures the profitability of the equity capital of the business, economic profitability (EP) measures the profitability of the enterprise.

CONCLUSION

It can be said that dairy farms, which take and do not take IPARD supports in Konya province, manage their investment capital well. However, businesses operating in dairy farms and benefiting from the IPARD program manage their investments in a better way. The economic and financial profitability of the enterprises not receiving IPARD support are higher than the interest rate of the banks, which give credit to the agricultural sector, and the profitability of the investment increases as the size groups increase. This situation is important for the competitiveness of enterprises. Small-scale businesses are less likely to compete with large-scale businesses. Because the mobility of large enterprises is higher than that of small enterprises and in case of liquidation, the liquidity to pay their debts is higher (%7.56). Although the financial and economic liquidity of enterprises is high in the research area, the share of equity is 92.44% and 7.56% foreign capital for IPARD supported ones. In those who do not receive support, the share of total equity is 85.76%, the share of foreign capital is 14.24%, and they hesitate to take risks. Risk and uncertainty in agricultural enterprises is already quite high and the fact that input costs in livestock enterprises are high and the market is unstable, is considered as a disadvantage. In addition, large enterprises also cannot compete in the market. For this reason, business administrators need to manage capital better and take precautions to reduce input costs. It is of great importance that the management of the business as well as the planning of the enterprise and the results of the operation are evaluated for each production activity.

ACKNOWLEDGEMENT

This study has been prepared by using the Ph.D. dissertation entitled “Impact of IPARD Program on Competitiveness of Dairy Farms in Konya”. This study was supported as a whole project by the TUBİTAK project numbered 116K697 and Selcuk University, Scientific Research Fund (BAP) project numbered 17401049.

REFERENCES

Acar M. (2003). Tarımsal İşletmelerde Finansal Performans Analizi. Journal of Faculty of Economics and Administrative Sciences. 20, 21-37, ISSN 1301-3688.

Açıl A. F. and Demirci R. (1984). Tarım Ekonomisi Dersleri, Ankara Üniversitesi Ziraat Fakültesi Yayınları. No:880. Ankara.

Akgüç Ö. (1995). Mali Tablolar Analiz. Muhasebe Enstitüsü Yayını, 9. Baskı, İstanbul.

Altıntaş G., and Akçay Y. (2007). Tokat İli Erbaa Ovasında Tarım İşletmelerinin Ekonomik Analizi Ve İşletmelerin Başarısını Etkileyen Faktörlerin Ortaya Konulması. Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Dergisi, 24(2):33-42.

Baraz B. and Besler S. (2010). “Rekabet Yönetimi”. Anadolu Üniversitesi.

Bayramoğlu Z. (2003). Konya İlinde Süt Sığırcılığı Projesi (100x2) Kapsamında Yer Alan İşletmelerin Ekonomik Analizi. Selçuk Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Konya.

Çetin B. (2013). Uygulamalı Tarım Ekonomisi. Nobel Akademik Yayıncılık, Ankara. ISBN: 9786051335476.

Erkuş A. (1979). Ankara İli Yeni Mahalle İlçesinde Kontrollü Kredi Uygulaması Yapılan Tarım İşletmelerinin Planlanması Üzerine Bir Araştırma. Ankara Üniversitesi, Ziraat

Fakültesi Yayınları, No:709, Bilimsel Araştırma Ve İncelemeler: 415, Ankara.

İnan İ. H. (1994). Tarım Ekonomisi. Trakya Üniversitesi Tekirdağ Ziraat Fakültesi, Tekirdağ.

Kara M. (2008). Bölgesel Rekabet Edebilirlik Kavramı ve Bölgesel Kalkınma Politikalarına Yansımaları. Uzmanlık Tezi, DPT Ekonomik Modeller Ve Stratejik Araştırmalar Genel Müdürlüğü, Yayın No: DPT : 2774, Ankara.

Luehrman T.A. and Kester W.C. (1989). "Are We Feeling More Competitive Yet? The Exchange Rate Gambit". MIT Sdebt Management Review 30, no. 2 (winter 1989): 19–28.

Murat H. (2011). "Ege Ve Orta Anadolu Bölgesi Damızlık Sığır Yetiştiricileri Birliğine Bağlı Süt Sığırcılık İşletmelerinin Ekonomik Analizi". Doktora Tezi, Ankara Üniversitesi Sağlık Bilimleri Enstitüsü, Ankara.

Oğuz C. and Bayramoğlu Z. (2018). Tarım Ekonomisi Kitabı. Atlas Akademi, 3. Basım, Konya, ISBN:978-605-63373-3-8.

Oğuz C. and Yener A. (2017). Konya İli Süt İşletmelerinin Ekonomik Faaliyet Sonuçları ve Yenilikleri Benimseme Düzeyleri, Selçuk Üniversitesi Bilimsel Araştırma Projeleri Proje No: 15401020, Konya.

Oğuz C. and Bayramoğlu Z. (2015). Tarım Ekonomisi. Atlas Kitapevi, 2. Basım, Konya.

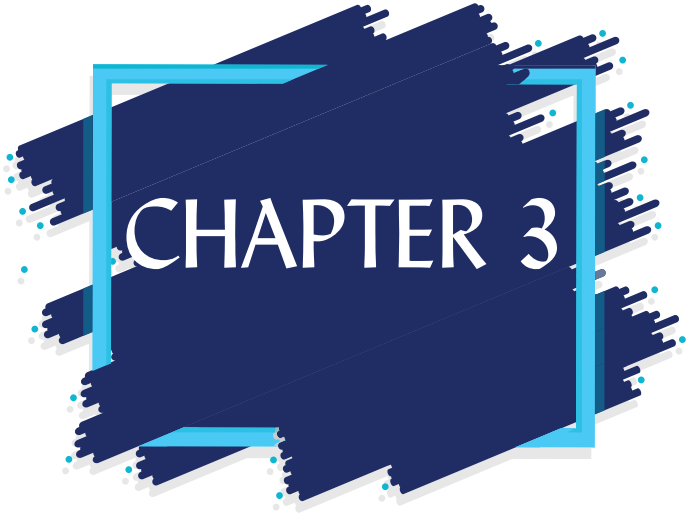
Oğuz C. and Karakayacı Z. (2017). Tarım Ekonomisinde Araştırma ve Örneklemem Metodolojisi. Atlas Akademi,1. Basım, Konya, ISBN:978-605-82785-2-3.

Özdemir S. (2015). Çevreye Duyarlı Konaklama İşletmelerinde Yöneticiler Açısından Rekabet Avantajı Olarak Yeşil Yıldız Uygulaması. Yüksek Lisans Tezi, Gazi Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

Yamane T. (1967). Elementary Sampling Theory. Prentice-Hall Inc.Englewood Cliffs, New Jersey.

YIELD AND QUALITY CHARACTERISTICS OF ORGANICALLY GROWN SOME QUINOA VARIETIES IN DIFFERENT LOCATIONS (*CHENOPODIUM QUINOA* WILLD.)

Fikret BUDAK[1]



1 Duzce University Faculty of Agriculture&Natural Sciences Department of Field Crops, Corresponding author. fikretbudak@rocketmail.com

YIELD AND QUALITY CHARACTERISTICS OF ORGANICALLY GROWN SOME QUINOA VARIETIES IN DIFFERENT LOCATIONS (*CHENOPODIUM QUINOA* WILLD.)

Fikret BUDAK[1]

1. INTRODUCTION

Quinoa (*Chenopodium quinoa* Willd.) is favorable plant is an important plant for animal feed and human food. Because it has high digestibility protein in dry matter and some quinoa varieties seed of these plants have saponin free. (Budak, 2018).

Quinoa (*Chenopodium quinoa* Willd.), a stress-tolerant species, has been cultivated along the Andes, from about 3000 B.C and is still being cultivated in Peru, Bolivia, Chile, Ecuador, Colombia and Argentina (Gonzalez et al., 2012). It is upright, reaching heights varying from 0.60 to 3.00 m, depending on the type of quinoa, genotypes, fertility of soil and environmental conditions where it grows. Andean crops such as beans, maize, and potato, quinoa has not been cultivated on a wide scale in Turkey. Recently, there has been a renewed interest in these plants. This interest is due partly because of its high protein content and balanced amino acid composition and partly because of the tolerance of the plant to a wide range of unfavorable climatic conditions (Rastrelli et al.,1998). This plant has a remarkable adaptability to different agro-ecological regions. It can grow at relative humidity from 40% to 88%, and withstands temperatures from -4°C to 38°C. is tolerant and resistant to lack of soil moisture, and produces acceptable yields with rainfall of 100 to 200 mm (FAO/WHO, 2011). The nutritive and antioxidant properties of quinoa

1 Duzce University Faculty of Agriculture&Natural Sciences Department of Field Crops, Corresponding author. fikretbudak@rocketmail.com

could be extended to animal nutrition field where several experimental studies have been conducted on the use of quinoa in feed for chickens (Jacobsen et al., 1997; Improta et al., 2001; Munoz, 1980) and pigs (Cardozo et al., 1979; Van der Peet-Schwering et al., 1993), yielding excellent results. The plant has been considered a second-class grain from the by-products of a crop that can be used in feeding poultry, pigs and cattle in special conditions (Jacobsen, 2003; Rosero et al., 2010). Nevertheless, it has been reported the low uptake of quinoa by-products for livestock feed among local farming communities (Rosero et al., 2010). It has been reported the plants have high crude protein and low ADF content (Budak,2018). Quinoa contains gluten-free high-quality protein, so it can play an important role in the diet of people suffering from celiac disease (Doweidar and Kamel,2011). The agronomic performance and nutritive value of quinoa was analyzed to define alternatives to local forages for dry-season organic feeding of ruminants and human food.

2. MATERIALS AND METHODS

The experiment was carried out during growing season (5 th October 2017). Mean long period precipitation (1981-2010) 827.4 mm. Total rainfall during the vegetation period was 432,6 mm and 451.4 mm in Kaynaşlı and Akçakoca respectively.

The experiment was conducted in a completely randomized block design with three replications. In the study, Black Negra, Altiplano, Salcedo İnnia, Calender and Hwai were tested. Seeds were sown by hand into rows 50 cm apart and at a depth of about 5 cm. Each plot was consisted of 4 rows with 5 m). We investigated hay (dry matter=DM) and grain yield (GY), crude protein (CP) content in DM and grain, acid detergent fiber (ADF) in this trial. The data were tested to the analysis of variance with the

MSTAT-C package program according to the randomized complete blocks experimental design, and differences between means which were found significant were showed by the LSD test (Yıldız and Bircan,1991).

Table 1. *Physical and Chemical Properties of Soil*

Depth (cm)	Lime (%)	Total salt (%)	pH	Clay (%)	Sand (%)	Organic Matter (%)
0-30	6.18	0.091	6.8	20.23	20.02	1.53
30-60	6.30	0.090	7.3	20.35	20.56	1.22
60-90	7.12	0.080	7.2	20.40	21.12	1.10

2. RESULTS AND DISCUSSION

2.1. Hay (DM) yield.

The results are summarized in Table 1. The analysis of variance of data revealed location x varieties interaction were significant differences by a level of significance of $P<0.01$.

Table 1. *Mean hay (DM) yield (kg ha^{-1})*

Varieties/ Location	Kaynaşlı	Akçakoca	Mean
Black Negra	4.140 ab	4.310 a	4.230 A
Altiplano	4.421 a	4.480 a	4.450 A
Salcedo	3.650 **b**	4.561 a	4.110 AB
Innia	3.050 c	3.620 b	3.340 B
Calender	4.120 ab	4.920 a	4.521 A
Hwai	3.121 c	4.110 ab	3.620 B
Mean	3.750 B	4.331 A	

LSD % 1

DM ranged from 3.050-4.920 kg ha^{-1}. While the highest mean DM yield was obtained from Calender in Akçakoca, and the lowest yield Innia in Kaynaşlı locations. Concerning location the mean DM ranged from 4.331-3.750 kg ha^{-1}, while Akçakoca has the highest mean DM yield, and Kaynaşlı has the lowest yield. Besides, concerning varieties, the mean DM ranged from 3.340-4.521 kg ha^{-1}, while the highest mean yield was obtained from Calender, the lowest yield Innia variety**.**

2.2. Crude protein (CP) content of dry matter (DM)

The results are summarized in Table 2. The analysis of variance of the data showed that effect of V and LxV interaction on mean CP contents was significant differences by a level of significance of $P<0.05$. Concerning varieties the mean CPC ranged from 10.37-11.13%. The highest mean CP content was observed in Salcedo, the lowest Black Negra variety. Concerning location-varieties interaction the highest CP content was obtained from Innia in Akçakoca, the lowest Black Negra varieties Kaynaşlı. Corresponds with studies of Budak, (2018) determined that nitrogen and phosphorus manure enhanced CP content ranged from 10.86%- 14.93%. CP content depends on existing nitrogen fertilizer in the soil. N fertilizer effects on CP content highly.

Table 2. *Mean CP content of DM (%)*

Varieties	Kaynaşlı		Akçakoca		Mean
Black Negra	10.33 b		10.41 ab		10.37 B
Altiplano	10.43 ab		10.46 ab		10.45 AB
Salcedo	11.12 a		11.14 a		11.13 A
Innia	10.56 ab		11.23 a		10.90 AB
Calender	11.03 ab		11.21 a		11.12 A
Hwai	10.83 ab		10.76 ab		10.80 AB
Mean	**10.72**		**10.87**		

LSD 5 %

2.3. Acid detergent fiber (ADF) content

Digestibility is the most common nutritive parameter used in feeding standards for ruminants and is the basal unit when evaluating the nutritive value of forage (Tassoneet al., 2014). ADF is insoluble protein, as the ADF level increase, digestible energy levels decrease.

Table 3. *Mean acid detergent fiber levels (ADFL) (%)*

Varieties	Kaynaşlı		Akçakoca		Mean
Black Negra	35.13 de		36.25 cd		35.69
Altiplano	37.41 b		37.72 b		37.57
Salcedo	36.18 cd		34.47 e		35.33
Innia	35.76 d		36.79 c		36.28
Calender	38.41 a		38.74 a		38.58
Hwai	36.72 c		37.34 b		37.03
Mean	36.60		36.89		
LSD 1 %					

The results are summarized in Table 3. The analysis of variance of the data showed that effect of LxV interaction on mean ADF contents was highly significant differences by a level of significance of $P<0.01$. According to the mean result of the ADF contents ranged from 34,47-38,74 %, Forage intake is affected by crude protein, fibre and ash content (Ibrahim et al.,2012). Acid detergent fibre (ADF) is a major indicator of digestibility, negatively affects feed quality (Han et al., 2003). Corresponds with studies of Kering et al., (2011) reported that N fertilization consistently decreased ADF content in berrnuda grass forage. Kakabouki et al.,(2014) reported that there were significant differences between fertilization treatments concerning the ADF content. Balabanlı et al.,(2010) reported that N fertilization significantly decreased native rangeland ADF content from 46.45 to 39.02%. In this study ADF content was higher than previous study in which used ni-

trogen and phosphorus decreased ADF contents slightly. Budak,(2018) reported that N and P manure decreased ADF content.

2.4. Grain Yield (GY)

The results are summarized in Table 4.The analysis of variance of data revealed effect of LxV interaction on mean GY were highly significant differences by a level of significance of of P<0.01. Concerning location was insignificant statistically of P<0.01. In respect of varieties, the mean GY ranged from 39.97-55.13 kg ha^{-1}, while the highest mean yield was observed in Calender and Altiplano, the lowest yield in Hwai and Innia varieties.

Table 4. *Mean grain yield (GY) (kg ha^{-1})*

Varieties	Kaynaşlı		Akçakoca		Mean
Black Negra	541.2 b		514.6 d		527.9 AB
Altiplano	567.1 a		531.3 b		549.2 A
Salcedo	497.6 c		552.6 ab		525.1 B
Innia	412.9 d		405.6 d		409.3 C
Calender	534.8 b		567.8 a		551.3 A
Hwai	**401.8 de**		**397.5 e**		**399.7 C**
Mean	492.6		494.9		
LSD 1 %					

2.5. Crude Protein Content of Grain

The analysis of variance of data revealed effect of variety and variety-location interaction on GCP content were highly significant differences by a level of significance of of P<0.01. In regard to location, the Mean GCP content ranged from 13.05-13,19 %, but the effect on CP contents was insignificant. Besides, concerning varieties, the mean GCP ranged from 12.00-13.77%, while the highest mean

GCP was observed Calender, and the lowest in Black Negra. The analysis of variance of data revealed LxV interaction was highly significant differences by a level of significance of $P<0.01$. According to the mean result of the LxV interaction on GCP ranged from 11.79-13.86%. The highest mean GCP content observed in Calender, while the lowest in Black Negra on Kaynaşlı location. In this connection, corresponds with studies of Villa et al. (2014) reported that the carbohydrates constitute 55.3%, the lipids 12.4 %, and the proteins 11.7% in quinoa. The some varieties of quinoa have saponins compound so animal nutritionists have generally considered saponins to be deleterious compounds. In ruminants, some saponins are considered to have detrimental effects on protozoa through their binding with sterols present on the protozoal surface; furthermore, in other domestic animals the dietary saponins have significant effects on all phases of metabolism, from the ingestion of feed to the excretion of wastes (Francis et al., 2002).Saponins can have effects on animal growth and feed intake. In turn, chickens feeded with higher levels of bitter quinoa (with saponin) have been reported a deficiency of vitamin A (Ward, 2000)

Table 5.*Mean crude protein content of grain (GCP) (%)*

Varieties	Kaynaşlı		Akçakoca		Mean
Black Negra	11.79 b		12.22 ab		12.00 B
Altiplano	13.14 ab		13.20 a		13.17 AB
Salcedo	12.71 ab		13.18 a		12.95 B
Innia	13.33 a		13.50 a		13.42 A
Calender	13.86 a		13.67 a		13.77 A
Hwai	13.46 a		13.39 a		13.43 A
Mean	**13.05**		13.19		
LSD 1 %					

In this connection, corresponds with studies of Basra et al., (2014) informed that the major fact that determines the grain protein content is nitrogen availability, and quinoa is highly responsive to nitrogen fertilizer and higher CP content, in a crop with high yield, can be obtained just by application of higher nitrogen quantities. The higher protein content at higher nitrogen levels was mainly due to the structural role of nitrogen in building up amino acids (Bhargava et al., 2010; Gomaa, 2013). The progressive increase in protein contents of quinoa seed with the increasing nitrogen rates were also reported by Jacobsen et al.(1994), Shams, (2012). Erley et al.,(2005) informed that mean CP content of quinoa cultivars (Faro and Cochabamba) increased gradually (12.3% to 14.6%, respectively) with the increasing nitrogen levels from 0 kg N to 120 kg N ha^{-1} and Miranda et al.,2013 reported an Mean CP content of 18.8% using cold resistance quinoa cultivars (Regalona Baer and Villarrica). Kakabouki et al.,2014 also stated that increasing nitrogen level increased CP content of quinoa from 7% to 27% under different tillage system.

CONCLUSION

The study has shown that guinoa has high potential as an alternate forage crop concerning yield and guality, and its grain for human food and also possibilities of organic or good agriculture implementation in almost every region of the World.

REFERENCES

Balabanlı, C., S. Albayrak, O.Yüksel (2010). Effects of nitrogen, phosphorus and potassium fertilization on the quality and yield of native rangeland. Turkish Journal of Field Crops, 2010, 15(2): 164-168.

Basra S.M.A., Iqbal, S. and I. Afzal, (2014). Evaluating the Response of Nitrogen Application on Growth, Development and Yield of Quinoa Genotypes. *Int. J. Agric. Biol*.,16: 886–892.

Bhargava, A., S. Shukla and D. Ohri. (2010). Mineral composition in foliage of some cultivated and wild species of Chenopodium. Span. J. Agric.Res. 8(2): 371-376

Bonifacio, A. Chenopodium Sp.: Genetic resources, ethnobotany, and geographic distribution. **Food Reviews International**, v. 19, p. 1–7, (2003).

Budak, F., (2018). Influence of Nitrogen and Phosphorus Levels on Yield and Quality of Quinoa (*Cheneopodium quinoa* Willd.) FEB Advances in Food Sciences. Vol.40 4/2018, 120-127.

Cardozo, A. and M. Tapia. 1979. Valor nutritivo. In: M. Tapia, H. Gandarillas, S. Alandia, A.Cardozo and A. Mujica (Eds.). pp. 149–192,Quinua y Kañ iwa, Cultivos Andinos. Bogotá CIID, Oficina Regional para la América Latina, ISBN: 0-88936-200-9.

Doweidar, M.M. and A.S.Kamel. (2011). Using of quinoa for production of some bakery products (gluten-free), Egyptian J. Nutrition, 26(2):21-52

Erley,G.S., H-P.Kaula, M. Kruseb,W.Aufhammer.,(2005). Yield and nitrogen utilization efficiency of the pseudocereals amaranth, quinoa, and buckwheat under differing nitrogen fertilization. Europ. J. Agronomy 22 (2005) 95–100

FAO/WHO. 2011. Quinoa: An ancient crop to contribute to world food security. Regional

Office for Latin America and the Caribbean.

Francis, G., Z. Kerem and K. Becker. 2002. The biological action of saponins in animal systems: a review. British J. Nutr. 88:587–605

Gomaa,E.F. 2013. Effect of nitrogen, phosphorus and biofertilizers on quinoa plant, Journal of Applied Sciences Research, 9(8):5210-5222

Gonzalez, J. A., Y. Konishi, M. Bruno, M. Valoy and F. E. Pradoc. (2012). Interrelationships among seed yield, total protein and amino acid composition of ten quinoa (*Chenopodium quinoa*) cultivars from two different agroecological regions. J. Sci. Food. Agric. 92:1222–1229

Han, F., S. E. Ullrich, I. Romagosa, J. A. Clancy, J. A. Froseth and D. M. Wesenberg. (2003).Quantitative genetic analysis of acid detergent fibre content in barley grain. J. Cereal Sci. 38:167-172

Ibrahim, M., M. Ayub, A. Tanveer and M. Yaseen. (2012). Forage quality of maize and legumes as monocultures and mi-tures at different seed ratios. J. Anim. Plant. Sci. 22(4):987-992.

Improta, F. and R. Kellems. 2001. Comparison of raw washed and polished quinoa (Chenopodium quinoa Willd) to wheat, sorghum or maize based diets on growth and survival of broiler chicks. Livestock Res.Rural Dev. 13(1):10.

Jacobsen, S.-E., Jørgensen, I., Stølen, O.,(1994). Cultivation of quinoa (*Chenopodium quinoa*) under temperate climatic conditions in Denmark. J. Agric. Sci. 122, 47–52

Jacobsen, E., B. Skadhauge and S. Jacobsen. 1997. Effect of dietary inclusion of quinoa on broiler growth performance. Anim Feed Sci Tech, 65:5–14.

Jacobsen, S. 2003. The worldwide potential for Quinoa (Chenopodium quinoa Willd). Food Rev. Internat. 19(1-2):167–177.

Kakabouki, I., D. Bilalis, A. Karkanis, G. Zervas, E. Tsiplakou and D. Hela. (2014). Effects of fertilization and tillage system on growth and crude protein content of quinoa

(*Chenopodium quinoa* Willd.): An alternative forage crop. Emir. J. Food Agric. 2014. 26 (1): 18-24Kering, M. K., J. Guretzky, E. Funderburg and J. Mosali. (2011). Effect of nitrogen fertilizer rate and harvest season on forage yield, quality, and macro nutrient concentrations in Midland bermuda grass. Commun. Soil. Sci. Plant Anal. 42:1958-1971.

Kuhn, M., S.Wagner, .Aufhammer, J.H.Lee, E.Kübler and H.Schreiber. (1996). Einfluß von pflanzen baulicher Maßnahmen auf die Mineralstoffgehalte von Amaranth, Buchweizen, Reismelde und Hafer. Dt Lebensm Rundschau, 92:147-152.

Miranda,M., A.Vega-Gálvez, E.A.Martínez, J.López, R.Marín, M.Aranda and F.Fuentes. 2013. Influence of contrasting environments on seed composition of two quinoa genotypes: Nutritional and functional properties, Chilean Journal of Agricultural Research, 73(2):108-116.

