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2020 - № 58

THE COMPLEX OF SUBTROPICAL INSECT PESTS IN LANKARAN AND ASTARA NATURAL REGIONS OF AZERBAIJAN

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ABSTRACT. The data on the species composition, changes in the number of pests during the year for each of the 11 plant species are presented. Trophic connections only with citrus fruits have 8 types; only with other investigated subtropical plants - 10 species; and are found on plants of both groups - 14 species.

KEYWORDS: subtropics, imago, maggot, polyphage, pomegranate, tea, laurel, medlar, kinkan, feijoa, persimmon

The taxanomic analysis of the complex of subtropical insect pests in Lankaran and Astara regions has revealed 32 species referred to 3 groups – Diplopoda (*Polyxenidae*) - 1 specie, Akari (*Tetranychidae*) – 2 species, Insecta – 30 species, including 2 representatives of Coleoptera insect order (family: *Scarabaeidae-1, Curculionidae-1*), 24 species of Hemiptera insect order (family: *Aleyrodidae -1, Aphididae-2. Coccidae-5, Diaspididae- 12, Margarodidae- 1, Pseudococcidae-3*), and 3 species are referred to Lepidoptera insect order (family: *Papilionidae-1, Gracillariidae-1, Pyralidae-1*). Most of the species revealed are polyphage (95%), two species are monophages (6,2%), and the rest are oligophages. The dominant species of the citrus insect pests are *Dialeurodescitri* Ashmead, *Chrysomphalusdictyospermi* Morgan, *Pseudococcus comstocki* Kuwana, *Lepidosaphes beckii* Newman, *L.gloveri* Packard. According to our findings, the dominant species of the other subtropical plants under study are *Pseudococcus comstocki* Kuwana, *Pulvinaria floccifera* Westwood.

Introduction

Subtropical fruit crops such as mandarin, lemon, orange, kinkan, feijoa, persimmon, Actinidia delicata (kiwi), pomegranate, tea, laurel, medlar are cultivated in Lankaran and Astara regions, the zone of humid subtropics of Azerbaijan. The complex of harmful organisms available on subtro-

pical crops has its specific characteristics.

In European countries, in particular, the Mediterranean countries, such as Spain, Italy, Greece, the countries in the Balkan Peninsula, Turkey, etc., subtropical and citrus crops make up the majority of the whole agricultural production. In this regard, the protection of these plants from pests and diseases is a priority in such countries. Invasive pests take an important place in relevant studies, such as [1,2,3,4,5]. The data on the morphological, biological and ecological features of invasive subtropical pests, in particular, citrus ones, such as the California shield, Australian gutterworm, are given in *Diseases and pests of introduced plants* by Y.V.Sinadsky [6]. Interesting researches on identifying the new species of subtropical and citrus pests have been conducted in [7,8,9,10].

In Azerbaijan, the insects associated with subtropical cultures in Lankaran natural area were studied by various researchers such as Akhundova L.M., Ismaylov F.Y, Imamguliyev A.G., Kuliyev G.A., Mamedova S.R. [11,12,13,14,15,16]. They found many species of both pests and useful fauna.

The study material and method: The field part of the work consisted of collecting insects (imagos, maggots) from various subtropical plants by mowing with an entomological net, shaking off trees and shrubs, manual collection and using an exhauster. Also, observations were made on the behavior of insects, their number and the vegetative organs of the plant damaged by them (leaves, flowers, fruits) were counted. This part of the work was carried out in private and farm enterprises of Lankaran natural area using generally accepted entomological methods (Fasulati, 1974; Zlotin, 1989) [17, 18]. The diagnostics of the species was carried out in the laboratory using determinants [19].

Results: Many species of insects were brought along with food plants, without having entomophages among the local entomofauna, they quickly multiplied and settled. During the study period from 2017 to 2019, we found 32 species of subtropical plant pests in Lankaran and Astara regions, referring to 3 groups, 4 orders, 10 families and 16 generations.