Munoz, V. 1980. Effect of 5 levels of Chenopodium quinoa (Quinoa) as a partial substitute of soybean cake in the broilers chickens feeding. Thesis Zootechnician Degree, Universidad de Nariñ o, Pasto, Colombia.

Rastrelli, L., P. Saturnino, O. Schettino and A.Dini. 1995. Studies on the constituents of Chenopodium pallidicaule (Canihua) sedes:Isolation and characterization of two new flavonol glycosides. J. Agric. Food Chem. 43:2020-2024.

Rosero, O., D. Rosero and D. Lukešová. 2010. Determination of the capacities of farmers to adopt quinoa grain (Chenopodium quinoa willd) as potential feedstuff. Agric. Trop. Subtrop. 43(4):308–315.

Shams, A.S. 2012. Response of quinoa to nitrogen fertilizer rates under sandy soil conditions, Proc. 13thInternational Conf. Agron., Fac.of Agric., Benha Univ., Egypt, 9-10 September 2012, p:195-205.

Tassone, S., G. Masoero and P.G. Peiretti. (2014). Vibrational spectroscopy to predict in vitro digestibility and the maturity inde- of different forage crops during the growing

cycle and after freeze- or oven-drying treatment.Animal Feed Sci. Technol. 194: 12–25

Van der Peet-schwering C., M. Van Krimpen, P. Kemme, G. Binnendijk, J. Van Diepen, A.Jongbloed, G. Henniphof-Schlick and D. Bubenheim. 1993. Quinoa: An Emerging

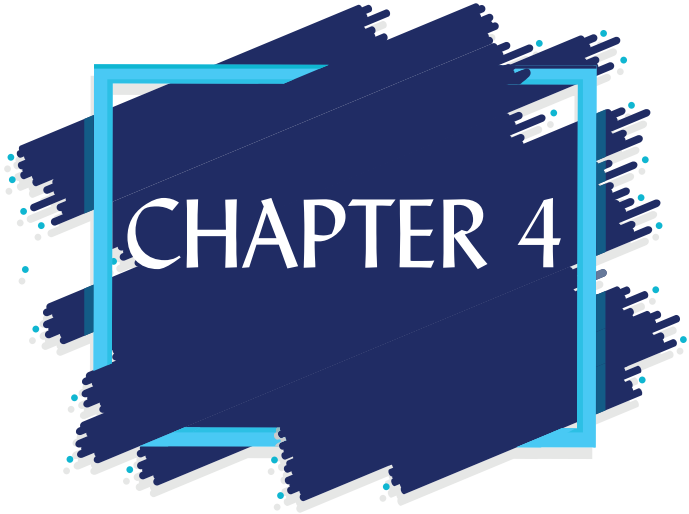
“New” crop with potential for CELSS. NASA Technical Paper 3422.

Yıldız N. and H. Bircan,(1991) “Practical statistics, (Uygulamalı İstatistik)” Atatürk Universitesi Yay, no. 704, pp. 308-60, 1991

Ward, S. 2000. Response to selection for reduced grain saponin content in quinoa (Chenopodium quinoa Willd). Field Crops Res. 68(2):157–163.

THE EFFECT OF DIFFERENT MANURES ON AGRONOMIC PERFORMANCE AND QUALITY OF QUINOA (*CHENOPODIUM QUINOA* WILLD.)

Fikret BUDAK[1]



1 Duzce University Faculty of Agriculture&Natural Sciences Department of Field Crops, Corresponding author. fikretbudak@rocketmail.com

THE EFFECT OF DIFFERENT MANURES ON AGRONOMIC PERFORMANCE AND QUALITY OF QUINOA (*CHENOPODIUM QUINOA* WILLD.)

Fikret BUDAK[1]

1. INTRODUCTION

Quinoa (*Chenopodium quinoa* Willd.) is considered a pseudocereal or pseudograin, native to Latin America which has the potential to grow with less inputs, water and tolerate a variety of biotic and abiotic stresses. "Quinoa is a stress-tolerant species, has been cultivated along the Andes, from about 3000-5000 B.C and is still being cultivated in Peru, Bolivia, Chile, Ecuador, Colombia and Argentina" (Gonzalez *et al.*, 2012). This plant is one of the most important economic crops. The plant has high crude protein and low ADF and NDF content as compared to other forage plant that NDF content of sorghum 52%, sudanse 53,28%, sorghum-sudanense 50 % and maize 54%, and 8,69 % crude protein content (Budak et.al. 2017). Accordingly Black Negra genotype is a favorable plant for animal and human food because of high digestibility protein and saponin free of seed. "This plant has fulfilled various roles in these ancestral cultures, in addition to its role in human and animal nutrition, quinoa had a sacred importance" (Bonifacio, 2003). "Quinoa can be successfully grown on marginal soils showing its very low nutrient requirements" (Jacobsen, 2003)., but nitrogen and phosphorus are an essential element required for successful plant growth. Each of these fundamental nutrients plays a key role in plant nutrition. Nitrogen and phosphorus applications have been inevitable to increase the yield and guality of plant. Although "inorganic nitrogen compounds (*i.e.*, $NH4^{+}$, $NO2^{-}$,

1 Duzce University Faculty of Agriculture&Natural Sciences Department of Field Crops, Corresponding author. fikretbudak@rocketmail.com

and $NO3^{-}$) account for less than 5% of the total nitrogen in soil" (Brady,2008). The influence of N (calcium ammonium nitrate (27% N)) rate on grain yield was even stronger than for amaranth. Gomaa (2013) informed that "the application of 0, 119 and 238 kg N ha^{-1} with biofertilizers led to consistent increase the grain yield per hectare of quinoa as compared with untreated plants (control) over the years". "Grain yield was enhanced to 94 % at N 120 compared to N0" (Erley et al., 2005). Thanapornpoonpong *et al.* (2008) explored "the effect of different nitrogen rates (0.16 and 0.24 g N kg^{-1} soil) on protein content of seed and amino acid profile of amaranth and quinoa. Nitrogen fertilization effected amino acid content of quinoa and amaranth. Both had rich lysine contents (6.3-8.2 g 100 g^{-1} protein) but low methionine (1.28 g 100 g^{-1}protein). Thus, "diets of humans can be improved by maintaining and increasing essential amino acid content and proteins by applying N fertilizer" (Basra et al., 2014). The protein of quinoa seed is rich in essential amino acids, particularly methionine, threonine and lysine, which are the limiting amino acids in most cereal grains (Bhargava et al., 2007; Comai et al., 2007). Quinoa contains gluten-free high-quality protein, so it can play an important role in the diet of people suffering from celiac disease (Kuhn et al., 1996; Doweidar and Kamel, 2011). Kakabouki et al. (2014) reported that "nitrogen fertilization increased also the grain yield of quinoa under different tillage system. Quinoa responds to N and P application not only increase yield but also the quality of forage and grain "Nitrogen level of 75 kg N ha^{-1} was proved to be optimum level for nitrogen supplementation of soil for quinoa growth and development to harvest maximum economic yield under ecological conditions of Egypt" (Basra et al.,2014). The agronomic performance and nutritive value of quinoa was analyzed to define alternatives to local forages for dry season feeding of ruminants and for quality food for human being. So, the investigation was carried

out to determine appropriate level of nitrogen and phosphorus for getting the highest yield and quality of quinoa genotypes under central anatolia condition. This plant is a promising alternative cultivar.

2.MATERIALS AND METHODS

The trials were conducted during 2016 and 2017 (September2016- October 2017) growing season for two years in Ankara. The soils of the testing ground were a silty-clay loam (17,6 % clay, 19,6 % silt, and 23,2 % sand) with pH 6.5, 1,0 % organic matter, 0.051% salt, 0.11% total N, 1.12 ppm phosphorus and 233 ppm potassium. Total rainfall during the vegetation period of the plant was 171,4 mm, and 181,5 mm. Plants were irrigated two times. The study was carried out in a completely randomized block design with three replications. In this experiment 4 different nitrogen (N0: 0 kg ha^{-1}, N1: 25 kg ha^{-1}, N2:50 kg ha^{-1} and N3: 75 kg ha^{-1}) and 4 phosphorus levels (P0:0 kg ha^{-1}, P1: 15 kg ha^{-1}, P2: 30 kg ha^{-1} and P3: 45 kg ha^{-1}) were tested on Black Negra cultivar. Seeds were sown by hand into rows 40 cm apart and at a depth of 2-3 cm. Each plot was consisted of 6 rows with 5 m. Herbage (H), hay (dry matter=DM) and grain yield (GY), crude protein (CP) content in DM and grain, acid detergent fiber (ADF) and neutral detergent fiber (NDF) content in DM were investigated in the experiment. The latest data provided were tested to the analysis of variance with the MSTAT-C package program according to the randomized complete blocks e-perimental design, and differences between averages which were found significant were showed by the LSD test (Yıldız and Bircan, 1991).

3.RESULTS AND DISCUSSION

3.1.Herbage (H) and Hay (DM) Yield

The results are summarized in Table 1 and 2 Nitrogen and phosphorus level effects were the main sources of variation in all characters tested. The analysis of variance of data revealed effect of nitrogen and phosphorus levels on mean H and DM yield were highly significant differences by a level of significance of of P<0.01. H and DM yield of quinoa responded to Nitrogen (N) and phosphorus (P). There was significant differences among fertilization treatments concerning H and DM yields. The analysis of variance of data revealed N-P interaction was highly significant differences by a level of significance of of P<0.01. Differences between years was insignificant. According to the average of the N-P interaction on herbage yield. All fertilization (N and treatments resulted in values higher than those of the control. Concerning N-P levels, the average HY ranged from 36.9-21.2 t ha^{-1}, while the highest mean yield was recorded in (N3-P3), and the lowest yield (21.2 t ha^{-1}) in N0-P1 applications.

Table 1. *Average Herbage Yield for Two Years (t ha^{-1})*

Fertilizer Level	N0	N1	N2	N3	Average
P0	21.6 e	25.3 d	25.2 d	27.4 c	**24.88 C**
P1	21.2 e	24.7 d	27.3 c	31.5 b	26.18 B
P2	22.9 de	26.3 cd	35.8 b	35.7 b	30.18 A
P3	22.1 de	26.6 cd	35.3 b	36.9 a	30.22 A
Average	22.0 D	25.7 C	30.9 B	32,9 A	

LSD 1 %

Concerning N levels, the average HY ranged from 32.9 – 22.0 kg ha^{-1}, while the highest mean yield was observed in N3, and the lowest yield in N0. Concerning P levels, the average HY ranged from 30.22-24.88 t ha^{-1}, while the highest mean yield was recorded in P3, and the lowest

yield in P0 applications. When the appropriate N and P levels are practiced, the average HY yield increases (Table 1,2). In this connection, corresponds with studies of Mahmoud and Sallam (2017) reported that "the importance of N application N contents increased by 7.9 and by 39.7% in hay over the control when the plants are fertilized by 14.28 and 28.56 g N m^{-2} respectively". Besides, "Nitrogen fertilization at rates of 14.28 and 28.56 g m^{-2} increased the yield of biomass by about 33.5 and 60% more than the control under fresh and 10 dS m^{-1}saline water irrigation. Under irrigation with 20 dS m^{-1}, N application by corresponded rates increased the biomass by 57 and 100%, respectively". Kineber et al.(1991) reported that "nitrogen application enhance vegetative growth as well as the metabolism process in the plant and increase in dry matter accumulation. Myers (1998) found a mean yield increase of 42% at N application rates of 180 kg ha^{-1}. "Quinoa responds well to nitrogen fertilization" (Berti et al., 2000; Schooten and van Pin-terhuis, 2003; Erley et al., 2005).

Table 2. *Average Dry Matter Yield for Two Years (t ha^{-1})*

Fertilizer Level	N0	N1	N2	N3	Average	
P0	5.1 g	6.3 d	6.3 d	7.2 c	6.2	B
P1	5.2 e-g	5.7 de	7.1 c	7.9 bc	6.5	AB
P2	5.4 e	6.7 cd	8.7 ab	8.4 b	7.3	A
P3	5.3 f	6.6 cd	8.3 b	9.1 a	7.3	A
Average	**5.3 C**	6.3 B	7.6 AB	**8.2 A**		

LSD 1 %

Concerning P levels the average DM yield ranged from 7.3-6.2 t ha^{-1}, while the highest mean DM was observed in P3 and P2 and the lowest in P0 , and also, concerning N levels the mean DM yield ranged from 8.2- 5.3 t ha^{-1}, while the highest mean yield was observed in N3, and the lowest yield in N0. (Table 2). The analysis of variance of

data revealed there was insignificant differences between years, but N-P interaction on mean yield was highly significant differences and ranged from 9.1-5.1 t ha^{-1}. the highest mean DM yield was observed in N3-P3 and the lowest in N P free. In this connection many researchers informed that nitrogen application enhance vegetative growth as well as the metabolism process in the plant and icrease in dry matter accumulation (Kineber *et al.,*1991). Malik *et al*. (1993) found that N2-fi-ing bacteria produce plant growth hormones such as indole acetic acid, gibberellins and cytokinins. Nitrogen fertilization is reported to effect developmental stages of crop (Khan *et al.,* 2013; Thanapornpoonpong *et al.,* 2008). Our findings are in accordance with those researcher's results. Quinoa responds positively to the nitrogen and phosphorus levels. Schootenand and Pin-terhuis (2003) reported that N level had a significant effect on DM content.

These results showed that H and DM yield of quinoa well responded to N- P application. According to the result the increase in H and DM yield were observed depending on nitrogen and phosphorus levels.

3.2.Crude Protein (CP) Content of DM

The analysis of variance of data revealed effect of N and P and N-P interaction on average CP was highly significant differences by a level of significance of $P<0.01$. CP content responded to N and P positively as a result of statistical analysis. According to the mean result of CP content the ranged from 10.5 % - 11.28. In terms of P effect while the average highest CP content was observed in P2, and the lowest in P1 but the differences among level insignficant. In terms of N effect the average CP ranged from 10.5 % - 12.0 % and the differences among level highly signficant. The analysis of variance of the data showed that there was no significant differences between

years, but N-P interaction effect on CP content was highly significant.

Table 3. *Average CP Content of DM for Two Years (%)*

Fertilizer Level	N0	N1	N2	N3	Average
P0	10.7 bc	10.9 bc	11.2 b	11.7 ab	11.13
P1	10.6 bc	10.8 bc	11.1 b	11.6 ab	11.02
P2	10.5 bc	10.5 b-d	11.7 ab	12.4 a	11.28
P3	10.0 **d**	10.3 c	11.6 ab	12.3 a	11.05
Average	10.5 B	10.6 B	11.4 AB	12.0 A	

LSD 1 %

The mean result showed that, CP content the ranged from 10.0 % - 12.4 %. In terms of N-P interaction, while the lowest CP ratios were obtained from N0 – P3 the highest average CP content were recorded in N3–P2 and N3-P3. Because N is essential in the formation of protein, and protein makes up much of the tissues of most living thing, N level had more effect on CP content than P level (interaction $p<0.01$, Table 3). Schootenand and Pin-terhuis (2003) reported that "at 70 and 84 growing days there was a substantial effect of N level on CP content".

3.3.Acid Detergent Fiber (ADF) Content

The results are summarized in Table 4. The analysis of variance of data revealed that there was no significant differences between years, but the effect of N and P levels and N-P interaction on mean ADFLwere highly significant differences by a level of significance of $P<0.01$. According to the mean result of the ADFL ranged from 31.08 % -32.40 %. In terms of N-P interaction the highest average ADF content 33.45 were recorded in N1–P2, while the lowest ADF content were obtained from N0– P0. Concerning P levels, while the highest ADFC (32.40 %) was recorded in P2, and the lowest (31.31 %) in P3 levels. Likewise, the average ADFC ranged from % 31.08 – 32.53

%, while the highest ADFC was observed in N1, and the lowest in N0. “Acid detergent fibre (ADF) is a major indicator of digestibility, negatively affects feed quality” (Han et al., 2003). Kakabouki et al. (2014) reported that “there were significant differences between fertilization treatments concerning the ADF conten”t. “The highest ADF content was found under N2 (200 kg ha $^{-1}$) treatment. Forage intake is affected by crude protein, fibre and ash content” (Ibrahim et al., 2012). Corresponds with studies of Kering et al. (2011) reported that “N fertilization consistently decreased ADF content in berrnuda grass forage”.

Table 4. *Average ADF Content for Two Years (%)*

Fertilizer Level	N0	N1	N2	N3	Average
P0	30.23 d	33.25 a	33.26 a	31.48 b	32.05
P1	31.12 bc	31.20 c	32.60 ab	31.85 b	31.70
P2	32.20 ab	33.45 a	32.87 ab	30.96 cd	32.40
P3	30.77 cd	32.22 bc	30.45 d	31.78 b	31.31
Average	31.08 B	32.53 A	32.30 A	31.52 AB	

LSD1 %1

Correspond with study of Balabanlı et al. (2010) reported that “N fertilization significantly decreased native rangeland ADF content from 46.45 to 39.02%”. “Digestibility is the most common nutritive parameter used in feeding standards for ruminants and is the basal unit when evaluating the nutritive value of forage ADF is insoluble protein, as the ADF level increase, digestible energy levels decrease. The ADF concentration of fertilized herbage were significantly lower in plots with additions N+P than in plots P free. The ADF concentration were affected by N+K fertilization. Increasing N fertilization decreased cellulose and lignin contents from 29.30 to 24.18% and 6.85 to 2.77%. Cellulose and lignin contents decreased from N+P and N+K fertilization. However, application of N, P

and K did not affect hemicellulose content of native rangeland (Tassone et al., 2014). In our study N and P aplications have contributed reducing of ADFC, and increasing of digestibility.

3.4.Neutral Detergent Fiber (NDF) Content

The results of NDFL are summarized in Table 5. In the light of information of analysis of variance of data revealed there was no significant differences between years.The effect of N levels and N-P interaction on average NDFLwere highly significant differences by a level of significance of P<0.01. There were no significant differences among P fertilization treatments concerning the NDF content. That means P levels effect on NDFC was insignificant statistically. N levels effect on NDFL was highly significant. The analysis of variance of the data showed that N-P interaction effect on NDFL was highly significant. According to the mean result of NDFC the ranged from 39.25% - 47.15 %. The highest average NDFC was recorded in N1 –P2, while the lowest NDFC was observed in N0-P0. The NDF level is one of the most parameters concerning the digestibility for ruminants.

Table 5. *Average NDF Content for Two Years (%)*

Fertilizer Level	N0	N1	N2	N3	Average
P0	39.25 c	43.10 bc	46.32 a	42.10 bc	42.70
P1	39.78 c	45.12 ab	43.22 bc	42.61 b	42.68
P2	40.17c	47.15 a	45.20 b	44.30 ab	44.20
P3	42.47 b	44.31 b	46.41ab	45.21 b	44.60
Average	40.42 C	44.92 A	45.29 A	43.56 B	
LSD 1%					

Corresponds with studies of Balabanlı et al. (2010) reported that “N and P fertilization significantly decreased native rangeland NDF content from 74.32 to 68.46%. The NDF concentrations were significantly lower in plots with additions N+P than in plots P free. Increasing N fertiliza-

tion decreased cellulose and lignin contents from 29.30 to 24.18% and 6.85 to 2.77%."

3.5. Grain Yield (GY)

The results are summarized in Table 7.The analysis of variance of data revealed effect of nitrogen and N-P interaction on mean GY were highly significant differences by a level of significance of of $P<0.01$. There was no significant differences between years. All fertilization (N and P) treatments resulted in values higher than those of the control. But Concerning P levels, the average GY ranged from 0.72 – 0.89 t ha^{-1}, the effect of P levels may be extremely minor. Thus, P level was not statistically significant of $P<0.01$. In respect of N levels, the average GY ranged from 0.59 – 1.21 t ha^{-1}, while the highest average yield was observed in N3, and the lowest yield in N0.(N free).

In this study, the grain yield of quinoa increased with the increasing nitrogen level. The analysis of variance of data revealed N-P interaction was highly significant differences by a level of significance of of $P<0.01$. According to the mean result of the N-P interaction on GY from 0.52 -1.31 t ha^{-1}. The highest average GY observed in N3-P2, while the lowest yield by in N0-P0. As N and P levels increased, GY increased. The latest data showed that N levels effect on GY was higher than P levels, Findings showed that all values of P levels effect were the same in N2 level, but there were significant differences among other nitrogen treatments statistically. The increase of yield is depends on N and P level in soil. The GY increased as N and P levels were implemented accurately.

In this connection, corresponds with studies of Mohommad et al. (2017) reported that "nitrogen fertilization at rates of 14.28 and 28.56 g m^{-2} increased the seed yield where the application of nitrogen significantly increased

the yield under non-saline and saline conditions of irrigation water. Besides, N contents in seed increased by 15,9 and 36,8% in seeds over the control when the plants are fertilized by 14.28 and 28.56 g N m^{-2}, respectively".

Table 6. *Average GY for Two Years (t ha^{-1})*

Fertilizer Level	N0	N1	N2	N3	Average
P0	0,52 e	0,56 de	0,68 d	1,10 b	0,72
P1	0,61 d	0,66 d	0,76 c	1,12 b	0.79
P2	0,60 de	0,75 c	0,81 c	1,31 a	0,87
P3	0,63 d	0,78 c	0,86 c	1,30 a	0.89
Average	0,59 C	0,69 BC	0.78 B	1.21 A	
LSD %1					

Jacobsen et al. (1994) informed that "there was a significant grain yield increase when the amount of nitrogen fertilizer was increased from 40 to 160 kg N ha^{-1} and, the yield decreased by 24–1% when the nitrogen supply was reduced from 160 to 40 kg N ha^{-1}, while the yield decrease was 120 kg N ha^{-1} and 2–7 % when the nitrogen supply was reduced to 80 and 120 kg N ha^{-1} respectively". Razzaghi et al. (2012) and Schulte auf'm Erley et al. (2011) reported that "nitrogen improved both biomass and seed yield". Erley et al. (2005) stated that "grain yield of quinoa was affected by nitrogen fertilization from 0 to 120 kg ha^{-1} being 1790 kg to 3495 kg ha^{-1}. Geren (2015) reported "GY in quinoa crops ranged from 867 kg to 3308 kg ha^{-1} there were significant differences among nitrogen treatments, concerning the yield the highest grain yield (3308 kg ha^{-1}) was found in the at 150 kg N ha^{-1} level". Besides, Shams (2012) reported that the increases in quinoa grain yield per hectare with the increase in N fertilizer application from 90 up to 360 kg N ha^{-1} over the control treatment were 518%, 769%, 936% and 1394% in average of both years. Gomaa (2013) informed that the application of 0, 119 and 238 kg N ha^{-1} with biofertilizers led to consistent increase the grain yield per hectare of quinoa as compared with un-

treated plants (control) over the years. Budak, (2018) reported that "GY increasing significantly higher (80 %) in N and P treatment than control N and P free. Kakabouki et al. (2014) reported that "nitrogen fertilization increased also the grain yield of quinoa under different tillage system".

3.6.Crude Protein Content of Grain (GCP)

The analysis of variance of data revealed effect of N, P and N-P on GCP content were highly significant differences by a level of significance of of P<0.01. There was no significant differences between years. All fertilization (N and P) treatments resulted in values higher than those of the control. According to the mean result of GCP content the ranged from 12,03 % - 15.84 %. In regard to P, the average GCP content ranged from 11.31 % - 14.17 %. while the highest average GCP content was recorded in P2, and the lowest in P0, but was insignificant differences by a level of significance of of P<0.01. Besides, concerning N levels, the average GCP ranged from 11.31% - 16.73%. Wile the highest mean GCP was observed in N3, and the lowest in N1. The analysis of variance of data revealed N-P interaction was highly significant differences by a level of significance of of P<0.01. According to the mean result of the N-P interaction on GCP ranged from 11,31- 16,73 %. The highest mean GCP content observed in N3-P3, while the lowest in N1-P0. GCP increase was significantly high (about 45,9 %) in N3-P3 plots.

Table 7. *Average GCP Content for Two Years (%)*

Fertilizer Level	N0	N1	N2	N3	Average
P0	12.23 ef	11.31 f	13.76 c-f	16.31 a	13.40
P1	13.85 c-e	12.23 ef	14.06 b-d	15.76 ab	13.97
P2	12.61 d-f	12.80 d-f	15.57 a-c	15.68 ab	14.17
P3	13.28 c-e	12.81 d-f	12.75 d-f	16.73 a	13.89
Average	12.74 C	12.29 C	14.03 B	16.12 A	
LSD1%					

Kakabouki et al. (2014) also stated that “increasing nitrogen level, increased CP content of quinoa from 7% to 27% under different tillage system”. Concordantly, corresponds with studies of Basra et al., (2014) informed that the major fact that determines the grain protein content is nitrogen availability, and quinoa is highly responsive to nitrogen fertilizer and higher CP content, in a crop with high yield, can be obtained just by application of higher nitrogen quantities. The higher protein content at higher nitrogen levels was mainly due to the structural role of nitrogen in building up amino acids (Finck, 1982; Bhargava et al., 2006; Miranda et al., 2013). Erley et al. (2005) informed that “average CP content of quinoa cultivars (Faro and Cochabamba) increased gradually (12.3% to 14.6%, respectively) with the increasing nitrogen levels from 0 kg N to 120 kg N ha^{-1}” and, Miranda et al. (2013) reported that “an average CP content of 18.8% using cold resistance quinoa cultivars (Regalona Baer and Villarrica). The progressive increase in protein contents of quinoa seed with the increasing nitrogen rates were also reported by many research workers (Jacobsen et al., 1994; Erley et al., 2005; Shams, 2012). Budak, 2018 reported that the management of nitrogen is a key component in achieving higher CP content than N free**.** (about 45,9 %).

The result of the trials shown that guinoa as a an alternate forage crop concerning forege and grain yield and guality, and its grain for human food and also possibilities of quinoa cultivation almost everywhere.

REFERENCES

Alvarez, M., von Rütte., S., (1990). Cited in: Jacobsen, S.-E., Jørgensen, I., Stølen, O., 1994.Cultivation of quinoa (Chenopodium quinoa) under temperate climatic conditions in Denmark. J. Agric. Sci. 122, 47–52.

Balabanlı, C., S. Albayrak and O.Yüksel (2010). Effects of nitrogen, phosphorus and potassium fertilization on the quality and yield of native rangeland. Turkish Journal of Field Crops, 2010, 15(2): 164-168.

Basra S.M.A., Iqbal, S. and I. Afzal, (2014). Evaluating the Response of Nitrogen Application on Growth, Development and Yield of Quinoa Genotypes. *Int. J. Agric. Biol*.,16: 886–892.

Berti, M., R. Wilckens, F. Hevia, H. Serri, I. Vidal and C. Mendez. (2000). Fertilizacion nitrogenada en quinoa (*Chenopodium quinoa* Willd.). Cienc. Investig. Agrar. 27:81-90.

Bhargava, A., Shukla, S., Ohri, D., (2006). Chenopodium quinoa-an Indian perspective. Industrial Crops and Products, 23: 73-87.

Bhargava, A., S. Shukla and D. Ohri. (2010). Mineral composition in foliage of some cultivated and wild species of *Chenopodium*. Span. J. Agric.Res. 8(2): 371-376

Brady N.C., Weil R.R. Soil Colloids: Seat of Soil Chemical and Physical Acidity. In: Brady N.C., Weil R.R., editors. The Nature and Properties of Soils. Pearson Education Inc.; Upper Saddle River, NJ, USA: (2008). pp. 311–358.

Bonifacio, A. Chenopodium Sp.: Genetic resources, ethnobotany, and geographic distribution. Food Reviews International, v. 19, p. 1–7, (2003).

Budak, F., S. Kızıl Aydemir. (2017). Determination and comparison of yield and yield components of sorghum (S*orghum bıcolor* L.), sudan grasses (*Sorghum sudanense* L.), Sorghum sudangrass hybrids (S*orghum bıcolor - Sorghum bıcolor var. Sudanense*) and corn (*Zea mays* L.) Varieties

grown as a second crop on Western transition zone after hungarian vetch (*Vicia pannonıca crantz*). Fresenius Environmental Bulletin Volume 26 - No. 8/2017 p: 5153-5162

Budak,F.,(2018). Influence of Nitrogen and Phosphorus Levels on Yield and Quality of Quinoa. Advances in Food Sciences Volume 40: 4/2018 120-127.

Doweidar, M.M. and A.S.Kamel. (2011). Using of quinoa for production of some bakery products (gluten-free), Egyptian J. Nutrition, 26(2):21-52.

Erley,G.S., H-P.Kaula, M. Kruseb, W.Aufhammer.,(2005). Yield and nitrogen utilization efficiency of the pseudocereals amaranth, quinoa, and buckwheat under differing nitrogen fertilization. Europ. J. Agronomy 22 (2005) 95–100

Jacobsen, S.-E., Jørgensen, I., Stølen, O.,(1994). Cultivation of quinoa (Chenopodium quinoa) under temperate climatic conditions in Denmark. J. Agric. Sci. 122, 47–52

Jacobsen,S.E.(2003). The worldwide potential for quinoa (*Chenopodium quinoa* Willd.), Food Rev. Int. 19(1–2):167–177.

Gonzalez, J. A., Y. Konishi, M. Bruno, M. Valoy and F. E. Pradoc. (2012). Interrelationships among seed yield, total Protein and amino acid composition of ten quinoa (*Chenopodium quinoa*) cultivars from two different agroecological regions. J. Sci. Food. Agric. 92:1222–1229.

Gomaa,E.F. 2013. Effect of nitrogen, phosphorus and biofertilizers on quinoa plant, Journal of Applied Sciences Research, 9(8):5210-5222

Han, F., S. E. Ullrich, I. Romagosa, J. A. Clancy, J. A. Froseth and D. M. Wesenberg. (2003).Quantitative genetic analysis of acid detergent fibre content in barley grain. J. Cereal Sci. 38:167-172.

Ibrahim, M., M. Ayub, A. Tanveer and M. Yaseen. (2012). Forage quality of maize and legumes as monocultures and mixtures at different seed ratios. J. Anim. Plant. Sci. 22(4):987-992.

Kakabouki, I., D. Bilalis, A. Karkanis, G. Zervas, E. Tsiplakou and D. Hela. (2014). Effects of fertilization and tillage system on growth and crude protein content of quinoa (*Chenopodium quinoa* Willd.): An alternative forage crop. Emir. J. Food Agric. 2014. 26 (1): 18-24.

Kering, M. K., J. Guretzky, E. Funderburg and J. Mosali. (2011). Effect of nitrogen fertilizer rate and harvest season on forage yield, quality, and macro nutrient concentrations in Midland bermuda grass. Commun. Soil. Sci. Plant Anal. 42:1958-1971.

Khan, H.Z., S. Iqbal, N. Akbar, M.F. Saleem and A. Iqbal. (2013). Integrated management of different nitrogen sources for maize production. *Pak. J. Agri. Sci.,* 50: 55–61

Kuhn, M., S.Wagner, W.Aufhammer, J.H.Lee, E.Kübler and H.Schreiber. (1996). Einfluß von pflanzenbaulicher Maßnahmen auf die Mineralstoffgehalte von Amaranth, Buchweizen, Reismelde und Hafer. Dt Lebensm Rundschau, 92:147-152.

Mahmoud A.H., S. Sallam, (2017). Response of Quinoa (Chenopodium quinoa Willd) Plant to Nitrogen Fertilization and Irrigation by Saline Water Ale-andria science e-change journal, vol.38, no. 328 2april-june 2017.

Schooten, H. A. van; Pin-terhuis, J. B., (2003). Quinoa as an alternative forage crop in organic dairy farming. 12th Symposium of the European Grassland Federation, Pleven, Bulgaria, 26-28 May 2003 pp.445-448 ref.3

Shams, A.S. 2012. Response of quinoa to nitrogen fertilizer rates under sandy soil conditions, Proc. 13thInternational Conf. Agron., Fac.of Agric., Benha Univ., Egypt, 9-10 September 2012, p:195-205.

Schulte auf'm Erley G., Behrens T., Ulas A., Wiesler F., Horst W.J.(2011). Agronomic traits contributing to nitrogen efficiency of winter oilseed rape cultivars. Field Crops Research 124, 114-123

Simmonds,N.W. (1971). The breeding system of *Chenopodium quinoa*. I. Male Sterility, Heredity, 27:73-82.

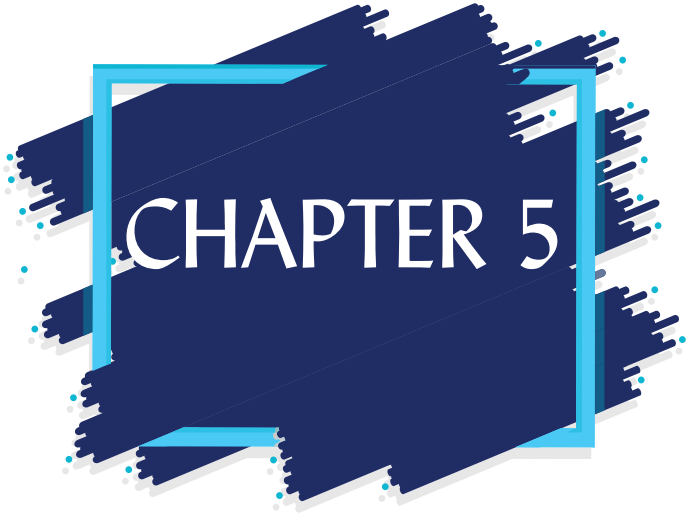
Tassone, S., G. Masoero and P.G. Peiretti. (2014). Vibrational spectroscopy to predict in vitro digestibility and the maturity inde- of different forage crops during the growing cycle and after freeze- or oven-drying treatment. Animal Feed Sci. Technol. 194: 12–25.

Thanapornpoonpong, S. Vearasilp, E. Pawelzik, and S. Gorinstein, (2008). Influence of various nitrogen applications on protein and amino acid profiles of amaranth and quinoa. *J. Agric. Food Chem.,* 56: 11464–11470

Yıldız N. and H. Bircan,(1991) "Practical statistics, (Uygulamalı İstatistik)" *Atatürk Universitesi Yay*, no. 704, pp. 308-60, 1991.

INNOVATIVE RESEARCH IN NEW TREND COMPOUND: ALLICIN FROM ALLIACEA FAMILY

Senay UGUR[1], Khazina AMIN[2], Zeliha SELAMOGLU[3]



1 Department of Plant Production and Technologies, Faculty of Agricultural Sciences and Technologies, Omer Halisdemir University, Campus, Nigde 51240 Turkey
2 Department of Plant Production and Technologies, Faculty of Agricultural Sciences and Technologies, Omer Halisdemir University, Campus, Nigde 51240 Turkey
3 Department of Medical Biology, Faculty of Medicine, Nigde Omer Halisdemir University, Campus, Nigde 51240 Turkey

INNOVATIVE RESEARCH IN NEW TREND COMPOUND: ALLICIN FROM ALLIACEA FAMILY

Senay UGUR[1], Khazina AMIN[2],

Zeliha SELAMOGLU[3]

1. INTRODUCTION

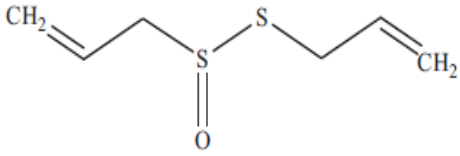
1.1. Alliacea family

The family of 13 genera 600 species of plants, "*Alliacea*", is widely distributed around the world including temperate, tropical and semiarid regions. Several species of this family have earned global fame due to their economic and medicinal value. The most cultivated members of this family include garlic (*Allium sativum L.*), onion (*Allium cepa*), shallot (*Allium ascalonicum*), leek (*Allium ampeloprasum*), wild garlic [*Allium ursinum*], scallion (*Allium fistulosum*), chive (*Allium schoenoprasum*), chinese chive (*Allium tubersoum*) and rakkyo (*Allium bakeri*). Besides of the kitchen use, these *Allium* vegetables have an immense range of effects due to their complicated chemistry.

1 Department of Plant Production and Technologies, Faculty of Agricultural Sciences and Technologies, Omer Halisdemir University, Campus, Nigde 51240 Turkey

2 Department of Plant Production and Technologies, Faculty of Agricultural Sciences and Technologies, Omer Halisdemir University, Campus, Nigde 51240 Turkey

3 Department of Medical Biology, Faculty of Medicine, Nigde Omer Halisdemir University, Campus, Nigde 51240 Turkey



Allium vegetables have been prized by every culture as foods, spices and traditional remedies. Throughout the ages, people worldwide - the Greeks, Chinese, Egyptians, Roman, Indians, Koreans, Vikings and Babylonians - have used these vegetables to improve well-being. The contemporary scientists have given credit to a distinct compound (allicin) which is accountable for health benefits of *Allium* members. Garlic is considered one of the twenty most important vegetables, has been used worldwide, either as a vegetable for kitchen purposes or as an ingredient for folk and modern medicines. Garlic is also an excellent source of allicin and more than 200 different compounds as well. It has been proposed as a rich source of total phenolic contents among the commonly used vegetables. It contains high levels of potassium, phosphorus, sulphur and zinc; adequate measures of vitamins A, C and selenium and minor amounts of calcium, magnesium, manganese, sodium, B-vitamins and iron. *Allium* vegetables are a good source of sulphur compounds (particularly allicin), flavonoids, antioxidants, essential oils, amino acids, fatty acids, carbohydrates and pectin. Allicin alone reacts with oxygen to yield more than 70 sulphur compounds [1].

1.2. Occurrence and structure of allicin

Have you ever pondered why unbroken garlic cloves or onion bulbs are quite unscented as compared to the diced ones? The answer is hidden in their complex chemistry!

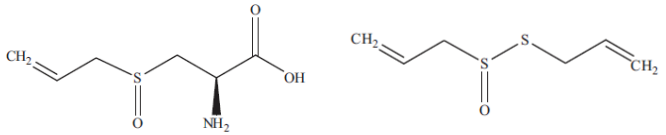
Intact garlic cloves hold a stable and unscented chemical named alliin having no biological activity. However, freshly crushed garlic cloves release an enzyme named alliinase, which quickly transforms the stable and unscented compound "alliin" to the pungent sulphur compound "allicin".

Allicin [$C_6H_{10}OS_2$] is a major biologically active compound of garlic that accounts for giving its characteristic aroma and taste. It is firstly reported by Chester J. Cavallito and John Hays Bailey back in 1944. It is well recognized for its broad-spectrum anti-microbial, anti-hypertension, anti-cancer, antioxidant, lipid reducing and anti-blood coagulation activities.

Allicin is a yellowish and oily liquid which is responsible for garlic's pungent odor and taste. It dissolves through heat and relatively more soluble in alcohol as compared to water. It has a very short half-life [the time required for one-half of a given measure of the compound to deteriorate is called half-life]. The chemical structure of allicin is chiral but naturally it is found in racemate form (the dissymmetric molecular structures of a compound that are mirror images of one another). It harbors the thiosulfinate functional group R-S[O]-S-R. The racemic form of allicin can be produced by oxidation of diallyl disulfide.

$$[SCH_2CH=CH_2]_2 + RCO_3H \rightarrow CH_2=CHCH_2S[O]$$
$$SCH_2CH=CH_2 + RCO_2H$$

Allicin, due to its volatile nature, is a part of the defense mechanism against various pests and pathogens on garlic plants. This organosulfur compound is formed by the action of alliinase enzyme on alliin when tissue damage occurs [2]. Stereochemical structures of the bioactive constituents of garlic (alliin and allicin) are given in Figure 1.



Alliin **Allicin**

Figure 1. *Stereochemical structures of Alliin and Allicin [2].*

2. BIOSYNTHESIS OF ALLICIN

Allicin (thio-2-propene-1-sulfinic acid S-allyl ester]) is synthesized and released upon tissue disruption, producing a potent characteristic scent and taste in garlic. In the biosynthesis process, cysteine is firstly converted into alliin [+S-allyl-L-cysteine-sulfoxide] followed by the action of an enzyme alliinase which breaks down alliin into allyl sulfenic acid, pyruvic acid, and ammonium. Under the influence of alliinase enzyme, alliin is enzymatically transformed into allicin. Alliin and alliinase enzyme both are present in different parts of the garlic cloves. This is the main reason of initiating the chain reaction only after cells damage or crushing the garlic cells. The alliin complex with alliinase enzyme is formed in the presence of water. The alliin-alliinase complex is highly unstable further exposed to dehydration by pyridoxal phosphate and produces allyl sulfenic acid, pyruvic acid and ammonia as shown in figure 2 and 3 [3].

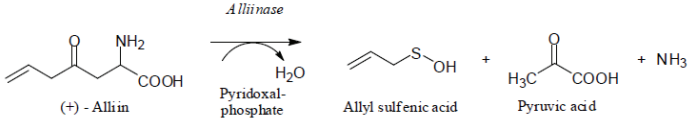


Figure 2. *Enzymatic transformation of alliin to allyl sulfenic acid*

Allyl sulfenic acid is highly unstable at ambient temperature. Due to its high reactivity, two molecules of allyl sulfenic acid spontaneously combine to form allicin with

lose of water molecule. In this way, the condensation of allylsulfenic acid molecules occurs to form allicin (Figure 3).

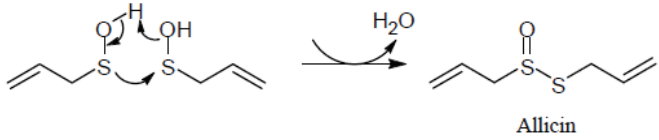


Figure 3. *Biosynthesis of allicin from allylsulfenic acid*

At ambient temperature, the whole enzymatic transformation process takes place in 10-15 minutes. The catalytic activity of alliinase enzyme is optimum at pH 6.5 and temperature 33°C. The alliinase enzyme is highly sensitive to acids for its proper activity. The activation energy of allicin decomposition is recorded as 14.7 kJ/mol.

High volatility and instability render the process of isolation, purification and standardization of allicin based products. In recent decades, there is a considerable interest in the synthesis of commercial grade allicin. Commercially, it is being produced by the oxidation of allyl disulfide with hydrogen peroxide in an acidic medium or the treatment of dichloromethane solution of allyl disulfide with magnesium monoperoxyhydrate in ammonium-butyl-sulfate or the oxidation of allyl disulfide with m-chloroperbenzoic acid in chloroform. All these procedures are taken place at low temperature (from zero degree to room temperature) depending upon their purification method and protocols used [3, 4].

3. ACTION MECHANISM OF ALLICIN

Allicin is well recognized for its wide-ranging anti-bacterial, anti-fungal, anti-parasitic, anti-viral, anti-inflammation, anti-hypertension, anti-cancer, antioxidant, lipid reducing and anti-blood coagulation activities. These wide-spectrum activities of allicin are due to the multiple inhibitory effects

and the majority of activities are considered to be mediated through redox-dependent mechanisms.

The antioxidant and antibiotic activities of allicin are due to its ability to trap free radicles and inhibiting the certain thiol-containing enzymes shown in Figure 4. Allicin shows the high permeability through phospholipid bilayers to interact with the SH groups. The rapid reaction of thiosulfinates with thiol groups present in the microbial enzymes blocks their activity. The reaction of allicin with the thiol compounds (L-cysteine) to form the S-thiolation product (S-allylmercaptocysteine) adversely affects the growth of microorganisms. Allicin is also involved to inhibit the thiol-protease papain, the NADP+-dependent alcohol dehydrogenase reaction in *Thermoanaerobium brockii* (an anaerobic, thermophilic, spore-forming bacteria). These inhibition effects of allicin are irreversible.

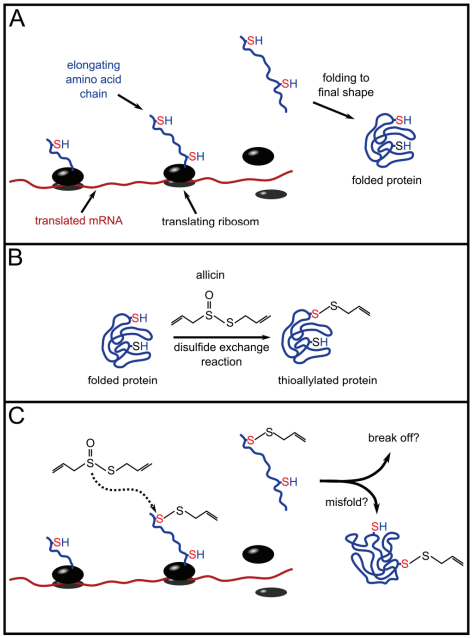


Figure 4. An inhibitory influence of allicin on proteins and protein synthesis: [A] the process of protein synthesis is shown in the absence of any stress. After proper translation, the resultant protein is folded into its final structure. [B] The cysteine residue, available for attack, [displayed in red color] reacts with allicin through disulfide exchange reaction. The cysteine residue that is sterically blocked [displayed in blue color] does not react with allicin. [C] Cysteine residue that is normally blocked for reaction with allicin [as compare to B] is now potential target resulting into an absence of translation or misfolded non-functional proteins [5].

Allicin also targets other bacterial enzymes including the acetyl-CoA forming system [which consists of phosphotransacetyl-CoA synthetase and acetate kinase]. The inhibition of acetyl-CoA forming system is noncovalent and can be reversible. Moreover, the bacteriostatic concentrations of allicin (0.2 - 0.5 mM) partially inhibit bacterial growth by blocking the RNA and protein synthesis. Allicin targets and blocks the alpha-subunit of RNA polymerase which contains a sulfhydryl group to react with the monomercuric derivative of fluorescein that is a specific reagent for thiol groups. This implies that RNA polymerase may be an initial target for allicin.

Allicin at higher concentrations has been documented to be lethal for a variety of microbial pathogens but have not seen any detrimental effect on tissue cultured mammalian cells. The substantial difference in sensitivity level between the microbial and mammalian cells to allicin exposure is due to many folds higher concentration of glutathione in the mammalian cells as compared to microbial cells. However, very high concentrations of allicin [>100 μg/mL] may also prove toxic for mammalian cells.

In the anti-parasitic activity, especially in amoeba, allicin has been found to inhibit the mechanisms of cysteine proteinases, thioredoxin reductases, as well as, alcohol dehydrogenases which are crucial for maintaining the appropriate redox phase within the parasites. Inhibition of the parasitic enzymes has been found at even lower concentrations of pure allicin.

The condensation product of allicin, called ajoene, has a related oxygenated sulfur group that shows anti-parasitic activity as well. It inhibits the propagation of *Trypanosoma cruzi* [a protozoan parasite] by hindering the process of phosphatidylcholine biosynthesis. Ajoene also blocks the phosphatidylcholine biosynthesis in *Paracoccidioides brasiliensis* [a human pathogenic fungus]. The inhibition potential of ajoene undoubtedly suggests that many other pathogenic specific enzymes may also be targets of allicin.

All the above descriptions on various biological activities of allicin have impelled this exceptional molecule into becoming a principal candidate for therapeutical applications [5, 6, 7].

4. BIOLOGICAL ACTIVITIES

Many plant and fungus species are pharmacologically important natural sources due to secondary metabolites [8, 9, 10]. Allicin is pharmacologically a significant and the most functional compound of garlic. It is well recognized for the clinical applications due to its broad-spectrum anti-microbial, anti-hypertension, anti-cancer, antioxidant, lipid reducing and anti-blood coagulation activities. The unique structure of allicin is designed for its defense mechanism against the soil microbes. When pathogens attack the garlic cloves, the cell membranes are ruptured and all the alliin present is transformed into allicin within few seconds. Researchers have explored the secret powers of allicin by

analyzing its molecular composition and have concluded that allicin defends garlic against certain pests and microbes by hindering enzymes which cause damage. A wide range of allicin's activities is discussed below in detail:

4.1. Antioxidant activity

The antioxidant property of allicin depends upon the reaction of thiol-possessing enzymes. The health promoting activities of allicin is also contributed by its superlative antioxidant potential as it can inhibit the production of "Reactive Oxygen Species (ROS)" and other oxygen radicals [11]. It has been well known that ROS are unstable molecules where they trigger oxidative stress and damage tissues [12]. both in plant and human. As an antioxidant, allicin helps to protect our body from damage caused by harmful free radicals. This property of allicin plays an important role in avoiding a broad range of common diseases, such as, cancer, cardiovascular disorders, inflammatory and neurodegenerative problems including Alzheimer's disease or dementia [11, 12].