Table 1 shows the taxonomic structure of the complex of the insect pests found on such crops, data on the occurrence of representatives of different families on individual plants, as well as the plant organs damaged by them. According to the table, the largest number of species – 24 (75%) be-

longs to the Hemiptera order, among which the dominant position with 12 species is taken by the Diaspididae family – the shield beetles. Single species belong to the orders of beetles and lepidopterans, *Curculionidae, Scarabaeidae* and *Papilionidae, Gracillariidae, Pyralidae* families, respectively.

Taxon	total	Citrus plants	Subtropical plants	Plant organs damaged
Coleoptera order	**2**			
Curculionidae family	1			
1.Pantomorussp.		+	+	Leaves
Scarabaeidae family	1			
2.TropinotahirtaPoda		+		Flowers
Hemiptera order	**24**			
Aleyrodidae family	1			
3.Dialeurodes citriAshmead		+	+	Leaves
Aphididae family	2			
4.Toxopteraaurantii (Boyer de Fonscolombe)			+	Leaves, shoots
5.Aphis punicaePass.			+	Flowers, fruits
Coccidae family	5			
6.Ceroplastes destructor Newstead*		+	+	Branches, shoots, leaves
7.C. japonicus Green		+	+	Branches, shoots, leaves
8.Coccus hesperidum L.		+		Branches, shoots, leaves, fruits
9.Pulvinariaaurantii Cockerell		+		Branches, shoots, leaves, fruits
10.P. floccifera Westwood		+	+	Branches, shoots, leaves, fruits
Diaspididae family	12			
11. Aonidiellacitrina Coqw.		+	+	Leaves, shoots, fruits

12.A. auranti Mask*		+	+	Leaves, shoots, fruits
13.Aspidiotusnerii Bouché		+	+	The whole plant
14.A. destructor (Siqnorett)		+	+	Branches, shoots, leaves
15.Chrysomphalus dictyospermi Morgan		+	+	Branches, shoots, leaves, fruits
16.Lepidosaphesbeckii Newman		+	+	Branches, shoots
17.L.gloveri Packard		+	+	Branches, shoots
18.L. granati Koroneos			+	Branches, shoots
19.Lopholeucaspis japonica Cockerell			+	Leaves, shoots, branches, fruits
20.Parlatoriazizip hi Lucas		+	+	Leaves, shoots, branches,
21.Pseudaulacaspi s pentagonaTarg.-Tozzetti		+	+	Leaves, branches
22.Diaspidiotus perniciosus Comstock			+	Leaves, shoots, branches
Сем. Margarodidae				
23.Iceryapurchasi Maskell		+	+	Branches, shoots, leaves, fruits
Pseudococcidae family	3			
24.Pseudococcusc alceolariaeMaskel l		+		Leaves, shoots, branches,
25.Ps. comstockiKuwana		+	+	The whole plant

26.Ps.viburniSignoret*			+	Branches, shoots, leaves, fruits
Lepidoptera order	**2**			
Papilionidae family	1			
27.Sp.				flowers
C.Gracillariidae				
28.Phyllocnistis citrellaStainton		+		leaves
Pyralidae family	**1**			
29.Euzophera bigella Zeller			+	Leaves, fruits
Arachnida infraclass ***Tetranychidae family***	**2**			
30.Tetranychus urticaeKoch	1		+	Leaves, fruits
31. Tuckerella.sp.	1		+	fruits
Diplopoda class	1			
Polyxenidae family	1			
32.Polyxenus lagurus**	1		+	Branches, shoots, fruits

Note: The «*» marked kinds are found in fauna of Azerbaijan for the first time, and «**» marked ones are newly found as subtropical insect pests.

Confinedness to the host plant. The analysis of the complex of subtropical pest insects in the region shows that the most pests were observed on citrus crops: 17 species on lemon plants, 19 species on mandarin plants, 16 species on orange plants, and 15 species on kinkan plants. On other subtropical crops, the number of pests ranged from 3 on tea and kiwi, to 9 on persimmon (Diagram 1). Since the studies were conducted on stationary plots, the area and density of trees on which were almost the same, in this regard, the number of pests on them differs slightly. The small number of pests noted on kiwi can be explained by the fact that, in comparison with other crops, these plants have been cultivated relatively recently.