4.2. Anti-bacterial activity

Garlic, the potent source of allicin, has been recognized to prevent the progression of gram-positive and gram-negative, as well as toxins production in the body system. Allicin can penetrate into bacterial cell wall and can prevent the release of many enzymes that produce toxins in the body that trigger to certain diseases. It can kill a variety of bacteria in an effective way include *Pseudomonas*, *Escherichia coli, Staphylococcus aureus, Streptococcus mutans*, *Streptococcus pneumonia, Streptococcus sobrinus*, *Proteus*, *Klebsiella*, *Salmonella*, *Bacillus subtilis*, *Porphyromonas gingivalis*, *Prevotella intermedia, Micrococcus, Clostridium and Mycobacterium (Figure5)*. Some of which have shown resistance to many antibiotics

like penicillin, streptomycin, cephalexin, vancomycin, and doxycilline.

The antibacterial activity of allicin is due to its great chemistry. The presence of oxygen in the structure of allicin –S[=O]–S– releases the S-allyl moiety, which seems to be an aggressive tool against bacteria.

A very interesting feature of the antibacterial activity of allicin is that most of the bacterial species are not able to acquire resistance against it. The working mechanism of allicin is completely different from commonly used antibiotics. According to a research studies, the development of resistance against beta-lactam antibiotics is 1000-fold easier as compared to the development of resistance against pure allicin [13].

Use of garlic extracts or allicin's supplements also inhibit intestinal microflora and it is an effective remedy against potentially toxic enterobacteria which cause skin and soft-tissue infections, lower respiratory tract infections (such as Tuberculosis), urinary tract infections, endocarditis and abdominal infections. Researchers have also found allicin to prevent and treat dental caries and adult periodontitis caused by bacteria [5, 6, 7, 14, 15].

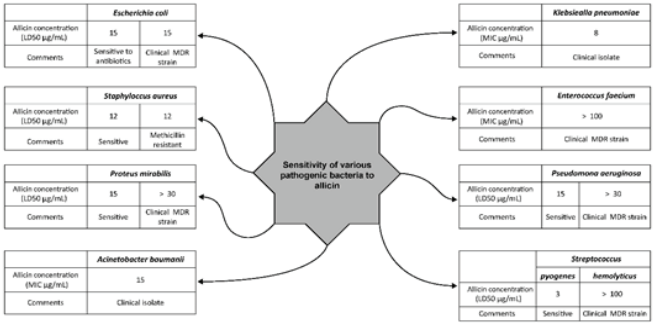


Figure 5. *Sensitivity of various pathogenic bacteria to allicin.*

4.3. Anti-fungal activity

As in antibacterial activity, the main functional anti-fungal compound from garlic extract is allicin and other derivatives. In vitro and in vivostudies have revealed a great efficacy of allicin against a wide range of yeasts and fungi,including Aspergillus,Candida, Torulopsis, Trichophyton Rhodotorula, Cryptococcus and Trichosporon (Figure 6). Allicin has also shown a synergistic activity with amphotericin B in vitro which is also known as one of the key antifungal drug. Garlic extracts are also super effective against the dermatophytic fungi.

The sensitivity of various pathogenic fungi to pure allicin has been found to be very significant. Allicin prevents the germination of fungal spores and growth of hyphae, destroys the fungal cells by hindering the synthesis of the fungal cell wall, reducing the oxygen uptake, decreasing the cellular progression, inhibiting the biosynthesis of nucleic acids and proteins and altering the lipid profile of the fungal cell membrane [5,7,11].

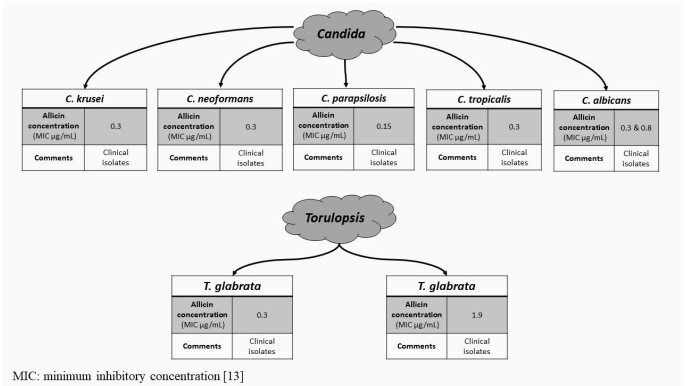


Figure 6. *Effect of allicin on various fungal strains.*

4.4. Anti-parasitic activity

Considering the activity that garlic, onion and their active compounds exert on parasitic protozoa, many studies have been published. The studies have proved the efficiency of garlic and onion extracts against Opalina dimidicita, Opalina ranarum, Balantidium entozoon, Crithidia, Entamoeba histolytica, Giardia lamblia, Giardia intestinalis, Leishmania, Leptomonas and Tripanosoma brucei (Table 1).

Due to the prevalence of nasty side effects and resistance to the synthetic pharmaceuticals to cure parasitic diseases, such as giardiasis (an infectious disease of small intestine caused by Giardia lamblia parasites), there has been a rising concern to find natural alternatives. In China, DATS (an allicin product, more stable than the highly volatile allicin) is commercially available as a medicine, named "Dasuansu". It is recommended for treating giardiasis and diseases caused by E. histolytica and Trichomonas vaginalis. The organo-sulphur compounds from garlic (allicin and ajoene) are also effective against protozoal parasites. Antiparasitic properties of onion extract towards different strains of Leishmania and T. vaginalis have also been published.

Allicin at higher concentrations has been documented to be lethal for a variety of parasitic pathogens but have not seen any detrimental effect on tissue cultured mammalian cells. The substantial difference in sensitivity level between the bacterial and mammalian cells to allicin exposure is due to many folds higher concentration of glutathione in the mammalian cells as compared to bacterial cells. This fact clearly suggests the affinity of pure allicin towards the parasites and to use it safely for medical purposes [11, 13, 16].

Table 1. *Effect of allicin on various parasitic pathogens [13].*

Parasitic strain	**Allicin concentration [µg/mL]**	**Comments**
Entamoeba histolytica	5	Inhibition of 90% virulence
Entamoeba histolytica	30	total growth inhibition
Giardia lamblia	30	Very sensitive
Leishmania major	30	Very sensitive
Leptomonas colosoma	30	Very sensitive
Crithidia fasciculate	30	Very sensitive

4.5. Ant-viral activity

The anti-viral properties of several commercial garlic preparations and products, including powder tablets and capsules, garlic oils, fermented garlic oil and garlic aged in aqueous alcohol is used to sooth infections and diseases caused by viruses, such as, coxsackievirus species, influenza A and B viruses, herpes simplex viruses, human cytomegalovirus, rhinovirus, human immunodeficiency virus (HIV), viral pneumonia, vesicular stomatitis virus, rotavirus vaccinia virus and human rhinovirus type 2. The allicin condensation product, well-known as ajoene, appears to have more anti-viral activity than allicin. Ajoene blocks the integrin-dependent signaling processes in a human immunodeficiency virus (HIV) infected cell system. Antiviral potential of these garlic compounds is related to their synthesis, high levels of allicin and the presence of other thiosulfinates, mainly diallyl disulfide (DADS), and diallyl trisulfide (DATS) and ajoene [11, 12].

4.6. *Cytotoxic activity*

The main organosulfur compounds (including allicin) in garlic exhibit strong potential of stimulating the immune system and safeguard the body from tumor. Several research studies both *in vitro* and in laboratory animals have demonstrated the cytotoxicity activity of allicin in an effective way. Results have demonstrated that garlic plays a vital role in the reduction of death caused by malignant diseases such as skin cancer, brain tumor, breast cancer etc.

Allicin has also proved its activity to enhance the cell-mediated cytotoxicity in the peripheral mononuclear cells in human body. It is suggested that the immune stimulatory and anti-tumor properties of allicin are mediated by redox-sensitive signaling mechanisms. According to a recent study, the active constituents of garlic extracts stimulate ROS-dependent cytotoxicity on the cell line squamous carcinoma (SCC-15) and help to prevent an uncontrolled growth of abnormal squamous cells [17, 18, 19].

5. MEDICINAL VALUE OF ALLICIN

Allicin is an efficient natural antibiotic that destroys certain pathogens. The antibacterial potential of allicin was studied in detail in 1999 when methicillin-resistant *Staphylococcus aureus* was spreading quickly across hospitals and certain communities. Since then, this powerful compound has been acknowledged as one of the most efficient natural cure to cope with various infections and relative illnesses.

Likewise an effective antibiotic, allicin has other health benefits including antioxidant, anti-inflammatory, immunity booster, blood thinner, reducing high blood pressure, anti-acne, healing wounds, treating yeast infections, common cold and anti-cancer [4, 7, 17]. Allicin contains

high levels of anti-oxidants. It scavenges free radicals and harmful toxins from the body.

- Its quick anti-inflammatory and anti-allergic responses stop the infection in its tracks.

- It stimulates the production of white blood cells, restores suppressed antibody responses, and enables the immune system to kill detrimental bacteria and other pathogens.

- Due to its aspirin-like activity, it keeps the blood thin and helps the body to avoid blood clots. In this way, allicin contributes to eliminate the risk of heart-related disorders such as cardiovascular attacks, atherosclerosis and stroke. It brings down the oxidative stress and low-density lipoprotein (LDL) oxidation and has anti-thrombotic effects.

- Allicin is also helpful to improve and maintain the overall health of lower respiratory tract and soft-tissue organs by lowering the risks of infections.

- Allicin helps to control the alleviated blood pressure. It assists in smooth muscle relaxation by stimulating the production of endothelial-derived relaxation factor and widens the blood vessels.

- Allicin is believed to have anti-acne properties due to its anti-inflammatory and anti-bacterial effects. By applying allicin powder or paste directly on the acne outbreaks reduces swelling and redness in the affected area and ultimately dries the zits quickly.

- Allicin has been proved helpful in healing wounds (internal and external both) which lead to infection and inflammation. Allicin powder is highly effective in soothing wounds of animal bites and killing

bacteria that are responsible for infections of the bladder and urinary tract characterized by a burning sensation through urination, cramps and sometimes fever in severe conditions.

- Allicin cream or powder with any proper substrate (yogurt or *Aloe Vera*) is an effective remedy against yeast infection of the vagina accompanied by intense itching and skin lesions.

- Use of garlic extract in cold and flu can alleviate symptoms due to antiviral activity.

- Allicin is considered a potential remedy to treat various forms of cancer. Modern studies show a comparatively low cancer rate in people who eat garlic regularly. Garlic has revealed a good potential in both the prevention and healing of cancer.

From immune boost up to cancer prevention, there is a myriad of health benefits offered by allicin. In addition, garlic/allicin has potential to care the overall human health, lowering the risk of various ailments.

6. POTENTIAL SIDE EFFECTS OF ALLICIN

Despite the numerous beneficial effects of allicin, there are some exceptional cases too. The benefits of allicin do not come without likely un-favorable effects. Long term use of allicin in any form may have some nasty side effects which include bad breath, body odor, body rashes, allergic reactions and drug interactions.

Allicin, a sulfur-based medicinal compound coats the oral tissues [teeth, saliva and gums] which lead to an unpleasant breath. The notorious odor of allicin can diffuse through sweat glands, resulting in a foul body odor. Peo-

ple sensitive to garlic may tend to have an allergic effect of allicin supplements. This may include wheezing, vomiting, nausea, rashes and diarrhea. Allicin can adversely interact with some drugs like saquinavir (a drug for HIV and AIDS) and warfarin (blood-thinners). If a person has an existing digestive problem, taking raw garlic or allicin supplements may disturb the gastrointestinal tract. Allicin supplements should be avoided in case of diabetes and blood clotting disorder. It should also be avoided when anti-coagulants and HIV medications are in use. Pregnant women and nursing mothers are recommended not to use allicin to avoid allergic reactions and health issues [20, 21].

CONCLUSION

Allicin is a fascinating biologically active compound which has exhibited great promise in both the inhibition and treatment of several human ailments. This mothernature's defender can boost up the immune system, lower cholesterol and blood pressure level, fend off bacterial, viral and fungal infections, kill a wide range of parasites and even restrain mosquitoes from attacking–yes all of these benefits from a compound that comes from fresh garlic.

REFERENCES

[1] Heywood, V.H. Brummitt, R.K., Culham, A., Seberg, O. Alliaceae. In: Flowering Plant Families of the World. New York, Firefly Books. 2007, Pp. 340-341.

[2] Martins, N.; Petropoulos, S.; Ferreira, C.F.R. Chemical composition and bioactive compounds of garlic (*Allium sativum* L.) as affected by pre- and post-harvest conditions: A review. Food Chemistry. 2016, 211: 41-50.

[3] Nikolic, V.; Stankovic, M.; Nikolic, Lj.; Cvetkovic, D. Mechanism and kinetics of synthesis of allicin. Pharmazie. 2004, 59(1): 10-4.

[4] Ilic, D.P.; Nikolic, V.D.; Nikolic, L.B.; Stankovic, M.Z.; Stanojevic, L.P.; Cakic, M.D. Allicin and related compounds: Biosynthesis, synthesis and pharmacological activity. Facta Universitatis. 2011,9(1): 9-20.

[5] Borlinghaus, J.; Albrecht, F.; Gruhlke, M.C.; Nwachukwu, I.D.; Slusarenko, A.J. Allicin: Chemistry and biological properties. Molecules. 2014, 19 (8): 12591-618.

[6] Fujisawa, H.; Watanabe, K.; Suma, K.; Orıguchi, K.; Matsufuji, H.; Seki, T.; Arıga, T. Antibacterial potential of garlic-derived allicin and its cancellation by sulfhydryl compounds. Bioscience, Biotechnology, and Biochemistry. 2009, 73 (1): 1948-1955.

[7] Marchese, A.; Barbieri, R.; Sanches-Silva, A.; Daglia, M.; Nabavi, S.F.; Jafari, N.J.; Morteza, I.; Marjan, A.; Nabavi, S.M. Antifungal and antibacterial activities of allicin: A review. Trends in Food Science and Technology. 2016, 52: 49.

[8] Akgul, H.; Sevindik, M.; Coban, C., Alli, H.; Selamoglu, Z. New approaches in traditional and complementary alternative medicine practices: *Auricularia auricula* and *Trametes versicolor*. J Tradit Med Clin Natur. 2017, 6(2): 239.

[9] Sevindik, M.; Akgul, H.; Pehlivan, M.; Selamoglu, Z. Determination of therapeutic potential of *Mentha longifolia*

ssp. *longifolia*. Fresen Environ Bull. 2017, 26: 4757-4763.

[10] Sevindik, M.; Akgul, H.; Bal, C.; Selamoglu, Z. Phenolic Contents, Oxidant/Antioxidant Potential and Heavy Metal Levels in *Cyclocybe cylindracea*. Indian Journal of Pharmaceutical Education and Research. 2018, 52(3): 437-441.

[11] Rahman, M. S. (2007). Allicin and other functional active components in garlic: Healthbenefitsand bioavailability. International Journal of Food Properties, 10, 245–268.

[12] Kelsey, N. A., Wilkins, H. M., & Linseman, D. A. (2010). Nutraceutical antioxidants asnovel neuroprotective agents.Molecules,15, 7792–7814.

[13] Corzo-Martinez, M.; Corzo, N.; Villamiel, M. Biological properties of onions and garlic. Trends in Food Science & Technology. 2007, 18 (12): 609-625.

[14] Snoussi, M.; Trabelsib, N.; Dehmenia, A.; Benzekric, R.; Bouslamac, L.; Hajlaouia, B.; Al-sienid, A.; Papetti, A. Phytochemical analysis, antimicrobial and antioxidant activities of *Allium roseum* var. *odoratissimum* (Desf.) Coss extracts. Industrial Crops and Products. 2016, 89 (1): 533–542.

[15] Ankri, S.; Mirelman, D. Antimicrobial properties of allicin from garlic. Microbes and Infection. 1999, 2 (1): 125−129.

[16] Wallock-Richards, D.; Doherty, C.J.; Doherty, L.; Clarke, D.J.; Place, M.; Govan, R.W.; Campopiano, D.J. Garlic Revisited: Antimicrobial activity of allicin containing garlic extracts against *Burkholderia cepacia* complex. Plos One. 2014, 9[12]: e112726. doi:10.1371/journal.pone.0112726.

[17] Reiter, J.; Levina, N.; van der Linden, M.; Gruhlke, M.; Christian, M.; Alan, J. Slusarenko. Diallylthiosulfinate [Allicin], a volatile antimicrobial from Garlic (*Allium sativum*), kills human lung pathogenic bacteria, including MDR strains, as a vapor. Molecules. 2017, 22(10): 1711.

[18] Saleheen, D.; Ali, S.A.; Yasinzai, M.M. **Antileishmanial activity of aqueous onion extract** *in vitro.* Fitoterapia. 2004, 75(1):9-13.

[19] Thomson, M.; Ali, M. Garlic (*Allium sativum*): a review of its potential use as an anti-cancer agent. Curr Cancer Drug targets. 2003, 3 (1): 67-81.

[20] Lanzotti, V.; Scala, F.; Bonanomi, G. Compounds from *Allium* species with cytotoxic and antimicrobial activity. Phytochem. Rev. 2014, 13 (1): 769-791.

[21] Szychowski, K.A.; Binduga, U.E.; Rybczyńska-Tkaczyk, K.; Leja, M.L.; Gmiński, J. Cytotoxic effects of two extracts from garlic (*Allium sativum* L.) cultivars on the human squamous carcinoma cell line SCC-15. Saudi J Biol Sci. 2016. DOI: 10.1016/j.sjbs.2016.10.005.

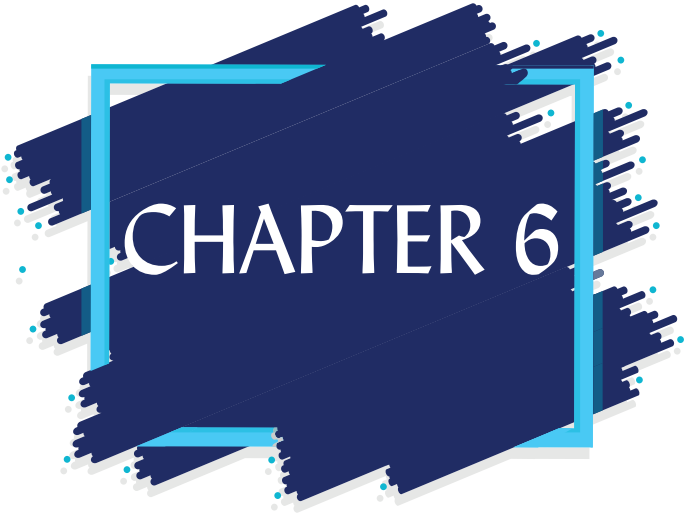
[22] Amagase, H.; Petesch, B. L.; Matsuura, H.; Kasuga, S.; Itakura, Y. Intake of garlic and its bioactive components. *The Journal of Nutrition*. 2001, 131 (3): 955S–962S.

[23] Tattelman, E. **Health effects of garlic.** American Family Physician. 2005, 72(1): 103-106.

DETERMINATION OF PODS PROPERTIES AND YIELD QUANTITY OF PEA VARIETIES AND LINES (*Pisum Sativum* L.)

Ümit GİRGEL[1] , Alihan ÇOKKIZGIN[2]

Volkan GÜL[3], Betül GIDIK[4], Görkem ÇETİN[5]



1 Bayburt University, Aydintepe Vocational School, Bayburt/Turkey, umitgirgel@bayburt.edu.tr

2 Gaziantep University, Nurdagi Vocational School, Gaziantep/Turkey, acokkizgin@gantep.edu.tr

3 Bayburt University, Applied Sciences Faculty, Bayburt/Turkey, volkangul@bayburt.edu.tr

4 Bayburt University, Applied Sciences Faculty, Bayburt/Turkey, betulgidik@bayburt.edu.tr

5 Bayburt University, Applied Sciences Faculty, Bayburt/Turkey gorkem.cetin@tarimorman.gov.tr

DETERMINATION OF PODS PROPERTIES AND YIELD QUANTITY OF PEA VARIETIES AND LINES (*Pisum Sativum* L.)

Ümit GİRGEL[1] , Alihan ÇOKKIZGIN[2]

Volkan GÜL[3], Betül GIDIK[4], Görkem ÇETİN[5]

INTRODUCTION

Pea (*Pisum sativum* L.) is one of the world's oldest domesticated crops (Smýkal *et al.*, 2013). It was cultivated in the Near East as early as 7000 to 6000 BC (Zohary & Hopf, 1973). It's origin the near East, the Mediterranean Central Asia and Abyssinia (Vavilov 1926). Moreover, pea is one of the most important food legumes in the world not only for its very old history of domestication, but also for its all-purpose use as vegetables, pulses and feed (Choudhury *et al.*, 2006).

Pea is the 2th most important legume crop after bean. In the world, field pea cultivation was carried out in 8.1 million hectares of land and it had 16.2 million tons of production and 1990.6 kg/ha yield. On the other hand field pea cultivation areas in Turkey, 942 hectares and pea had a production value of 2673 tons and yield 2837.6 kg/ha in Turkey (FAO, 2017).

1 Bayburt University, Aydintepe Vocational School, Bayburt/Turkey, umitgirgel@bayburt.edu.tr

2 Gaziantep University, Nurdagi Vocational School, Gaziantep/Turkey, acokkizgin@gantep.edu.tr

3 Bayburt University, Applied Sciences Faculty, Bayburt/Turkey, volkangul@bayburt.edu.tr

4 Bayburt University, Applied Sciences Faculty, Bayburt/Turkey, betulgidik@bayburt.edu.tr

5 Bayburt University, Applied Sciences Faculty, Bayburt/Turkey gorkem.cetin@tarimorman.gov.tr

Peas are a plant belonging to the family leguminosae, that contains 630 genera and over 18000 species (Judd *et al.* 2008). Peas are included *Pisum* genus in this family. And the somatic chromosome number is 2n = 14 (Lamprecht 1974). Pea has its prominent place in plant biology and genetics, owing to work of J.G. Mendel (1866).

The pea generally is considered to be self-pollinated (White, 1917). Reported percentages of cross-pollination in the commercial cultivars are less than 1% (Gritton, 1980). There are two wild populations in terms of phyllogenetically, variously described as subspecies of *P. sativum* or as species, *P. sativum* subsp. *elatius* Bieb. and *P. sativum* subsp. *sativum* (Warkentin, *et al.* 2015).

The aim of this study is to determine the wild pea genotypes, field pea cultivars and lines that were hybridized and achieved in past years wild and cultured pea cultivars by the investigators. Another aim is to provide a gene source for future breeding studies.

Materials and Methods

This study; in order to determine the yield and pod characteristics of the wild pea genotypes, field pea cultivars and lines that were hybridized and achieved in past years wild and cultured pea cultivars by the investigators were conducted in the province of Bayburt in the 2016 and 2018 years. The research area was the experimental area of Aydıntepe Vocational School (40°24’05.7”N 40°08’31.3”E) and it was carried out with three replications according to the randomized complete block design. In the study, Bolero, Jof, Karina, Nihal, Reyna, Utrillo commercial cultivars with *Pisum sativum* L. ssp.*elatius*, *Pisum sativum* L. ssp. *sativum* subspecies and 3 pea lines obtained by crossing were used.

In the study, each parcel was 5 row, the distance between the row is 50 cm and the parcel length is 5 m and the total parcel area was 12.5 m^2. There is a transition climate between the Eastern Black Sea climate and the Eastern Anatolian climate in the Bayburt province, Aydıntepe district (40°24'05.7"N 40°08'31.3"E).

According to the average of many years (1960-2017) in the province of Bayburt; The average annual rainfall is 440.6 mm, the average annual temperature is 7.1 °C (Anonymous, 2018).

In the research first pod height, pod lenght, pod width, seed number per pod, pod number per plant and seed yield properties were investigated.

The data obtained from study were analyzed according to one factor randomized complete block design (RCBD) using the SAS (Statistical Analysis System software v.9) package program (SAS, 2004). Duncan's multiple range test (DMRT) was used to compare the means (Duncan, 1955).

Results and Discussion

According to the results obtained from the study, the differences between genotypes were found to be statistically significant for all parameters examined.

The difference between the years was statistically significant in terms of all parameters except the pod width.

The interactions of YearxGenotype were statistically significant for the first pod height, pod length and seed number per pod (Table 1).

Table 1. ***Summary of Variance Analysis***

Source	DF	Mean Square					
		First pod height	Pod length	Pod width	Seed number per pod	Pod number per plant	Seed yield
Replication	4	33.840	0.580	0.021	0.543	30.826	65.375
Year	1	134.620**	7.898**	0.085	4.909**	520.244**	3940.909**
Genotype	10	337.792**	6.131**	0.459**	2.003**	138.308**	2679.900**
YearxGenotype	10	237.695**	6.439**	0.090	1.672**	27.550	120.409
Error	40	18.188	0.325	0.039	0.358	17.340	147.975
CV (%)		14.533	9.203	14.204	9.282	32.878	14.835

**p<0.01 and *p<0.05

First Pod Height (cm)

The highest values in terms of plant height was obtained from in 2016 year, line 3 (46 cm) and in 2018 year, line 1 (43.33 cm) (Table 2). After two years the mean values were evaluated and Karina cv. (36.3 cm) and the Line 1 (36.17 cm) determined as the highest pod height. On the other hand lowest values obtained from *Pisum sativum L. ssp.elatius* wild pea.

Although the first pod height is affected by environmental factors, it is managed by genetic factors. These results are in line with the findings of Kang *et al.* (2017).

Table 2. ***Means of first pod height (cm), of pea genotypes***

Genotype	2016	2018	Mean
Bolero	25.00 cd	28.20 de	26.60 C
Jof	29.27 bc	34.73 bcd	32.00 ABC
Karina	35.33 b	37.27 abc	36.30 A
Nihal	27.00 cd	34.27 bcd	30.63 BC
Reyna	29.07 bc	30.47 cde	29.77 BC
Utrillo	27.13 cd	28.47 de	27.80 BC
Pisum sativum L. ssp.elatius	2.87 e	14.38 g	8.60 D
Pisum sativum L. ssp. sativum	20.80 d	42.07 ab	31.43 ABC
Line 1	29.00 bc	43.33 a	36.17 A
Line 2	35.67 b	25.33 ef	30.50 BC
Line 3	46.00 a	20.00 fg	33.00 AB
Mean	27.92 B	30.77 A	29.35

Means followed by the same letter within columns are not statistically significant different

Pod Lenght (cm)

According to the 2016 year values, Nihal, Reyna, Utrillo standard varieties had the highest values in the same statistical group (8.632, 8.989, 8.777 cm respectively) (Table 3). In 2018 year, the number 3 line (7.79 cm) was determined as cultivar had the longest pod. In terms of two-year averages, Utrillo genotype (7.845 cm) had the longest pod.

The two-year average in terms of the shortest pod gained from the wild genotype *Pisum sativum* L. ssp.*elatius* (4.148 cm). It is reported that the length of the pods varies according to the cultivars and lines (Ashraf et al., 2011, Amjad & Anjum, 2002, Khichi et al. 2017). On the other hand, similar results reported by Demirci & Unver (2005).

Table 3. *Means of pod lenght (cm), of pea genotypes*

Genotype	2016	2018	Mean
Bolero	7.199 b	5.433 cde	6.316 CD
Jof	7.045 b	5.280 de	6.162 CD
Karina	6.226 c	5.487 cde	5.856 D
Nihal	8.632 a	4.967 de	6.799 BC
Reyna	8.989 a	5.900 bcd	7.445 AB
Utrillo	8.777 a	6.913 ab	7.845 A
Pisum sativum L. ssp.elatius	3.957 f	4.340 e	4.148 F
Pisum sativum L. ssp. sativum	5.693 dc	4.540 e	5.116 E
Line 1	5.273 de	6.620 abc	5.947 D
Line 2	5.227 de	7.017 ab	6.122 CD
Line 3	4.880 e	7.790 a	6.335 CD
Mean	6.536 A	5.844 B	6.190

Means followed by the same letter within columns are not statistically significant different

Pod Width (cm)

In 2016, genotypes that the widest pod were Nihal, Reyna, Utrillo (1.976, 1.774, 1.767 cm respectively) and in 2018, utrillo was the cultivar (1.847 cm) (Table 4). In terms of the average of two years, Nihal, Reyna, Utrillo (1.871, 1.720, 1.807 cm) cultivars had the highest values.

The lowest values were observed from wild genotypes in the first year, second year from line 1 (1.147 cm), and in the two year average, *Pisum sativum* L. ssp.*elatius* wild subspecies (1.051 cm).

Depending on plant genetics pod width values are different according to the cultivar or line. Similar results were obtained in other studies (Peksen *et al.* 2004).

Table 4. *Means of pod width (cm), of pea genotypes*

Genotype	2016	2018	Mean
Bolero	1.260 bc	1.457 abcd	1.358 B
Jof	1.211 bc	1.620 abcd	1.415 B
Karina	1.074 cd	1.313 bcd	1.194 BC
Nihal	1.976 a	1.767 ab	1.871 A
Reyna	1.774 a	1.667 abc	1.720 A
Utrillo	1.767 a	1.847 a	1.807 A
Pisum sativum L. ssp.elatius	0.929 d	1.173 cd	1.051 C
Pisum sativum L. ssp. sativum	0.945 d	1.367 abcd	1.156 BC
Line 1	1.400 b	1.147 d	1.273 BC
Line 2	1.353 b	1.210 cd	1.258 BC
Line 3	1.307 b	1.220 cd	1.287 BC
Mean	1.363	1.435	1.399

Means followed by the same letter within columns are not statistically significant different

Seed Number Per Pod (number/pod)

In 2016, Bolero, Karina and Reyna varieties had the highest seed number per pod (7.80 number/pod) on the

other hand in 2018, cv. Bolero (7.33 number/pod) had the highest seed number per pod value (Table 5). And in terms of two-year average, cv. Bolero (7.57 number/pod) had the highest seed number per pod.

The lowest values were gained from Line 3 (5.33 number/pod) for first year, from Nihal for the second year (5.20 number/pod) and from Line 3 (5.63 number/pod) for two-year average. The seed number per pod values have emerged as a result of the interaction between the genetic structure and the environmental conditions, and similar opinions are suggested by some researchers (Amjad & Anjum, 2002 Bozoglu *et al.*, 2007, Ojwang *et al.*, 2016, Lakić *et al.*, 2019).

Table 5. *Means of seed number per pod (number/pod), of pea genotypes*

Genotype	2016	2018	Mean
Bolero	7.80 a	7.33 a	7.57 A
Jof	6.73 bc	6.27 abc	6.50 CD
Karina	7.80 a	6.73 ab	7.27 AB
Nihal	7.07 abc	5.20 c	6.13 CDE
Reyna	7.80 a	5.87 bc	6.83 ABC
Utrillo	7.33 ab	5.73 bc	6.53 BCD
Pisum sativum L. ssp.elatius	6.33 cde	6.13 abc	6.23 CDE
Pisum sativum L. ssp. sativum	6.60 bcd	5.73 bc	6.17 CDE
Line 1	5.73 def	6.57 ab	6.15 CDE
Line 2	5.40 ef	5.87 bc	5.92 DE
Line 3	5.33 f	6.50 ab	5.63 E
Mean	6.72 A	6.18 B	6.45

Means followed by the same letter within columns are not statistically significant different

Pod Number Per Plant (number/pod)

In the first year of the study, the highest values were obtained from Line 1 (28 number/plant) and in the second

year from Line 3 (17.33 number/plant) (Table 6). After two years the mean values were evaluated and Line 1 (21.33 number/plant) determined as the highest pod number.

The lowest value was found in Utrillo cultivar (9.07 number/plant) in 2016, Jof cultivar (5.53 number/plant) in 2018 and *Pisum sativum* L. ssp. *elatius* Genotype (7.6 number/plant) according to the average of two years.

The number of pods per plant is a characteristic that is controlled by genetic factors. Therefore, it can take different values according to the genotypes. Similar ideas reported by other investigators (Amjad & Anjum 2002, Bicer & Anlarsal, 2004, Bozoglu *et al.*, 2007, Khichi *et al.* 2017).

Table 6. *Means of pod number per plant (number/pod), of pea genotypes*

Genotype	2016	2018	Mean
Bolero	10.20 c	8.53 cd	9.37 DEF
Jof	10.60 c	5.53 d	8.07 EF
Karina	19.27 abc	7.60 cd	13.43 CDE
Nihal	10.47 c	6.90 cd	8.68 DEF
Reyna	15.20 bc	8.57 cd	11.88 DEF
Utrillo	9.07 c	8.07 cd	8.57 EF
Pisum sativum L. ssp.elatius	9.47 c	5.73 d	7.60 F
Pisum sativum L. ssp. sativum	17.27 bc	10.83 bc	14.05 BCD
Line 1	28.00 a	14.67 ab	21.33 A
Line 2	23.33 ab	14.67 ab	19.00 AB
Line 3	17.33 bc	17.33 a	17.33 ABC
Mean	15.47 A	9.86 B	12.67

Means followed by the same letter within columns are not statistically significant different

Seed Yield (kg/da)

According to the 2016, 2018 and the average of these two years, cv. Reyna (138 kg/da, 110 kg/da ve 124 kg/da respectively) determined as the most productive genotype

(Table 7). The lowest yield values were determined in *Pisum sativum* L. ssp.*elatius* wild subspecies.

Genetic factors and environmental conditions determine seed yield. Cultivars and lines may have different yield values due to their genetic properties. It was reported that different yield values were obtained according to genotypes (Karadavut ve Ozdemir 2001, Amjad & Anjum, 2002, Toker & Canci, 2003, Peksen & Artik, 2004, Ashraf *et al.*, 2011, Bozoglu *et al.*, 2007, Solanki, 2008, Yucel, 2013, Ojwang *et al.*, 2016, Khichi *et al.* 2017).

Table 7. *Means of seed yield (kg/da), of pea genotypes*

Genotype	2016	2018	Mean
Bolero	106.0 bc	86.0 b	96.0 BC
Jof	67.0 f	59.0 d	63.0 D
Karina	89.0 cdef	82.0 b	85.5 C
Nihal	99.0 bcde	80.0 b	89.5 BC
Reyna	138.0 a	110.0 a	124.0 A
Utrillo	118.0 ab	89.0 b	103.5 B
Pisum sativum L. ssp.elatius	61.0 f	54.0 d	57.5 D
Pisum sativum L. ssp. sativum	101.0 bcd	78.0 cb	89.5 BC
Line 1	74.0 def	65.0 cd	69.5 D
Line 2	63.0 f	59.0 d	61.0 D
Line 3	71.0 fe	55.0 d	63.0 D
Mean	89.73 A	74.27 B	82.0

Means followed by the same letter within columns are not statistically significant different

Conclusion

According to the results obtained from the study in Bayburt conditions, Reyna commercial cultivar is suitable for the province.

On the other hand the lines used in the study will be useful for pea breeding studies in terms of the first pod height and the pod number per plant.

Acknowledgement

The project was supported by Bayburt University Scientific Research Projects Units. Special thanks to Bayburt University Scientific Research Projects Units.

REFERENCES

Amjad, M, & Anjum, M.A. (2002). Performance of nine pea cultivars under Faisalabad conditions. *Pakistan Journal of Agricultural Sciences*, 39(1):16-19.

Anonymous, (2018). Republic Of Turkey Ministry Of Agriculture and Forestry, Meteorological Service. Bayburt Province Statistical Database, www.mgm.gov.tr

Ashraf, M.I., Pervez, M.A.,Amjad, M.,Ahmad, R. & Ayub, M. (2011). Qualitative and Quantitative Response of Pea (*Pisum sativum* L.) Cultivars to Judicious Applications of Irrigation with Phosphorus and Potassium. *Pak. j. life soc. Sci.* 9(2):159-164.

Bicer, B.T. & Anlarsal, A.E. (2004). Determination of Botanical and Agronomical Characteristics of Some Chickpea (*Cicer arietinum* L.) Landraces. *Journal of Agricultural Sciences*, (4):389-396.

Bozoglu, H., Peksen, E., Peksen, A. & Gulumser, A. (2007). Determination Of The Yield Performance And Harvesting Periods Of Fifteen Pea (*Pisum sativum* L.) Cultivars Sown In Autumn And Spring. *Pak. J. Bot.,* 39(6):2017-2025.

Choudhury Ray P, Tanveer H. & Dixit GP (2006). Identification and detection of genetic relatedness among important varieties of pea (*Pisum sativum* L.), grown in India. *Genetica*, 130: 183-191.

Demirci, G. & Unver, S. (2005). The Effects Of Different Sowing Time On Yield And Yield Components In Pea (*Pisum sativum* L.) In Ankara Conditions. *Anadolu, J. of AARI*, 15(1):49-60.

Duncan, D.B. (1995). Multiple Range and Multiple F Tests. Biometrics, 11 (1):1-42.

FAO, (2017). Food and Agriculture Organization of the United Nations, Statistical Database. www.fao.org

Gritton, E. T. (1980). *Field Pea. Hybridization of Crop Plants,* (Ed. Fehr, W.R., and Hadley, H.H.,) 347-357

Judd, .S., Campbell , C.S., Kellogg , E.A., Stevens, P.F. & Donoghue, M.J. (2008). *Plant Systematics: A Phylogenetic Approach*, Sinauer Associates Inc.,U.S, 611p.

Kang, B.K., Kim, H.T., Choi, M.S., Koo, S.C., Seo, J.H., Kim, H.S., Shin, S.O., Yun, H.T., Oh, I.S., Kulkarni, K.P. & Lee, J.D. (2017). Genetic and Environmental Variation of First Pod Height in Soybean [Glycine max (L.) Merr.] *Plant Breed. Biotech.,* 5(1):36-44.

Karadavut, U. & Ozdemir, S. (2001). Effect Of *Rhizobium* Inoculation And Nitrogen Application On Yield And Yield Characters Of Chickpea. *Anadolu, J. of AARI,* 11(1):14-22.

Khichi, P., Pant, R. & Upadhayay, S., (2017). Performance of garden pea varieties for their growth and yield characteristics in Vidharbha region of Maharashtra, *India Journal of Applied and Natural Science*, 9(4):2300-2304.

Lakić, Z., Stanković, S., Pavlović, S., Krnjajić, S. & Popović, V. (2019). Genetic variability in quantitative traits of field pea (*Pisum sativum* L.) genotypes. *Czech Journal of Genetics and Plant Breeding*, 55(1):1-7.

Lamprecht, H. (1974). Monographie Der Gattung *Pisum. In* K. Mecenovic (ed.) Steiermarkische Landesdruckerei, Graz, Austria, 655p.

Mendel, G., (1866). Versuche uber pflanzen-hybriden. [Experiments on Plant Hybrids]. *Verhandlungen der naturfoschung Vereins*, 4, 3-47.

Ojwang, J.D., Nyankanga R.O., Olanya O.M., Ukuku D.O. & Imungi J., (2016). Yield components of vegetable pigeon

pea cultivars. *Subtropical Agriculture and Environments* 67:1-12.

Peksen, E., Peksen, A., Bozoğlu, H. & Gulumser, A. (2004). Comparison of Fresh Pod Yield and Pod Related Characteristics in Pea (*Pisum sativum* L.) Cultivars Sown in Autumn and Spring under Samsun Ecological Conditions. *Turk. J. Agric. For.* 28:363-370.

Peksen, E. & Artik, C. (2004). Comparison of Some Cowpea (*Vigna unguiculata* L. Walp) Genotypes from Turkey for Seed Yield and Yield Related Characters. *Journal of Agronomy,* 3(2): 137-140.

SAS (2004). SAS/STAT 9.1. *User's guide: Statistics.* SAS institute Inc., Carry, NC, USA, 5121pp.

Smýkal P., Coyne C., Redden R. & Maxted N. (2013). Peas, Genetic and Genomic Resources of Grain Legume Improvement. (ed: Singh, M., Upadhyaya, H.D. and Bisht, I.S.) *Chapter 3: Peas,* 41-80.

Solanki, G.S. (2008). Performance of Chickpea (*Cicer arietinum* L.) Varieties to Varying Seed Rates Under Agro-climatic Conditions of Vindhyan Plateau. Jawaharlal Nehru Agricultural University, Msc Thesis, 64p.

Toker, C. & Canci, H. (2003). Selection of Chickpea (*Cicer arietinum* L.) Genotypes for Resistance to Ascochyta Blight [*Ascochyta rabiei* (Pass.) Labr.],Yield and Yield Criteria. *Turk J Agric For*, 27:277-283.

Vavilov, N. I. (1926). Studies on the origin of cultivated plants. Bull. *Appl. Bot. PIant Breed*. 16:139-248.

Warkentin, T.D., Smýkal P., J. Coyne, C.J., Weeden, N., Domoney, C., Bing, D.J., Leonforte, A., Xuxiao, Z., Dixit, G.P., Boros, L., McPhee, K.E., McGee, R.J., Burstin J., and Ellis, T.H.N., (2015). *Chapter 2: Pea, Handbook of Plant Breeding*, Springer Science, New York, p37-83.

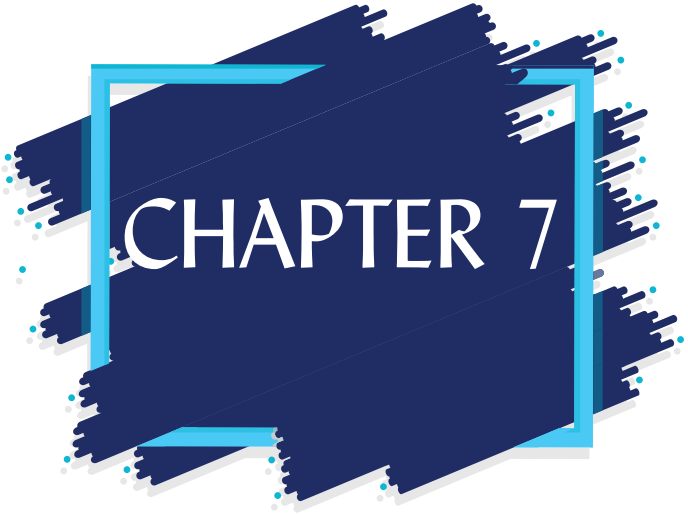
White, O. (1917). Studies of inheritance in *Pisum.* II. The Present State of Knowledge of Heredity and Variation in Peas. *Proc. Am. Phil. Soc.* 56:487-588.

Yucel, D.O. (2013). Impact Of Plant Density On Yield And Yield Components Of Pea (*Pisum sativum* ssp. *sativum* L.) Cultivars. *ARPN Journal of Agricultural and Biological Science*, 8(2):169-174.

Zohary, D. & Hopf, M. (1973). Domestication of Pulses in the Old World. *Science*, 182:887-894.

FIRE: LIFE CYCLE PART OF *PINUS HALEPENSIS* MILL. AND *PINUS BRUTIA* TEN.

Yusuf KURT[1]



1 Harran University, Arts and Science Faculty, Molecular Biology and Genetics Department, 63300, Osmanbey Campus, Şanlıurfa-Turkey

FIRE: LIFE CYCLE PART OF *PINUS HALEPENSIS* MILL. AND *PINUS BRUTIA* TEN.

Yusuf KURT[1]

1. INTRODUCTION

The Mediterranean-climate is known by cool, wet winters and hot, dry summer seasons. However, a high variability can be observed at climate from Mediterranean-climate region to region and countries in the regions (Medail & Diadema, 2009; Underwood et al., 2009). The southwestern Australia, Cape Region of South Africa, California, part of Chile and the Mediterranean Basin are five mediterranean-climate region of the World. They are very important ecosystems due to their high level of plant diversity and endemism rate (Underwood et al., 2009). The oldest and biggest mediterranean-climate region, the Mediterranean Basin, have been used and managed by the earlist human settlements about 12.000 years before present (Zeder, 2008) or earlier (Mann, 2011). But the Mediterranean basin still has high level of species diversity and genetic variation (Fady & Conord, 2010). The Mediterranean basin biodiversity has been affected, and will continue to affect like other mediterranean-climate regions, by threats such as human activities (increasing population density, grazing, harvesting, opening new agricultural lands, constructing buildings, hotels and factories in natural places and etc.) and natural and artificial fires (Richardson et al., 2007; Underwood et al., 2009).

The origin and effect of natural fires are extended millions of years before until dominance of terrestrial vegetation (Kenrick & Crane, 1997). The frequency and impact

1 Harran University, Arts and Science Faculty, Molecular Biology and Genetics Department, 63300, Osmanbey Campus, Şanlıurfa-Turkey

of artificial fires have been increasing since human began using fire (Pausas & Keeley, 2009; Richardson et al., 2007). The fires are grouped into three categories: ground, surface and crown based on fuel sources (Alvarez et al., 2012). The impact of fire to nature is a paradox (Fernandes et al., 2011). It can kill flora and fauna elements and cause extensive ecological damage such as reduced soil fertility, impact to air quality (local or regional), destruction of biodiversity, global warming and damage to forests, land resources and of course human assets. However, it is extremely beneficial for regeneration of some plant species and of nutrient cycling (Fernandes et al., 2011; Pausas & Keeley 2009). Many plants have evolved, and will continue to evolve, fire adaptive traits generally in fire-prone environments (See Bradshaw et al., 2011 and Keeley et al., 2011 to compare and understand differences between adaptation or exaptations of fire traits). Plants vary in their response to fire such as resprouting (Hodgkinson, 1998), soil seed banks (Santos et al., 2010), canopy seed banks (Schwilk & Ackerly, 2001), physical dormancy or bud banks (Klimesova & Klimes, 2007) and smoke-induced germination (Zuloaga-Aguilar et al., 2011). The Mediterranean Basin pines have some fire adaptive or response traits those indicated above (Fernandes et al., 2008).

Aleppo pine (*Pinus halepensis* Mill.) and Brutian pine/ Turkish red pine (*Pinus brutia* Ten.) are the two main forest tree species of the Mediterranean basin. Two pines are vicariant; Aleppo pine distribution occupies large parts of western Mediterranean and small areas in the eastern, while Brutian pine forms extensive eastern Mediterranean forests (Boydak, 2004; Fady et al., 2003; Petrakis et al., 2007). Distribution range of two pines shows paralellism with Mediterranean-climate type in the Mediterranean Basin (Figure 1).

Figure 1. *Distribution of Aleppo and Brutian pine in the Mediterranean Region (Black areas: Aleppo pine, Grey areas: Brutian pine (from Fady et al., 2003) and Dotted lines: Mediterranean region limits from Medail & Diadema, 2009).*

Aleppo and Brutian pine are evolutionary closely related and have traits that adapted Mediterranean-climate and fires (Fernandes et al., 2008). Fire is a natural component of two species forests. Both species have fire adaptive traits such as relatively thick bark, seretonious (closed) cones (canopy seed bank), dormant seeds with thick coat, flammable forest ground and surface characteristics. Therefore, they can easily form regeneration after fire. However, they also regenerate without fire (Boydak, 2004; Tapias et al., 2004; Fernandes et al., 2008; Alvarez et al., 2012).