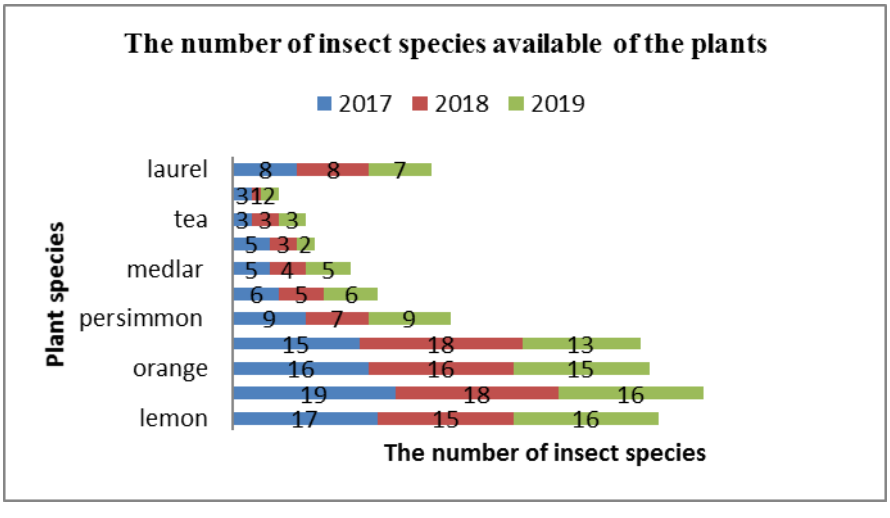

Diagram 1. Distribution of subtropical insect pests per feed crops

The vast majority of pest species observed on subtropical crops are polyphagous (95%) - this indicates that most of the species found have moved to subtropical crops from other plants, and are not tied to a specific host plant. However, there are also monophage species, such as *Lepidosaphes granati*, observed only

on the pomegranate and *Toxoptera aurantii* - a tea aphid found only on the tea bush.

Pests are also distributed unevenly per damaged plant organs (Diagram 2).

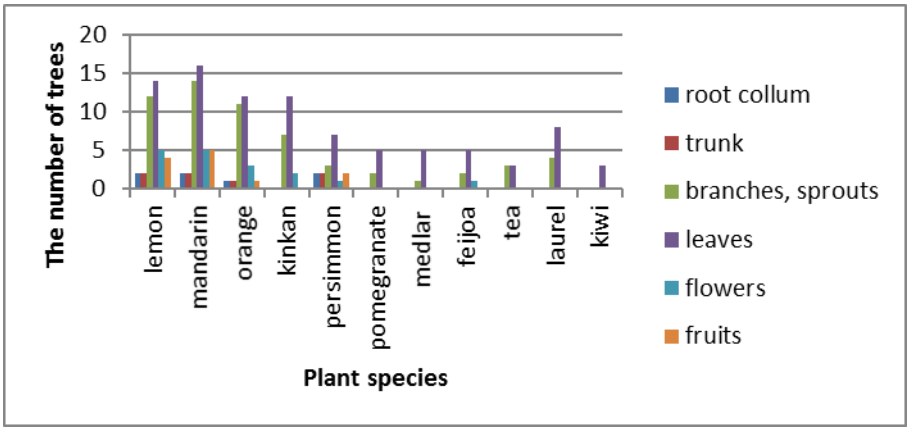

Diagram 2. The plant organs damaged by insect pests

Diagram 2 shows the number of trees of a certain type (the ordinate axis) with pests on one or another organ along the abscise axis. The least number of all pests were observed in the root part of the plant, only in the case when the pest affected all the organs (*Pseudococcuscomstocki* Kuwana). The pests mostly damaged leaves and fresh shoots. Thus, the whitefly (*Dialeurodes citri* Ashmead) was observed only on leaves. A number of pests were also observed on fruits of almost all citrus fruits, (*Aspidiotus nerii* Bouché., *Lepidosaphes beckii* Newman, *L. gloverii* Packard, *Lopholeucaspis japonica* Cockerell., *Pseudococcus calceolariae* Maskell, *Chrysomphalus dictyospermi* Morgan, *Coccus hesperidum* L.). Species such as the blossom feeder – *Tropinota hirta* Poda have been observed on mandarin and pomegranate flowers, and the weevil – *Pantomorus fulleri* Perkins, has been observed on mandarin leaves.