Fire is a part of development or life cycle of two pines. It is not a global herbivore for Aleppo and Brutia pine ecosystem (Bond & Keeley, 2005). It is a natural disturbance and a regeneration agent of both pine forests (Tapias et al., 2004; Fernandes et al., 2008). Fire has been damaged millions of hectars forested land in the Mediterranean basin countries since early human settlements (Ertugrul, 2005; Richardson et al., 2007). It is still affected thousand of hectars of Aleppo and Brutian pine forests in the Mediterranean basin (Ertugrul, 2005). However, today fire is used

as a management strategy for two pine forests (Spanos et al., 2000; 2010). High- and low-intensity fireperioda for Brutian pine is reported 25 and 9 years, respectively (Neyisci, 1986; 1993). Numerous studies have been shown post-fire regeneration (Buhk et al., 2006; Daskalakou & Thanos, 2010; Pausas et al., 2004; Tavsanoglu & Gurkan, 2009; Verkaik & Espelta, 2006) and effective germination after fires or with high temperatures (Nunez & Calvo 2000; Skordilis & Thanos, 1995; Thanos, 2000) for both species. The fast regeneration of two species can be attributed to their short juvenile phase and flowering time; for example early cone production and devolepment can be observed from 4 to 7 years old individuals. Also, canopy seed banks (serotinous cones) are formed in the early development stage (Boydak, 2004; Goubitz, 2001).

In this study, evolution, distribution, ecology and genetic diversity of two species are generally discussed. Life cycle of species is illustrated with fire effect. Fire adaptive traits of two species are detailly explained. Finally, fire management and conservation studies are discussed to consider future climate change.

2. Evolution and distribution of species

Aleppo and Brutian pine have been considered to be as a variety or subspecies of *Pinus halepensis* (Boydak, 2004). Palinological research (Biger & Liphschitz, 1991), biochemical markers (Korol et al., 2002; Schiller, 2000), some anatomical, morphological and biogeographical characteristics (Kaundun & Lebreton, 2010; Vidakovic, 1991), DNA analysis (Bucci et al., 1998; Tozkar et al., 2009) supported that these species are systematically differed from each other and regarded as two distinct species which probably shared a common ancestor (Akkemik et al., 2010; Schiller, 2000; Tozkar et al., 2009). According to fossil records, both species were occupied larger parts of central Europe

and Mediterranean basin than they do today (Boydak et al., 2006; Klaus, 1989; Schiller, 2000). The subspecies of Brutian pine (*stankewiczii* in the Crimea, *pityusa* on the coastal Caucasia and *eldarica* on a very small area between Iran and Afghanistan, see Figure 1) are also supported wide distribution pattern of species in the past (Boydak, 2004).

The natural distribution ranges of both species take place nearly all the Mediterranean basin countries (Figure 1). Brutian pine mainly distributes on eastern Mediterranean while Aleppo pine on western Mediterranean region (Fady et al., 2003). There is an important similarity between Aleppo and Brutian pine distribution areas and regions affected by Mediterranean-climate (Figure 1). In Turkey, Brutian pine is a natural forest tree species which has the most large natural distribution area and covers over 5.4 million hectars (Akkemik et al., 2018; General Directorate of Forestry [GDF], 2012). Aleppo pine covers about 2.5 million hectars forested area in the central and most of the western Mediterranean basin (Daskalakou & Thanos, 2010). Distribution range of both species is affected by natural and artficial fires and other human caused factors such as overgrazing, harvesting, land clearance, urbanization and other manipulation of natural ecosystems (Richardson et al., 2007). However, both species have great ecological potential and high genetic diversity. Therefore, they can be easily formed true climax vegetation after by damaged those above threats (Boydak, 2004; Daskalakou & Thanos, 2010; Goubitz, 2001).

3. Ecology and genetic diversity of species

Aleppo and Brutian pine generally distribute from sea level up to 1500 m at Mediterranean basin. Also, Aleppo pine distribution extends 2000 m in Morocco (Ayari et al., 2011; Boydak, 2004). Both pine species grow mainly in semi-arid and arid bioclimate and rarely distribute in hu-

mid areas (Barbero et al., 1998; Maestre & Cortina, 2004; Schiller & Atzmon, 2009). Mean annual temperatures are between -10 and 50 °C, while annual rainfalls range from 200 to 2000 mm in distribution areas (Boydak et al., 2006; Goubitz, 2001). Marls, limestone and dolomites are the main parent material of both species distribution areas. Both pine species also grow on many soil types like rendzina and red mediterranean soils (Barbero et al 1998; Boydak, 2004). Aleppo and Brutian pine are capable of forming true climax generally with understorey vegetation of shrubs (Boydak, 2004; Capitanio & Carcaillet, 2008; De las Heras et al., 2002). Both pine species are known invasive pines and can be form colonisation on distribution area of other Mediterranean plants before or after wildfire (Ganatsas & Thanasis, 2010; Rejmanek & Richardson, 1996). These variable ecological characteristics of both species can be attributed to wide genetic background and high plasticity potential.

Patterns of polymorphism within Brutian pine populations were found very high and showed altitudinal differentiation (Dangasuk & Panetsos, 2004; Kurt et al., 2012). Populations differentiation of Brutian pine was reported relatively low (Lise et al., 2007). Genetic diversity level in Aleppo pine populations were depended on their distribution region and found to be decreasing from east to west (Bucci et. al. 1998; Grivet et. al. 2009) like other vascular plants of the Mediterranean basin (Fady & Conord, 2010). Both species are genetically very close and can be hybridized where two species come in contact or co-occur (Dounavi et al., 2001; Drouzas et al., 2000; Panetsos & Aravanopoulos 2000). However, successful hybridization of two species was only accomplished when Brutian pine was the female parent and Aleppo pine as pollen donor, but not reciprocally (Bucci et al., 1998; Tozkar et al., 2009). The hybridization of two species can be attributed to co-occorunce of species and overlapping of phenologic characteristics (Weinstein, 1989).

4. Phenology of species

Aleppo and Brutian pine are monoecious pine trees and their pollination and distribution occur by wind (Boydak, 2004; Goubitz, 2001). Reproduction period or female cone developments of both pines take almost three years (Figure 2). Phenological stages of both species are roughly illustrated in Figure 2, according to data from previous studies and field observations (Boydak, 2004; Goubitz 2001; Keskin, 1999; Thanos & Daskalakou, 2000; Weinstein, 1989). Vegetative bud-developments start after than reproductive bud-developments and continue more slowly (Boydak et al., 2006; Weinstein, 1989).

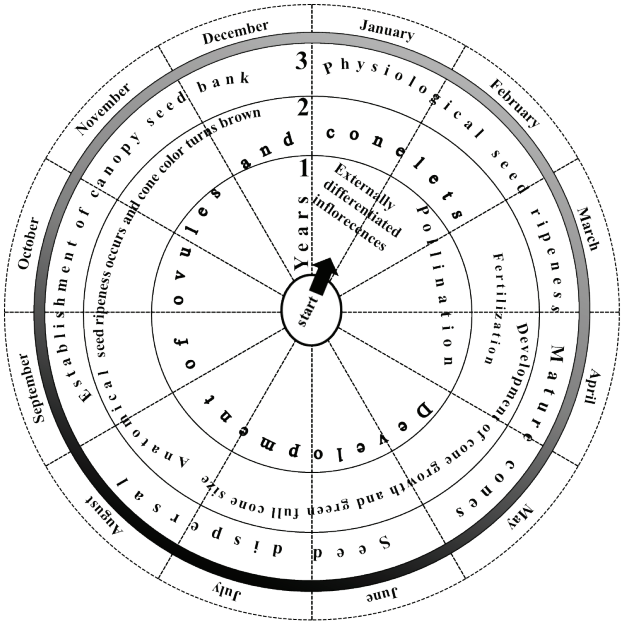


Figure 2. *Life cycle of species with monthly fire intensity (Each circle indicates a year which are numbered at the beginning of the years).*

Flowering of Aleppo pine starts earliar than Brutian pine. However, their phenological characteristics do not

completely distinct. Bud formation, flowering, pollination and duration time of these events depend on factors such as temperature, elevation and provenances of populations and/or individuals (Boydak et al., 2006; Climent et al., 2008; Weinstein, 1989). Fertilization occurs at least one year after the pollination. Cone development starts after fertilization and they reach full green cone size till end of second year. Anatomical and physiological seed maturation starts at the end of second year and continue untill second or third months of last year when cone color is brown (Figure 2). Seed dispersal of both pines occurs from May to at the end of last year. The maximum seed dispersal takes time in July, August and September when the greatest forest fire probability time throughout year (Boydak et al., 2006; Goubitz, 2001; Shmida et al., 2000).

5. Living and regeneration with fires

Mediterranean ecosystems are known as fire-prone environments and many plants of these ecosystems have vegetative and/or generative fire resistance traits. Fire is an important life cycle part and a natural selection agent to shape distribution range of some plants like Mediterranean pines (Bond & Keeley, 2005; Buhk et al., 2006; Keeley et al., 2011). Aleppo and Brutian pine forests are affected by fires every year, but they regenerate easily after fires because of their fire-adapted traits (Daskalakou & Thanos, 2010; Fernandes et al., 2008). The fire-adapted traits of two species are explained and discussed below:

Thick Bark: Aleppo and Brutian pine have relatively thick bark between the root collar and 2.5 m up to the stem at between 20 and 30 ages. Thick barks protect living part of them against ground and surface fire (Boydak, 2004; Fernandes et al., 2008). These fires damage aboveground material of forests and lower branches of both pines, but do not damage cambium tissue because of enough accu-

mulation of bark (Fernandes et al., 2008; Tapias et al., 2004). Therefore, thick barks of both pines are adaptive trait of fire-prone ecosystems (Keeley et al., 2011).

Canopy or aerial seed bank (serotinous cones): Aleppo and Brutian pine reproduce female inflorescence in the second year and form first cones between the age 4 and 7 years (Boydak, 2004; Climent et al., 2008). Post-fire regeneration and sustainability of species depend on low- and high-intensity fire intervals. The average times of fires were reported from 9 to10 years for low-intensity fires and from 22 to 25 years for high-intensity fires (Neyisci, 1986; Verkaik & Espelta 2006). Ages of earlist occurrence of conelets and forming serotinous cones were found below the average low-intensity fires. These events are supported fire adaptability of species which will guarentee their future generations (Boydak et al., 2006; Schwilk & Ackerly, 2001; Verkaik & Espelta 2006).

Aleppo and Brutian pine serotinous cones stand from 4 to 9 years on the trees with viable seeds inside. Occurrence and increasing of canopy seed bank depend on elevation, latitudinal and longitudinal gradients (Ayari et al., 2011) and provenance of populations (Climent et al., 2008; Hernandez-Serrano et al., 2014). Serotinous cones are only opened at the high temperature developed by crown fire, and massive seed dispersal occurs by winds after fire (Daskalakou & Thanos, 1996). Great majority of seeds in serotinous cones still survives after fire. As dormancy breaks and a favorable seed bed established by fire, seeds are ready to germinate throughout the rainy season (Boydak, 2004; Tsitsoni, 2009). Serotinous cones also protect seeds against some seed predators. Therefore, serotinous cones are the most important repository for regeneration and sustainability of both species after fire (Ayari & Khouja, 2014; Ayari et al., 2011; Fernandes et al., 2008).

Soil seed bank and seed coat thickness: Aleppo and Brutian pine disturb their seeds almost throughout the year (Figure 2). Therefore, both species have transient soil seed bank. After serotinous cone opening by crown fire, soils seed bank capasity are increased and suitable seedbed are formed (Boydak, 2004; Daskalakou & Thanos, 1996). Both species have germinable seeds on the ground at least one year (probably more) until consist of suitable conditions such as precipitation and temperature for germination. All seed characteristics (size, weight and seed coat thickness) of Brutian pine are bigger than Aleppo pine seeds (Boydak, 2004; Daskalakou & Thanos, 1996; Tsitsoni, 2009). Both species have dormancy because of thick seed coat which is contributed the most part of seed. Seed coat thickness of two species may be considered as an adaptation of these species to survive and regenerate after fire. Because, seed coat thickness may reduce effect of fire to the embryo. Fire breaks dormancy, reduces number of seed predators and forms nutritinous seedbed for germination (Nunez & Calvo, 2000; Spanos et al., 2000; Thanos, 2000). However, most of seeds dispersed before fire on the ground, losts their viability or germination ability due to high temperature effect by fire. Reduction in the temperature may occur at horizantal direction depending on environmental conditions such as stoniness and fuel composition (Santos et al., 2010). Therefore, post-fire germination of Aleppo and Brutian pine entirely depends on serotinous cones or canopy seed bank (Daskalakou & Thanos, 2010; Spanos et al., 2000).

Post-fire germination and growth: Crown fires open the serotinous cones, break dormancy of seeds and create nutritious germination media (Paula et al., 2006). Aleppo and Brutian pine germination after a crown fire are very heterogeneous and depend on so many factors such as elevation, temperature and origin of populations. Both species are regenerate directly after fire which is known

as “autosuccession” (Buhk et al., 2006; Tavsanoglu & Gurkan, 2009; Tsitsoni, 2009). However, regeneration of both pine are not depended only canopy seed bank and fire (Daskalakou & Thanos, 2010; Fyllas et al., 2008). All seeds of two species are not germinated in rainy seasons or after the crown fire. Delayed germination untill suitable conditions may be attributed an adaptive mechanism for sapling survival. When germinated saplings die due to unfavorable conditions (drought or frost), there are stil reserved seeds on the ground to be germinated in suitable conditions (Boydak, 2004; Tsitsoni, 2009).

Researches suggest that cone age did not affect the germination of both species and germination percentages of heated seeds found to be as high as control samples. Temperatures (above 150 ºC) and exposure time (above 1 minute) are negatively affected germination (Nunez & Calvo, 2000; Thanos, 2000). Suitable germination media and vigorous growth conditions are taken place by fire. Also, massive litter fall after fire provides seed bed that reduces evapotranspiration and may decrease damages of seed predators (Paula et al., 2006). Morever, fire delays the growth of competing vegetation at least for 2-3 years on heterogeneous landscape (especially on karstic lands). Therefore, germinating seeds rapidly develop tap roots into deep soil layers which provide high survival rate to saplings (Blade & Vallejo, 2008; Boydak et al., 2006; Verkaik & Espelta, 2006). It was reported that no notable differences in genetic diversity were found between the remnant mature populations (pre-fire populations) and the young populations (post-fire populations) after regeneration of Brutian pine (Aravanopoulos et al., 2004). The expressions “shoot forth from the ashes” or “born again from the ashes” are summarized both pine species regeneration after fire. Flammable materials are played important role at regeneration of both pine forests (Schwilk & Ackerly, 2001).

Flammability: Aleppo and Brutian pine forests have understorey biomass with maquis species which are generally contain flammable resin and essential oils. That makes both pine forests very flammable (Anne et al., 2011; Koukoura & Kyriazopoulos, 2007). Two pine species are also highly flammable coniferous (Schwilk & Ackerly, 2001). These easily flammable characteristics of two pine and their ecosystems and establishment of their post-fire regeneration are seen as a paradox. But it is a balance of fire-adapted ecosystems and evolutionary strategy with serotiny (Boydak, 2004; Schwilk & Ackerly, 2001). Maximum seed dispersal period, maximum litter fall time and the season of greatest forest fire of both pines are occured at the same time, from June to October (Figure 2). These characteristics suggest that both pine species are fire-adapted trees (Fernandes et al., 2008).

6. Fire management

Fire management activities are divided into social and technical categories. In the social category, public awareness should be keeped alive against wild-fire effects (Kalabokidis et al., 2008). The technical targets of crown fire preventing activities are included prescribed fire, grazing and to change vegetation with less flammable plants. All preventing activities are against to decrease quantity of flammable materials (Osem et al., 2011; Shakesby, 2011). In the recent years, grazing and prescribed fire were successfully used to manage flammable understorey vegetation (Osem et al., 2011; Prevosto & Ripert, 2008). Despite their destructive effects, grazing and forest fires can be used as constructive agents like other silvicultural methods (Osem et al., 2011). Also, fire is an arranger and selective force throughout the geological, biological and cultural evolution of Mediterranean forests (Diadema et al., 2007; Fyllas & Troumbis 2009; Pausas et al., 2008).

Fire management studies are also included pre- and post-fire activities. Prescribed burning of flammable materials create a suitable germination media for seeds and growth conditions for seedlings of Aleppo and Brutian pine (Boydak, 2004; Kalabokidis et al., 2008; Prevosto & Ripert, 2008). Cutting below branches of trees, clearing understorey vegetation and thinning in young stands (10 years old) are also pre-fire management activities which are decreased crown fire potential and increased regeneration of species (Esen et al., 2003; Garcia-Jimenez et al., 2017; Spanos et al., 2010; Verkaik & Espelta 2006). It was reported that pines in thinned stands suffered less fire damage than those in un-thinned sites (Garcia-Jimenez et al., 2017). In the post-fire activities such as to prepare burning area, to control herbaceous weeds and to plant fire resistant trees at the edges of forests are promoted Aleppo and Brutian pine saplings growth, cone production and decreased future fire potential (Bellot et al., 2004; Garcia-Jimenez et al., 2017; Gonzalez-Ochoa et al., 2004; Tavsanoglu & Gurkan, 2009; Tsitsoni et al., 2004).

7. Future climate change and conservation

Mediterranean landscapes are negatively affected by relationships among climate, fire regimes, vegetation and human activities from past to present (Shakesby, 2011; Vanniere et al., 2008). It is expected that global temperatures will rise about 2-4 ºC in the next 100 years. Thus, forest tree populations are exposed to increasing effects of drought stress, warmer winters, fire, disease and insects (Richardson et al., 2007; StClair & Howe, 2011). Long generation times and low mortality of established trees negatively affect evolutionary adaptation of forest trees to future climate changes. Because climatic changes are processed and, will continue to process, more quickly than adaptational changes in forest trees. However, high level of genetic diversity and gene flow may play important

roles on the evolutionary adaptation of forest trees to environmental changes (Kuparinen et al., 2010; Richardson et al., 2007). Increasing warming will probably affect more severe drier mountainous Mediterranean areas than wet ecosystems. It will be changed vegetation composition and flammability characteristics. Thus, effects of drought stress and fire frequency will be increased on Mediterranean ecosystems (De Luis et al., 2011; Fyllas & Troumbis, 2009). It is reported that Aleppo and Brutian pine forests at the species lower altitudinal and latitudinal distribution range will be affected harsher than middle- and upper-populations by future climatic changes (Sarris et al., 2011).

Forest genetic resources of Aleppo and Brutian pine, especially populations from low elevation and adapted to dry conditions, have to be conserved by sustainable management to stand out against above threats (Sarris et al., 2011). Existing genetic variation in populations should be protected and evolved in their habitats by in-situ genetic conservation methods. In addition to this, threatened populations should be conserved by ex-situ methods (Petrakis et al., 2007). Conservation efforts of both pine species should also be revised based on the predictions of future climatic change (Heller & Zavaleta, 2009). Populations of two species from full range of environmental conditions should be conserved and managed according to selection criteria of protected forest areas (Branquart et al., 2008).

Conclusion

Fire is an important and integral ecological component of the fragile Mediterranean ecosystems and life cycle part of Aleppo and Brutian pine. Two species are known fire-adapted tree species because of their evolutionary adaptive characterictics to fires. In addition, both species regenerates more vigorous and healthy saplings after fire. Thus, fire is not only a natural disturbance, but it is also an

efficient management agent for both pine regenerations. Fire frequency will probably increase according to future climatic predictions and affect more severe than today to both pine forest. Therefore, Aleppo and Brutian pine ecosystems conservation studies should be revised and managed considering future threats.

REFERENCES

Akkemik, U. (Ed.). (2018). Türkiye'nin Doğal-Egzotik Ağaç ve Çalıları. Published by General Directorate of Forestry, Ankara. 684 p.

Akkemik, U., Yilmaz, H., Oral, D. & Kaya, A. (2010). Some changes in taxonomy of Pines (*Pinus* L.) native to Turkey. *Journal of the Faculty of Forestry, Istanbul University,* 61, 63-78.

Alvarez, A., Gracia, M., Vayreda, J. & Retana, J. (2012). Patterns of types and crown fire potential in *Pinus halepensis* forests in the western Mediterranean Basin. *Forest Ecology and Management,* 270, 282-290.

Anne, G., Marielle, J., Corinne, L.M., Thomas, C. & Laurent, B. (2011). Effects of vegetation type and fire regime on flammability of undisturbed litter in Southeastern France. *Forest Ecology and Management,* 261, 2223-2231.

Aravanopoulos, F.A., Panetsos, K.P. & Skaltsoyiannes, A. (2004). Genetic structure of *Pinus brutia* stands exposed to wild fires. *Plant Ecology,* 171, 175-183.

Ayari A. & Khouja ML. 2014. Ecophysiological variables influencing Aleppo pine seed cone production: a review. Tree Physiology 34, 426-437.

Ayari, A., Moya, D., Rejeb, M.N., Mansoura, A.B., Albouchi, A., De Las Heras, J., Fezzani, T. & Henchi, B. (2011). Geographical variation on cone and seed production of natural *Pinus halepensis* Mill. forests in Tunisia. *Journal of Arid Environments,* 75, 403-410.

Barbero, M., Loisel, R., Quezel, P., Richardson, D.M. & Romane, F. (1998). Pines of the Mediterranean Basin. In: D.M. Richardson (Ed.), *Ecology and Biogeography of Pinus*, Cambridge University Press, pp. 153-170.

Bellot, J., Maestre, F.T., Chirino, E., Hernandez, N. & de Urbina, J.O. (2004). Afforestation with Pinus halepensis reduces native shrub performance in a Mediterranean semiarid area. *Acta Oecologica,* 25, 7-15.

Biger, G. & Liphschitz, N. (1991). The recent distribution of *Pinus brutia*: a reassessment based on dendroarchaeological and dendrohistorical evidence from Israel. *The Holocene*, 1(2), 157-161.

Blade, C. & Vallejo, V.R. (2008). Seed mass effects on performance of *Pinus halepensis* Mill. seedlings sown after fire. *Forest Ecology and Management,* 225, 2362-2372.

Bond, W.J. & Keeley, J.E. (2005). Fire as global 'herbivore': The ecology and evolution of flammable ecosystems. *Trends in Ecology and Evolution,* 20, 387–394.

Bradshaw, D.S., Dixon, K.W., Hopper, S.D., Lambers, H. & Turner, S.R. (2011). Little evidence for fire-adapted plant traits in Mediterranean climate regions. *Trends in Plant Science,* 16, 69-76.

Branquart, E., Verheyen, K. & Latham, J. (2008). Selection criteria of protected forest areas in Europe: The theory and the real world. *Biological Conservation,* 141, 2795-2806.

Boydak, M. (2004). Silvicultural characteristics and natural regeneration of *Pinus brutia* Ten.- a review. *Plant Ecology,* 171, 153-163.

Boydak, M., Dirik, H. & Calikoglu, M. (2006). Biology and silviculture of Turkish red pine (*Pinus brutia* Ten.). OGEM-VAK publication, Ankara, 253 p.

Bucci, G., Anzidei, M., Madaghiele, A. & Vendramin, G.G. (1998). Detection of haplotypic variation and natural hybridization in Halepensis-complex pine species using chloroplast simple sequence repeat (SSR) markers. *Molecular Ecology,* 7, 1-11.

Buhk, C., Gotzenberger, L., Wesche, K., Sanchez-Gomez, P. & Hensen, I. (2006). Post-fire regeneration in a Mediterranean pine forest with historically low fire frequency. *Acta Oecologica,* 30, 288-298.

Capitanio, R. & Carcaillet, C. 2008. Post-fire Mediterranean vegetation dynamics and diversity: A discussion of succession models. *Forest Ecology and Management,* 255, 431-439.

Climent, J., Prada, M.A., Calama, R., Chambel, M.R., Sanchez de Ron, D. & Alia, R. (2008). To grow or to seed: ecotypic variation in reproductive allocation and cone production by young female Aleppo pine (*Pinus halepensis*, *Pinaceae*). *American Journal of Botany,* 95, 833-842.

Dangasuk, O.G. & Panetsos, K.P. (2004). Altitudinal and longitudinal variations in *Pinus brutia* (Ten.) of Crete Island, Greece: some needle, cone and seed traits under natural habitats. *New Forest,* 27, 269-284.

Daskalakou, E.N. & Thanos, C.A. (1996). Aleppo pine (*Pinus halepensis*) postfire regeneration: The role of canopy and soil seed banks. *International Journal of Wildland Fire,* 6, 59-66.