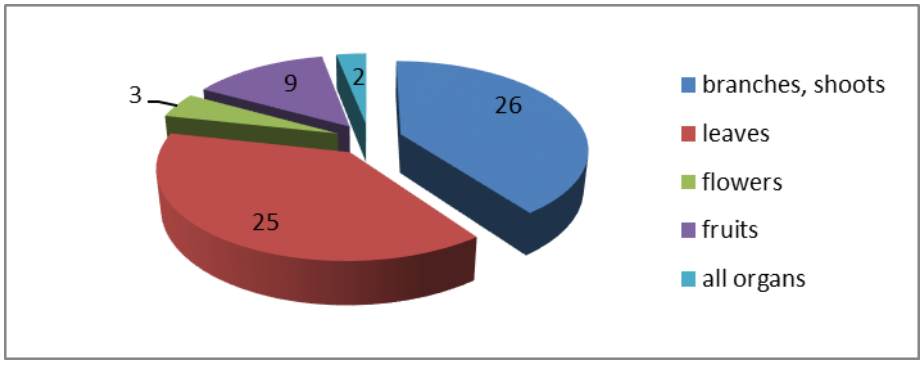

Diagram 3. The number of insect species observed on various plant organs

Among the pests, many species were observed on leaves, branches and shoots, as well as fruits. Diagram 3 shows the number of pests that have been found on various plant organs. As seen, the largest number of species was observed on leaves, fresh shoots and branches.

The periods of the pest activity are also very different. According to our observations, unlike other fruit plants, the peak activity of a number of pests on subtropical crops occurs in late winter and early spring. Such pest species as aphids were encountered in spring and summer (Toxoptera *theaecola* Buckt, *Aphis punicae* Pass.). In early April, after wintering, the adult whitefly begins to fly (*Dialeurodes citri* Ashm.). Many species of shield beetles had their peak activity in the autumn months. According to diagram 4, the majority of species are active throughout the year: *Aonidiella citrina* Craw, *Aspidiotus nerii* Bouché, *Chrysomphalus dictyospermi* Morgan, *Lopholeucaspis japonica* Cockerell, *Lepidosaphes beckii* Newman, *L.gloverii* Packard, *Ceroplastes japonicus* Green, *Coccus hesperidum* L., *Pulvinaria floccifera* Westwood, *P.aurantii* cockerell, *Icerya purchasi* Maskell, *Ps.Comstocki* Kuwana, and *Ps.Calceolariae* Maskell. One of the reasons for the large number of year-round acti-

ve species is due to the fact that many of the subtropical plants are evergreen.