Daskalakou, E.N. & Thanos, C.A. (2010). Post-fire seedling dynamics and performance in *Pinus halepensis* Mill. populations. *Acta Oecologica,* 36, 446-453.

De Luis, M., Novak, K., Raventos, J., Gricar, J., Prislan, P. & Cufar, K. (2011). Cambial activity, wood formation and sapling survival of *Pinus halepensis* exposed to different irrigation regimes. *Forest Ecology and Management,* 262, 1630-1638.

De Las Heras, J., Martinez-Sanchez, J.J., Gonzalez-Ochoa, A.I., Ferrandis, P. & Herranz, J.M. (2002). Establishment of *Pinus halepensis* Mill. saplings following fire: effects of competition with shrub species. *Acta Oecologica,* 23, 91-97.

Diadema, K., Medail, F. & Bretagnolle, F. (2007). Fire as a control agent of demographic structure and plant performance of a rare Mediterranean endemic geophyte. *C.R. Biologies,* 330, 691-700.

Dounavi, K.D., Koutsias, N. & Panetsos, K.P. (2001). Natural interspecific hybridization between *Pinus brutia* (Ten.) and *Pinus halepensis* (Mill.), verified by using the logistic regression modeling on morphological characters. *Forest Genetics,* 8, 151-158.

Drouzas, S.D., Aravanapoulos, F.A. & Panetsos, K.P. (2000). RAPD variation of natural hybrid population among *Pinus brutia* Ten. and *Pinus halepensis* Mill. Adaptation and Selection of Mediterranean *Pinus* and *Cedrus* for Sustainable Afforestation of Marginal Lands. Proceedings of the Final Conference of the European Union Joint Research Project FAIR CT 95-0097, Mytilene, Greece, pp. 77-82.

Ertugrul, M. (2005). The situation of forest fires in the world and in Turkey. *Journal of the Bartın Faculty of Forestry,* 7, 43-50.

Esen, D., Zedaker, S.M., Seiler, J.R. & Mou, P. (2003). Growth responses of six seed sources of *Pinus brutia* Ten. (Turkish red pine) to herbaceous weed competition. *New Forests,* 25, 1-10.

Fady, B. & Conord, C. (2010). Macroecological patterns of species and genetic diversity in vascular plants of the Mediterranean basin. *Diversity and Distributions,*16, 53-64.

Fady, B., Semerci, H. & Vendramin, G.G. (2003). EUFORGEN Technical Guidelines for genetic conservation and us efor Aleppo pine (*Pinus halepensis*) and Brutia pine (*Pinus brutia*). International Plant Genetic Resources Instıtute, Rome, Italy, 6 pages.

Fernandes, P.M., Rego, F.C. & Rigolot, E. (2011). The FIRE PARADOX Project: Towards science-based fire management in Europe. *Forest Ecology and Management,* 261, 2177-2178.

Fernandes, P.M., Vega, J.A., Jimenez, E., Rigolot, E. (2008). Fire resistance of European pines. *Forest Ecology and Management,* 256, 246-255.

Fyllas, N.M., Dimitrakopoulos, P.G. & Troumbis, A.Y. (2008). Regeneration dynamics of a mixed Mediterranean pine forest in the absence of fire. *Forest Ecology and Management,* 256, 1552-1559.

Fyllas, N.M. & Troumbis, A.Y. (2009). Simulating vegetation shifts in North-eastern Mediterranean mountain forests

under climatic change scenarios. *Global Ecology and Biogeography,* 18, 64-77.

Ganatsas, P. & Thanasis, G. (2010). *Pinus halepensis* invasion in *Pinus pinea* habitat in Strofylia forest (Site of NATURA network), southern Greece. *Journal for Nature Conservation,* 18, 106-117.

Garcia-Jimenez, R., Palmero-Iniesta, M. & Espelta, J.M. (2017). Contrasting effects of fire severity on the regeneration of *Pinus halepensis* Mill. and resprouter species in recently thinned thickets. *Forests,* 8, 55.

GDF. (2012). Forests of Turkey. Publication of General Directorate of Forestry, Ankara. ISBN 978-605-393-044-0.

Gonzalez-Ochoa, A.I., Lopez-Serrano, F.R. & De Las Heras, J. (2004). Does post-fire forest management increase tree growth and cone production in *Pinus halepensis*? *Forest Ecology and Management,* 188, 235-247.

Goubitz, S. (2001). Reproduction Ecology of *Pinus halepensis*: a Monoecious, Wind-Pollinated and Partially Serotinous Mediterranean Pine Tree. Ph. D. Thesis, Utrecht University, Utrecht, 108 p.

Grivet, D., Sebastiani, F., González-Martínez, S.C., Vendramin, G.G. (2009). Patterns of polymorphism resulting from long-range colonization in the Mediterranean conifer Aleppo pine. *New Phytologist,* 184: 1016-1028.

Heller, N.E. & Zavaleta, E.S. (2009). Biodiversity management in the face of climate change: A review of 22 years of recommendations. *Biological Conservation,* 142, 14-32.

Hodgkinson, K.C. (1998). Sprouting success of shrubs after fire: height-dependent relationships for different strategies. *Oecologia,* 115, 64-72.

Hernández-Serrano, A., Verdú, M., Santos-del-Blanco, L., Climent, J., González-Martínez, S. C. & Pausas, J. G. (2014). Heritability and quantitative genetic divergence of serotiny, a fire-persistence plant trait. *Annals of Botany,* 114(3), 571–577.

Kalabokidis, K., Iosifidies, T., Henderson, M. & Morehouse, B. (2008). Wildfire policy and use of science in the context of a socio-ecological system on the Aegean Archipelago. *Environmental Science & Policy,* 11, 408-421.

Kaundun, S.S. & Lebreton, P. (2010). Taxonomy and systematics of the genus *Pinus* based on morphological, biogeographical and biochemical characters. *Plant Systematics and Evolution,* 284, 1-15.

Keeley, J.E., Pausas, J.G., Rundel, P.W., Bond, W.J. & Bradstock, R.A. (2011). Fire as an evolutionary pressure shaping plant traits. *Trends in Plant Science,* 16, 406-411.

Kenrick, P. & Crane, P.R. (1997). The origin and early evolution of plants on land. *Nature,* 389, 33-39.

Keskin, S. (1999). Clonal variation in flowering and cone characteristics in a *Pinus brutia* seed orchard. Southwest Anatolia Forest Research Institute (SAFRI), Technical Bulletin No: 9, Antalya, 96 p.

Klaus, W. (1989). Mediterranean pines and their history. *Plant Systematics and Evolution,* 162, 133-163.

Klimesova, J. & Klimes, L. (2007). Bud banks and their role in vegetative regeneration – A literature review and proposal for simple classification and assessment. *Perspectives in Plant Ecology, Evolution and Systematics,* 8, 115-129.

Korol, L., Shklar, G. & Schiller, G., (2002). Diversity among circum-Mediterranean populations of Aleppo pine and differentiation from brutia pine in their isoenzymes: additional results. *Silvae Genetica,* 51, 35-41.

Koukoura, Z. & Kyriazopoulos, A. (2007). Adaptation of herbaceous plant species in the understorey of *Pinus brutia*. *Agroforest Systems,* 70, 11-16.

Kuparinen, A., Savolainen, O. & Schurr, F.M. (2010). Increased mortality can promote evolutionary adaptation of forest trees to climate change. *Forest Ecology and Management,* 259, 1003-1008.

Kurt, Y., Gonzalez-Martinez, S.C., Alia, R. & Isik, K. 2012. Genetic differentiation in *Pinus brutia* Ten. using molecular markers and quantitative traits: the role of altitude. *Annals of Forest Science*, 69, 345-351.

Lise, Y., Kaya, Z., Isik, F., Sabuncu, R., Kandemir, I. & Onde, S. (2007). The impact of over-exploitation on the genetic structure of Turkish red pine (*Pinus brutia* Ten.) populations determined by RAPD markers. *Silva Fennica,* 41: 211-220.

Maestre, F.T. & Cortina, J. (2004). Are *Pinus halepensis* plantations useful as a restoration tool in semiarid Mediterranean areas? *Forest Ecology and Management,* 198, 303-317.

Mann, C.C. (2011). The birth of religion. *National Geographic,* 219, 34-59.

Medail, F. & Diadema, K. (2009). Glacial refugia influence plant diversity patterns in the Mediterranean Basin. *Journal of Biogeography,* 36, 1333-1345.

Neyisci, T. (1986). The historical role of fires on *Pinus brutia* forests of Antalya-Doyran region. Forest Research Institute Publications, Technical Report No: 29, pp. 67-91.

Neyisci, T. (1993). Ecological adaptive traits of *Pinus brutia* Ten. to fires. International symposium on *Pinus brutia* Ten. Ministry of Forestry Publication, Marmaris, pp. 79-84.

Nunez, M.R. & Calvo, L. (2000). Effect of high temperatures on seed germination of *Pinus sylvestris* and *Pinus halepensis*. *Forest Ecology and Management,* 131,183-190.

Osem, Y., Lavi, A. & Rosenfeld, A. (2011). Colonization of *Pinus halepensis* in Mediterranean habitats: consequences of afforestation, grazing and fire. *Bioogical Invasions,* 13, 485-498.

Panetsos, K.P. & Aravanapoulos, F.A. (2000). Variation and evolution of *Pinus brutia* Ten. in Lesvos Island. Adaptation and Selection of Mediterranean *Pinus* and *Cedrus* for Sustainable Afforestation of Marginal Lands. Proceed-

ings of the Final Conference of the European Union Joint Research Project FAIR CT 95-0097, Mytilene, Greece, pp. 7-13.

Paula, S., Cervello, C.P. & Pausas, J.G. (2006). Fire as a germination cue: A review for the Mediterranean basin. Abstract. *Forest Ecology and Management,* (Suppl.1), 234, S176.

Pausas, J.G. & Keeley, J.E. (2009). A burning story: the role of fire in the history of life. *Bioscience,* 59, 593-601.

Pausas, J.G., Llovet, J., Rodrigo, A. & Vallejo, R. (2008). Are wildfires a disaster in the Mediterranean basin? – A review. *International Journal of Wildland Fire,* 17, 713-723.

Pausas, J.G., Ribeiro, E. & Vallejo, R. (2004). Post-fire regeneration variability of *Pinus halepensis* in the eastern Iberian Peninsula. *Forest Ecology and Management,* 203, 251-259.

Petrakis, P.V., Ioannidis, C. & Zygomala, A.M. (2007). Biotechnology of *Pinus brutia* and *Pinus halepensis* as important landscape plants of the east Mediterranean. *Tree and Forestry Science and Biotechnology,* 1, 26-38.

Prevosto, B. & Ripert, C. (2008). Regeneration of *Pinus halepensis* stands after partial cutting in southern France: Impacts of different ground vegetation, soil and logging slash treatments. *Forest Ecology and Management,* 256, 2058-2064.

Rejmanek, M. & Richardson, D.M. (1996). What attributes make some plant species more invasive? *Ecology,* 77, 1655-1661.

Richardson, D.M., Rundel, P.W., Jackson, S.T., Teskey, R.O., Aronson, J., Bytnerowicz, A., Wingfield, M.J. & Proches, S. (2007). Human impacts in pine forests: past, present and future. *Annual Review of Ecology, Evolution, and Systematics,* 38, 275-297.

Santos, L., Capelo, J. & Tavares, M. (2010). Germination patterns of soil seed banks in relation to fire in Portuguese littoral pine forest vegetation. *Fire Ecology,* 6, 1-15.

Sarris, D., Christodoulakis, D. & Korner, C. (2011). Impact of recent climatic change on growth of low elevation eastern Mediterranean forest trees. *Climatic Change,* 106, 203-223.

Schiller, G. (2000). Inter and intra specific genetic diversity of *Pinus halepensis* Mill. and *Pinus brutia* Ten. In: G. Ne'eman and L. Trabaud (Eds.). *Ecology, Biogeography and Management of Pinus halepensis and P. brutia Forest Ecosystems in the Mediterranean Basin*, Backhuys Publisher, Leiden, pp. 13-35.

Schiller, G. & Atzmon, N. (2009). Performance of Aleppo pine (*Pinus halepensis*) provenances grown at the edge of the Negev desert: A review. *Journal of Arid Environments,* 73, 1051-1057.

Schwilk, D.W. & Ackerly, D.D. (2001). Flammability and serotiny as strategies: correlated evolution in pines. *Oikos,* 94, 326-336.

Shakesby, R.A. (2011). Post-wildfire soil erosion in the Mediterranean: Review and future research directions. *Earth-Science Reviews,* 105, 71-100.

Shmida, A., Lev-Yadun, S., Goubitz, S. & Ne'eman, G. (2000). Sexual allocation and gender segregation in *Pinus halepensis*, *P. brutia* and *P. pinea*. In: G. Ne'eman and L. Trabaud (Eds.). *Ecology, Biogeography and Management of Pinus halepensis and P. brutia Forest Ecosystems in the Mediterranean Basin*, Backhuys Publisher, Leiden, pp. 91-104.

Skordilis, A. & Thanos, C. A. (1995). Seed stratification and germination strategy in the Mediterranean pines *Pinus brutia* and *P. halepensis*. *Seed Science Research,* 5, 151-160.

Spanos, I.A., Daskalakou, E.N. & Thanos, C.A. (2000). Postfire natural regeneration of *Pinus brutia* forests in Thasos island, Greece. *Acta Oecologica,* 21, 13-20.

Spanos, I., Raftoyannis, Y., Platis, P. & Xanthopoulou, E. (2010). Post-fire management and recovery of a pine forest in Greece. *Web Ecology,* 10, 27-31.

StClair, J.B. & Howe, G.T. (2011). Strategies for conserving forest genetic resources in the face of climate change. *Turkish Journal of Botany,* 35, 403-409.

Tapias, R., Climent, J., Pardos, J.A. & Gil, L. (2004). Life histories of Mediterranean pines. *Plant Ecology,* 171, 53-68.

Tavsanoglu, C. & Gurkan, B. (2009). Post-fire regeneration of a *Pinus brutia* (*Pinaceae*) forest in Marmaris national park, Turkey. *International Journal of Botany,* 5, 107-111.

Thanos, C.A. (2000). Ecophysiology of seed germination in *Pinus halepensis* and *Pinus brutia*. In: G. Ne'eman and L. Trabaud (Eds.). *Ecology, Biogeography and Management of Pinus halepensis and P. brutia Forest Ecosystems in the Mediterranean Basin*, Backhuys Publisher, Leiden, pp. 37-50.

Thanos, C.A. & Daskalakou, E.N. (2000). Reproduction in *Pinus halepensis* and *Pinus brutia*. In: G. Ne'eman and L. Trabaud (Eds.). *Ecology, Biogeography and Management of Pinus halepensis and P. brutia Forest Ecosystems in the Mediterranean Basin*, Backhuys Publisher, Leiden, pp. 79-90.

Tozkar, C.O., Onde, S. & Kaya, Z. (2009). The phylogenetic relationship between populations of marginally and sympatrically located *Pinus halepensis* Mill. and *Pinus brutia* Ten. in Turkey, based on the ITS-2 region. *Turkish Journal of Agriculture and Forestry,* 33, 363-373.

Tsitsoni, T.K. (2009). Seed quality characteristics of *Pinus halepensis* – seed germination strategy and early seedling growth. *Web Ecology,* 9, 72-76.

Tsitsoni, T., Ganatsas, P., Zagas, T. & Tsakaldimi, M. (2004). Dynamics of postfire regeneration of *Pinus brutia* Ten. in an artificial forest ecosystem of northern Greece. *Plant Ecology,* 171, 165-174.

Underwood, E.C., Viers, J.H., Klausmeyer, K.R., Cox, R.L., Shaw, M.R. (2009). Threats and biodiversity in the Mediterranean biome. *Diversity and Distributions,* 15, 188-197.

Vanniere, B., Colombaroli, D., Chapron, E., Leroux, A., Tinner, W. & Magny, M. (2008). Climate versus human-driven fire regimes in Mediterranean landscapes: the Holocene record of Lago dell'Accesa (Tuscany, Italy). *Quaternary Science Reviews,* 27, 1181-1196.

Verkaik, I. & Espelta, J.M. (2006). Post-fire regeneration thinning, cone production, serotiny and regeneration age in *Pinus halepensis*. *Forest Ecology and Management,* 231, 155-163.

Vidakovic, M. (1991). Conifers: morphology and variation. Graficki Zavod Tirvatske, Zagreb, Crotia, 755 p.

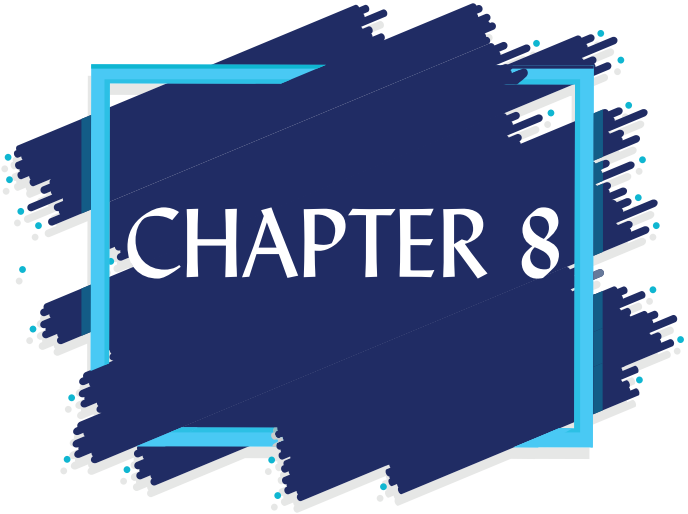
Weinstein, A. (1989). Geographic variation and phenology of *Pinus halepensis*, *P. brutia* and *P. elderica* in Israel. *Forest Ecology and Management,* 27, 99-108.

Zeder, M.A. (2008). Domestication and early agriculture in the Mediterranean Basin: Origins, diffusion, and impact. *Proceedings National Academy of Sciences,* 105, 11597-11604.

Zuloaga-Aguilar, S., Briones, O. & Orozco-Sgovia, A. (2011). Seed germination of montane forest species in response to ash, smoke and heat shock in Mexico. *Acta Oecologica,* 37, 256-262.

DIAGNOSED WITH ENVIRONMENTAL HAZARDS: LIVESTOCK ACTIVITIES IN SOUTHEASTERN ANATOLIA SAMPLE OF TIGRIS BASIN

Burak SALTUK[1]



1 Siirt University, Agriculture Faculty, Biosystem Engineering Department, 56100 Siirt-TURKEY, bsaltuk@siirt.edu.tr

DIAGNOSED WITH ENVIRONMENTAL HAZARDS: LIVESTOCK ACTIVITIES IN SOUTHEASTERN ANATOLIA SAMPLE OF TIGRIS BASIN

Burak SALTUK[1]

INTRODUCTION

No matter how rapid technology increases, especially in developing countries, the national economy still vastly depends on the agricultural sector. Animal breeding is a significant part of the agricultural sector. The increase in population has a positive correlation with demand for foods, resources, and goods. So, sustainability is required under such pressure on the world's resources. To meet demands, industries are becoming wilder and more gluttonous. As a result, the environment is affected negatively, and many hazards occur.

Animal wastes are highly beneficial when appropriately dealt, but otherwise, they are highly dangerous pollutants to nature, especially for ground and underground water resources. Animal breeding is not a well-developed industry in the study area. Generally, it is a little family business; education levels of farmers are low in the agricultural sector. This reduces the awareness of waste handling. To secure the well-being of nature and human health, modern production techniques are required. Though cattle production has been carried out in rural communities with intensive farming practices and exports also begun to be supported in recent years. Current supply and demand for meat and milk rates also decide the industry's next step.

1 Siirt University, Agriculture Faculty, Biosystem Engineering Department, 56100 Siirt-TURKEY, bsaltuk@siirt.edu.tr

Feeder ranching is yet another main component of the industrial machine in the region. During the structure of the present status of those engaged and the values of project preparation, the negative economic impacts of solid and liquid manure produced in existing installations on water and water resources were to be assessed both by the questionnaire studies conducted and by the on-site visual findings. The area's economy is dependent on farms, animals, crafts, and small-scale industries. Ranches are constructions with simplistic and primitive design in the region.

Waste and toxic gases produced in barns are of differing kinds and harm levels. Their harmful effects and impacts on the environment, animals, and individuals should be grasped and reduced by the most sensitive layout and execution of the necessary activities. In this scenario, the highest project layout standards are ensured. Without it, barns function as a contamination source (Alagoz et al., 1996).

Wastes vary from place to place as the conditions change; race, ration, system, and many other factors. The layout of the manufacturing units and their application impact whether the manure generated in the barns is robust, semi-solid, or liquid. For instance, waste is diluted by gathering and disinfecting manure using a pressure water system, i.e., the liquid is weighed. However, if many beddings are used, wastes will be more solid. If the solid component in wastes is 20-25% or more, it is called solid manure; if 10-20%, it is called semi-solid; if 0-10%, it is called liquid manure (Asabe, 2017).

Different types of manure can contain from 8-26 percent of solid matter. By separating the liquid and solid portions of manure, the solids can be used for other purposes.

Many dairy farms use separated manure solids for bedding (Epa, 2019).

The federal and national drinking water rules state that drinking water concentrations of nitrate should not exceed 10 milligrams per liter. Higher concentrations of nitrate-nitrogen than that can present a health problem, including the disorder called methemoglobinemia (blue baby syndrome) for babies under the era of 6 months. Nitrate can also affect adults, but there is much less proof (Harris, et al, 1998).

If waste generated from cattle farms is not correctly preserved, it may cause soil air, water, and groundwater pollution owing to the manure's nutrients and microorganisms. Waste storage provides farmers the most significant nutritional source for plant production. However, if the waste is not stored correctly, there is a risk to animal and human health from environmental contamination. Therefore, the waste (solid and liquid manure) generated in the barns should be shielded so as not to trigger any environmental pollution until it is transferred to the land (Cayley. et al., 2004). Improper use of industrial chemicals and additional manure increase plant nitrogen to a level that causes severe environmental pollution (Atilgan et al., 2006). Pathogens can pose health hazards by reaching more delicate crops, water, livestock, and individuals. Cattle firms which are constructed-in sites which are not appropriate for water resources and settlements and lack appropriate waste disposal, recycling, and therapy infrastructure are regarded as causes of several health-related issues (Pell, 1997; Gilchrist et al., 2007).

Use of manure in crop manufacturing without proper applications decreases the efficiency of wastes as fertilizers. Because manure is kept under inappropriate circumstances or wrongly implemented on the soil, it loses

a considerable quantity of nutrients owing to drying and evaporation and the anticipated advantages of agrarian manure for industrial commodity. (Boyaci et al., 2011). The most efficient variable in consumer purchasing choice is food reliability. Studies reveal consumer concerns about food reliability (Arısoy and Bayramoğlu, 2015).

The techniques to be used for gathering, transporting and storing manure and sewage (milling waste, wash water, surface runoff, leakage,) differ based on the sort of reproduction, weather, land topography, soil texture, geological structure, and price. In addition to these variables, the odor distress caused to farm inhabitants and nearby settlement units should also be taken into account. In order to determine the architectural characteristics of the manure and wastewater storage plant, the objective should be to maintain the value of the groundwater and groundwater resources and to reduce the odor effect, and a waste disposal plant should be constructed taking into account these factors (Chastain, J.P., Jacobson, L.D., 1996). Livestock breeding is an essential economic activity in the Tigris basin. Livestock breeding is the primary source of income for a majority of the population. Obtaining biogas energy from the potential animal manure in the basin will both ensure the disposal of the waste in the basin and economically contribute to the region.

MATERIALS AND METHODS

Study area

The research was conducted in south-east Anatolia in Turkey and included Diyarbakır, Mardin, Batman, Siirt, and Şırnak with counties in the Tigris Basin (Figure 1). The Tigris basin is among the biggest in Turkey as well as in the Middleast. The Tigris Basin was chosen as the research region. The Tigris Basin is composed of the

towns of Diyarbakir, Batman, Siirt, Sirnak, and Mardin. In school to determine this information, we have used the current amount of cattle from 5 provinces and districts collected from the literature and the Veterinary Information System (VETBIS) of the Ministry of Agriculture, Food and Cattle for the 2017-2018 season of the Tigris Basin (Anonymous, 2019a). 67 of 275 cities in the Batman area where animals were recognized were also included in the evaluation, close to water resources. 102415 livestock heads were grown in this area, and 28 percent of the total livestock numbers were grown in the neighboring water supply villages (Figure 2).

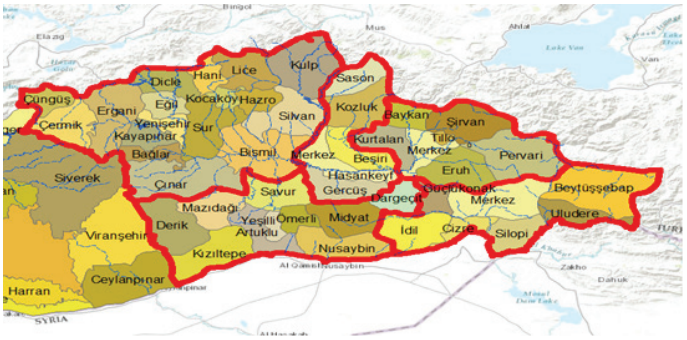


Figure 1. *Districts of Tigris Basin*

The research content is created by the information acquired from companies in which livestock activities are conducted intensively in the province and districts of Siirt via questionnaires. Similar research on the topic by multiple individuals and organizations have been benefited. The research was carried out in town centers and their associated villages, where cattle farming is widespread. Table 1 demonstrates information for Tigris Basin and its districts for 2017-18 Livestock Enterprises

Table 1. ***Data of Cattle Entities in Tigris Basin and its Districts for 2017 (Anonymous, 2019), (Anonymous, 2019a)***

Şırnak	2017	2018
Center	1492	4310
Beytüşşebap	286	561
Cizre	6566	12876
Güçlükonak	330	1232
İdil	5621	14844
Silopi	3188	3830
Uludere	805	1376
Total	18288	39029

Mardin	2017	2018
Arkutlu	5450	6500
Dargeçit	2500	5000
Derik	35000	60839
Kızıltepe	7000	7251
Mazıdağı	5450	5450
Midyat	7500	14206
Nusaybin	2500	4250
Ömerli	1800	2065
Savur	2500	7044
Yeşilli	1100	1150
Total	70800	113755

Siirt	2017	2018
Center	4653	3463
Tillo	227	377
Baykan	4292	5660
Eruh	1228	2335
Kurtalan	5000	5836
Pervari	2956	6577
Şirvan	4356	3943
Total	22712	28191

Diyarbakır	2017	2018
Bismil	17000	26342
Çermik	19136	34788
Çınar	22000	56000
Çüngüş	2750	3171
Dicle	9500	17500
Eğil	7700	11731
Ergani	25010	55000
Hani	8500	16500
Hazro	8000	19700
Kocaköy	11561	15973
Kulp	23250	53336
Lice	33500	41944
Silvan	45000	60000
Bağlar	28000	56684
Kyapınar	8400	25567
Sur	23460	28000
Yenişehir	12000	15942
Total	304767	538178

Batman	2017	2018
Center	20121	23847
Beşiri	5373	4489
Gerçüş	4183	4621
Hasankeyf	1096	1107
Kozluk	36032	37751
Sason	23701	30600
Total	90506	102415

384 producers of 5 cities associated with Diyarbakir, Batman, Mardin, Siirt and Sirnak provinces with intensive livestock production were intentionally selected to evaluate the area of research properly by contacting the officials of the Provincial Directorate for Agriculture. The farmers in these counties and associated areas, which suit the objective of the research, constituted the primary population of the research (Figure 2).

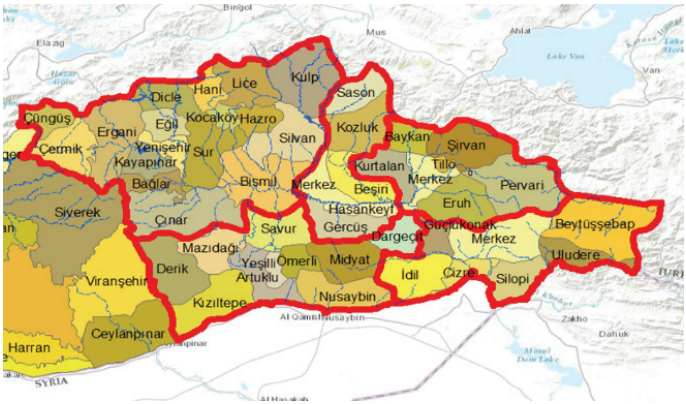


Figure 2. *Districts of the Tigris Basin*

The purpose was to assess the situation of the cattle breeding farms located in the fields of research by providing questionnaires for farm advisors employed both in the Provincial Directorate of Agriculture and for enterprises. The questionnaire, observations, and pictures were taken as materials and components for the determined enterprises. The number of businesses was calculated to which questionnaires in the districts and villages where livestock activities are performed in the region was calculated by the following Simple Random Sampling formulation according to the primary data; Using Main Mass Ratio Based Simple Occurrence Probability Sampling method 384 producers were interviewed (Newbold, 1995).

Equations: Simple Occurrence Probability Sampling method

$$n = \frac{z^2 * (p * q)}{d^2} \qquad \text{(Eq.1)}$$

n: Sample size,

z: 1,96 (standard z- value for 95% reliability level),

p: Main mass ratio which has prior knowledge about the subject or specific characteristics based on prediction.

q : (1-p) main mass ratio which does not have related characteristic.

d: Taken error tolerance level. In this study (- + 5%)

In the research, 10 percent mistake margin and 95 percent trust restrictions were implemented in determining the number of companies that are selected for questionnaires. The determining data regarding the status of storage of solid and liquid animal manure in the selected enterprises were provided utilizing a questionnaire prepared in the Department of Biosystem Engineering of Siirt University, Faculty of Agriculture The questionnaire types comprise of 53 questions and are designed to analyze all business information. Proportional allocation method was used to determine the number of enterprises surveyed. Proportional Stratified while selecting the number of enterprises to be surveyed by district decision on the application of random sampling method (Çiçek ve Erkan, 1996). Table 2 shows the number of surveys conducted accordingly.

Province	Number of Animals	Number of Surveys (Livestocks)
Şırnak	18.288	14
Mardin	70.800	54
Siirt	22.712	17
Diyarbakır	304.767	231
Batman	90.506	69
Total	507.073	384

Table 2. *Number of surveys (Livestock's Enterprise)*

RESULTS AND DISCUSSION

In this chapter the overall characteristics of the chosen livestock enterprises in Siirt Province and its districts are addressed, the present company models, the characteristics of the waste disposal system and the adverse effects that the animal waste generated in companies may have been discussed. Upon comparing the provinces in the basin in question, it was seen that Diyarbakır province has an essential place in the study area both in terms of field size and animal presence. When the provinces in the basin were examined, the total number of cattle for 2017 is 507.073 in Diyarbakır, 90.506 in Batman, 70.800 in Mardin, 22.172 in Siirt and 18.288 in Şırnak, according to the data of 2017 (Anonymous, 2019a). It was determined that the number of cattle grown in 239 farms that could have an immediate effect on the Diyarbakir region's water resources. According to literature, 38784 ton/month of animal manure will be generated in these villages. Therefore, the water resources in this province are expected to be exposed to higher levels of pollution than in other provinces (Fig. 3).

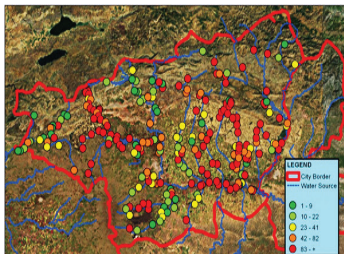


Figure 3. *Number of cattle in Diyarbakir Province* **(Atilgan, et al.,2016)**

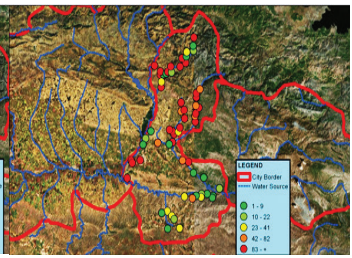


Figure 4*. Number of cattle in Batman Province (Atilgan, et al.,2016)*

It has been found that livestock production installations in the region were not situated individually, meat and dairy cattle living together and animals were retained in a blended manufacturing environment. Because of the old methods employed in the manufacturing processes, the productivity amount is decreasing, unhealthy animal goods are acquired, and the distribution of these goods is made by local purchasers only, making sales to the outer markets are challenging. The businesses must maintain their manufacturing operations within the framework of an economic, regulatory scheme as well as the quality of the design initiative. It was found that solid and liquid waste, especially in enterprises near to water supplies, can be immediately blended into groundwaters, which could contribute to environmental contamination and financial losses. Storage of wastes at the manufacturing point in such a way that it does not damage the atmosphere and the placement of companies by the norms of the design schemes is considered as an important topic for the research. The present capacity of the companies investigated in the region is determined to be an average of 12 heads. Business capability differs based on the financial status of tenants,

agricultural endorsements, and livestock policies. Capacity and percentages of enterprises are shown in (Table 3).

Animal Number(Heads)	Business Number(Number)	Percentage
1 – 7	134	35
8 – 14	138	36
15-21	74	19
21<	38	10
Total	384	100

Table 3. *Business Capacities and Percentages*

In particular, the constructs where solid and liquid manure is stored are entirely ignored. The reality that only animal pens are designed and their building regarded during the institution of the enterprise indicates that the manufacturers have not yet taken a conscious implementation of the design proposals. The farmers hold the view that the building of barns and corrals raises the expenses of investment. In examining the investment construction plans, it was determined that 73 companies (19 percent) were built on a particular project basis, with 311 enterprises (81 percent) being built without any initiative. The area of Batman was discovered to become the second in its amount of land and livestock. Sixty-seven out of 275 towns in the Batman region where pets were identified were found to be near to water supplies also included in the assessment. In this region, 102415 livestock heads are raised, and 28% of the complete livestock figures in this region are raised in the nearby towns of water supplies (Figure 4).

It has been disclosed that the holders of the enterprises that built a scheme benefited from the assistance program for agrarian development and therefore managed their enterprises. Only 31 (8%) of the enterprises surveyed, including those built on a venture with individual economic

assistance, have buildings in which solid and liquid animal waste is collected. Animal wastes are thrown outside open into the environment in 81 percent of the enterprises. It is notified, according to the responses provided to the questionnaire, that manure is used to increase the soil content of organic matter in fields where plant manufacturing is conducted in growing fields.

While collecting the data in the study area, the questionnaire created was conducted through questionnaires filled by the personnel in charge of the agricultural directorates. In the study area, Diyarbakır has the most significant potential in terms of the number of animals, followed by Mardin second Batman, third Şırnak fourth, and Siirt fifth. Çınar and Silvan districts of Diyarbakır have the highest number of livestock. The presence of these districts near water resources increases the potential pollution threat. In particular, the lack of fertilizer storage structures of the farms examined, and the fact that animal husbandry is carried out in closed shelters is not considered suitable for agricultural structures.

Derik district of Mardin province ranks first with the presence of 60839 bovine animals. Water resources of Derik district are at the border of 1-5 km and constitute a threat to the environment and animal health. While 46 percent of the enterprises surveyed do not produce products related to the project, the rest of the project is a project, but the projects are not followed.

The most significant potential in Batman province is in Kozluk district, and 37 percent of the animal wealth of the province is located in this district. The situation of Kozluk district in terms of agricultural structures is quite unfortunate according to the survey data.

İdil district of Şırnak covers 38 percent of the animal stock. In the research conducted in İdil district, it was stated that both shelters and storage structures are not suitable.

The animal husbandry potential of Siirt is mainly concentrated on sheep and is not preferred due to the high cattle investments and forage crop cultivation. The district with the highest number of cattle is Pervari. Due to the cold winter months of this district, animal wastes can easily be used as fuel. In addition, animal wastes produced in this district are sold as fertilizer to other districts of the city.

Based on this information, the situation of agricultural structures used in animal husbandry activities in the region is quite poor. Areas used as agricultural structures are mostly part of the habitats. The surveyed enterprises are close to water resources, and animal wastes are released randomly into nature without taking any precautions. In the buildings used as agricultural structures, essential components such as ventilation, lighting, and air conditioning are not paying attention. As a result, a decrease in yield and epidemic diseases may occur in animals. These poorly designed agricultural structures threaten not only animals but also human health. In order for the enterprises to be profitable, animals raised in agricultural structures must meet the Comfort-Zone criteria listed above. The Tigris Basin is kept in the foreground in order to increase the number of cattle, especially in agricultural supports. However, the support provided only increases the number of animals and the lack of supports to improve agricultural structures increases the number of animals, but does not positively affect the amount of product obtained from the animal. Implementation of programs to eliminate the physical deficiencies of enterprises, especially in agricultural subsidies, may improve not only quantitatively but also qualitatively.

One of the problems identified in the research area is that the plans prepared generally are not made by the farmers according to their wishes and they are not made in accordance with the planning specifications or the developments that may occur in the years following the planning stage of the enterprises are not considered. 68% of the shelters are located in the east-west direction, and 24% in the north-south direction and preventive measures have not been taken mostly from the extreme heat of the summer months. In the selection of shelter places, it was observed that the places that could best provide the drainage conditions were not selected, and rain and wastewater caused environmental pollution around the shelter. Since the shelter partitions in the enterprises are not planned to allow mechanization, there is difficulty in switching to mechanization in cleaning and feeding, and this situation increases the workers' need of the enterprises. In 46% of the studied shelters, corrugated zinc with a very high heat conduction coefficient was used on the roof, and 49% of the enterprises did not take any precautions for insulation on the roof. Therefore, the temperature inside the shelter can reach very high levels during the summer months.

Although briquettes were used in 80% of the walls, 38% of the enterprises were not plastered, and the whitewashes required for hygienic conditions were made both internally and externally in 40% of the enterprises and only internally in 30% of the enterprises. This situation adversely affects the hygienic conditions of the shelter. Also, 88% of the enterprises surveyed were found to be insufficient in total window areas, which leads to poor ventilation and lighting, exhausting of used, dirty air and preventing the entry of clean air into unfavorable environmental conditions within the shelter.

When the shelters are examined in terms of area per animal, 72% of them are insufficient, and the area per animal

is 4-5 m below. Since animals cannot find the area they need, there is a decrease in their ability to eat and feed. It was detected that the companies investigated in the Central District and District of Baykan are usually constructed near each other, and neighboring companies accumulate waste within a region near both companies. As a result, huge waste, odor, and visual pollution accumulate in the very same area. Intensive odor generation is recorded based on the climate, which is dry and warm, particularly throughout the summer in the area.

Furthermore, it was found that diseases and economic losses in the farm are the primary factors for livestock fatalities in companies surveyed. The companies investigated in the area did not perform cleaning operations within the barns, and the environment is not a hygienic atmosphere needed for the livestock. The truth that the solid and liquid animal waste generated in the facility is not removed from indoors, the current extraction processes in the barn are unsatisfactory and that the manure taken from the interior is not adequately preserved in the enterprise is determined to constitute the most significant issues. It was noted that there were solid and liquid accumulations of manure everywhere since the wastes had been collected in the company courtyard or in near range, and it was found that this waste could have a negative impact on both animal and human health. A further significant problem for enterprises is the pollution of odors. The effect of this negative environmental factor is because there is no current height distinction between the constructions of enterprises and other neighboring enterprises alongside the dominant direction of the wind. The choice and placement of the farms in most of the companies investigated in the region were not taken notice of. Most farms have been constructed in the settlement fields, usually beside village settlements. It has been found that solid and liquid animal waste has a harmful impact on the environment because it is placed in stacks around the house and the workplace.

CONCLUSION AND SUGGESTIONS

It is a fact that a significant portion of the people living in the centers and villages in the research area are far below the average living standards of their social lives and income levels. These people who live here and make a living are often forced to migrate to the big cities to find jobs. Therefore, it is imperative that these people, whose livelihood index is shallow, provide new job opportunities and seek new resources to utilize their workforce. It is necessary to be careful in terms of the environment while increasing production potential. For this purpose, the rules of human health and animal welfare must be followed when establishing stables.

In the research area, livestock activities such as barn and haystack are located next to or under the houses. The majority of the families engaged in animal husbandry are in the lower-income and education group and cause both the loss of yield due to the inadequate internal environment for the animal they breed and the environmental damages caused by the lack of proper storage of manure. Livestock activities in order to generate income, especially in enterprises in Şirvan district and villages constitute important liquid and solid waste problem. Randomly dropping the feces and urine of the animals living in the stables, usually on the lower floor or on the side of the houses creates significant pollution.

In our survey study, it was stated by the producers that diseases increased, especially in the summer months. As a result, it was concluded that animal wastes stored randomly or poured into streams, water channels caused bacteria and parasites to form, and a wide range of infectious diseases as a result of human contact. The actual distance between the company and the normal use regions of the enterprises researched varies according to some require-

ments. These requirements may be referred to as rural zone form, agriculture form, and sort of disposal scheme, and neighboring regions of use.

The solid and liquid manure generated by animal husbandry should be correctly preserved to avoid adversely affecting the atmosphere.

Because of the fact that waste and manure generated by enterprises not hurt the pets or the day-to-day care employees in enterprises as far as hygiene is concerned and environmental plans are concerned, waste storage buildings in the auxiliary machinery unit should be regarded at the barn scheduling phase. Different steps should be made, and specific requirements should be pursued carefully to prevent negative consequences and to bring negative impacts to the highest feasible stage. These requirements are as follows: the values specified in the Water Pollution Control Regulations in environmental legislation should be considered when calculating the distances of the animal farms to be constructed in any area to residence units, air assets such as rivers (Anonymous, 2004). Where manures are stored in the enterprise, floor, and soil waves should be commonly monitored and monitored. The manure storage capability should be in such a way that the immediate dissipation of ground flow and pollution of water can be prevented by blending with the soil (İnan, 2012).

The manure in animal barns should be held in a locked warehouse for future use. When manure is regularly collected in the open, it generates both pollution of the environment and air pollution because of its chemicals. Therefore, manure ponds should be scheduled in every company which can store the manure generated for certain phases correctly Gilchrist, et al., 2007). Accordingly, the following minimum ranges should be taken into account when selecting the area on which solid and liquid manure stor-

age sites and installations are situated;-50 m away from all kinds of surface water,-1600 m away from the area where bovine barns and hencoops are situated and individuals and other neighbours; Rational manufacturing without harming the atmosphere should be carried out; feeding places should be dry. It is necessary to cover the bottom of the manure acquired from the farms and prevent anaerobic decomposition. Manure stores should be constructed according to the building methods. The fuselage storage regions should be compacted and inclined to the fuselage. The mist should be cleaned commonly in the shed, and the manure should not smudge into the corpses of the livestock. Otherwise, if manure is present in the flesh, organisms land on the underside of the skin and the smell is produced from the animal. Also, the predominant wind direction should not be transferred to the housing region by the smell in farms. In this regard, the solid and liquid animal waste, as mentioned in the Turkish Environmental legislation, should be correctly stored in a storehouse, and odor excretion should be lowered. Farmers engaged in agriculture and animal husbandry should be provided with training on fertilization and disinfestation. Solid and liquid wastes from the enterprises should not be left in the soil inappropriately. Protected areas where wastes can be disposed should be established by the relevant public institutions. For example; In areas where animal husbandry is concentrated, storage units can be installed by public or private enterprises, especially in the common transportation areas of the villages. In this way, the possibility of utilization of wastes (biogas plants) will be possible. Besides, in order to benefit from agricultural endorsements, it should be paid attention to the fact that modernization will be established in the stables installed and the projected stables shall be constructed. By supporting cooperatives rather than supporting individual enterprises, both labor and labor can be opened, and productivity and environmental impacts of stables can be reduced to a minimum.

REFERENCES

1. Alagoz, T., Kumova, Y., Akyüz, A., Atilgan, A., 1996. A Study on the Hazardous Wastes Produced in the Livestock Facilities and Environmental Pollution They Create (In Turkish) Symposium of agriculture and environment relations, 13-15 May 1996, S.441-448, M.Ü. Faculty of Engineering, Mersin.

2. Anonymous, 2004. Water Pollution Control Regulations. (In Turkish) Resmigazete.gov.tr (www Document). URL: http://www.resmigazete.gov.tr/eskiler/2004/12/20041231.htm

3. Anonymous, 2019. Statistical Institute, Livestock Statistics 2017 (In Turkish) (www Document) URL: https://www.drdatastats.com/turkiye-buyukbas-hayvan-sayisi-haritasi-2017-yili/

4. Anonymous, 2019a. Republic of Turkey Ministry of Food, Agriculture and Livestock Veterinary Information System Records.

5. Asabe (American Society of Agricultural and Biological Engineers), 2017. Manure Storages,(www Document). URL: https://elibrary.asabe.org/abstract.asp?aid=44187&t=3&redir=aid=44187&redir=[confid=s2000]&redirType=-standards.asp&redirType=standards.asp Accessed date 27.04.2018

6. Arısoy, H., Bayramoğlu, Z., 2015. Consumers' Determination of Red Meat and Meat Products Purchase Behaviour – City of Ankara Sample Turkish Journal of Agriculture - Food Science and Technology, 3(1): 28-34, 2015.

7. Atilgan, A., Erkan M., Saltuk B., Alagoz T., 2006. Environmental Pollution Caused By Existing Manure from Animal Farms in the Mediterranean, Ecology Journal, Izmir, 15(58): 1-7 (In Turkish)

8. Atilgan, A., Saltuk, B., Oz, H., Artun, O., 2016. Management Of Manure From Lıvestock Housıng In Tıgrıs Basın And Its Envıronmental Potentıal Impact. Engıneerıng For Rural Development Jelgava, 25.-27.05.2016

9. Boyaci, S., Akyuz A., Kukurtcu, M., 2011. Environmental Pollutions Caused by Manure in Animal Barns and Potential Solutions, Research Journal of Agricultural Sciences, 4(1): 49-55. (In Turkish)

10. Cayley, J., Johnson, J., Ward, D., 2004. Nutrient Management Act - Siting Regulations for Manure Storage Structures. (www document), URL:http://www.gov.on.ca/OMAFRA/english/engineer/facts/04-11.htm

11. Chastain, J.P., Jacobson, L.D., 1996. Site Selection for Animal Housing and Waste Storage Facilities. (www document) URL:http://www.bae.umn.edu

12. Çiçek, A., and O. Erkan. 1996. Sampling and Research Methods in Agriculture Economics (In Turkish). Gaziosmanpaşa University Agriculture Faculty Journal, No: 12, Lecture Notes No: 6, Tokat, Turkey

13. Epa (the United States Environmental Protection Agency), 2019. Beneficial Uses of Manure and Environmental Protection. 2019 (www Document), URL: Http: // https://www.epa.gov/npdes/beneficial-uses-manure-and-environmental-protection Accessed date: 30.08.2019

14. Gilchrist, M.J., Greko, C., Wallinga, D.B., Beran, G.W., Riley, D.G., Thorne, P.S., 2007. The Potential Role of Concentrated Animal Feeding Operations in Infectious Disease Epidemics and Antibiotic Resistance. Environmental Health Perspectives. 115 (2): 313-316.

15. Harris, B.L., Hoffman D.W., Mazac, F.J., 1998. Reducing Contamination by Improving Livestock Manure Storage and Treatment Facilities. (www Document), http://nasdonline.org/static_content/documents/1626/d001508.pdf Accessed Date: 09.09.2019

16. İnan, İ. 2012. Comparison of the efficiencies of composting and anaerobic digestion processes used to stabilize animal wastes and treatment sludges. Uludag University, Institute of Science and Technology, Master Thesis (In Turkish).

17. Newbold, P., 1995. Statistics for Business and Economics. Prentice-Hall International, New Jersey, 867

18. Pell, A.N., 1997. Manure and Microbes: Public and Animal Health Problem? Journal of Dairy Science. 80: 2673-2681.

GECE AKADEMİ

www.gecekitapligi.com

/gecekitapligi

/gecekitapligi

/gecekitap

9 786058 022973