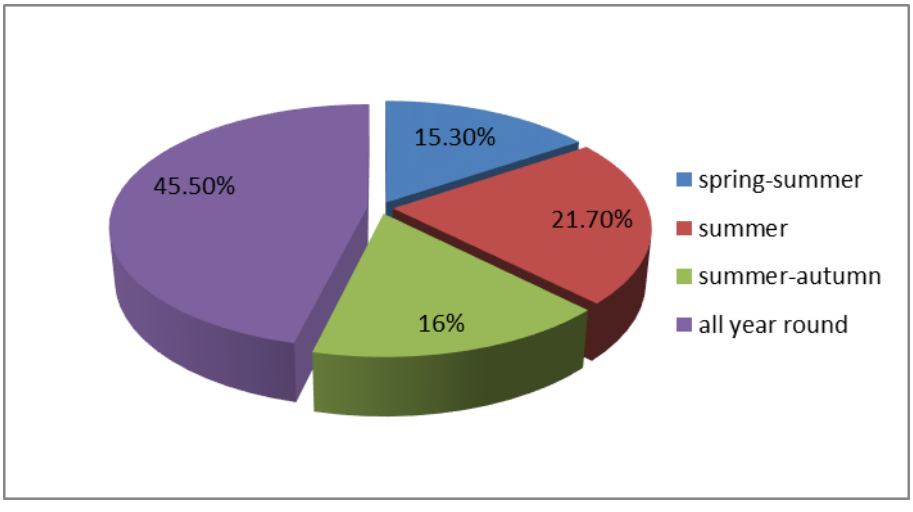

Diagram 4. Distribution of insect pests per their seasonal activities

Conclusion: According to the results of the studies, the subtropical pest complex in Lankaran and Astara regions is represented by 32 species referring to 3 classes - Diplopoda (*Polyxenidae*); Arachnida - 1 specie, (*Tetranychidae*) - 2 species; Insecta - 30 species, including 2 representatives of Coleoptera order (family: *Scarabaeidae*, *Curculionidae*), 24 species of Hemiptera order (families: *Aley*, *Aleyrodidae*, *Aphididae*, *Coccidae*, *Diaspididae*, *Margarodidae*, *Pseudococcidae*), and 3 species belong to Lepidoptera order (families: *Papilionidae*, *Gracillariidae*, *Pyralidae*). The occurrence of these species was high.

The largest number of species associated with damaged plant organs was observed on leaves and fresh shoots (25 species). It has been found that the majority of pests (45.5%) have a year-round development cycle synchronized with the vegetation of evergreen citrus plants. The peak activity of other species occurs in the autumn months, during the fruiting period of plants.

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A CHARACTERIZATION OF HYBRIDS BETWEEN *T. AESTIVUM* L. WITH *AE. VARIABILIS* EIG

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ABSTRACT. Straight and reciprocal crosses were produced between T. aestivum and Ae. variabilis without embryo rescue and hormone treatment. Most hybrid morphological traits were intermediate between parents, the plants grew vigorously but were highly sterile. However, F2 seeds were able to germinate normally, were also steril. The amount of seed setting of F1 plants variated between 1.25 and 18.06 %. The average frequency of chromosome associations at metaphase I was 26.78 univalents and 4.04 bivalents.

KEYWORDS: *Ae. variabilis*, seed setting, sterility, meiosis

1. Introduction

Aegilops variabilis Eig (syn. *Ae. peregrina* (Hack. In J.Fraser) Maire et Weiller) is an allotetraploid species (2n = 4x = 28, genomically S^vS^vUU) which includes sectio *Aegilops*, growing around the Mediterranean and into Jordan and Syria. It grows on a large variety of soils and in stable and disturbed habitats including pastures, abandoned fields, edges of cultivation, disturbed areas, and roadsides [20]. *Ae. variabilis* is an important gene source for wheat breeding. It has been reported that genomes U and S of *Ae. variabilis* derived from those of *Ae. umbellulata* and *Ae. sharonensis* [24]. The genome S of *Ae. variabilis* could be very closely related to the B genome of wheat and is probably responsible for the preferential pairing found.

It is known that the U genome of *Ae. variabilis* is characterized by the presence of acrocentric chromosomes [25], whereas A, B, D, and S chromosomes are metacentric. The short arms of the U genome might show low association frequencies and consequently may lead to an excess of AD-US and U-S open bivalents. This same behavior would be expected for US-

B bivalents if pairing was at random, but most of the US-B associations might actually involve S-B chromosomes and therefore they might form ring bivalents.

Ae.variabilis has been recognized as a source of genes for resistance to fungi, nematodes and high protein content in the grain [28]. Therefore, *Ae. variabilis* is an excellent gene source for wheat improvement. The genes and alleles of interests can be introduced into wheat by interspecific hybridization [7].

The tertiary gene tetraploid *Aegilops variabilis* is an alien germplasm resource that provides much needed genetic diversity for resistance to *Cochliobolus sativus* (spot blotch) and *Tilletia indica* (Karnal bunt). This resource has been hybridized with several bread wheat cultivars yielding cytologically normal F_1 hybrids (2n = 5x = 35, ABDUS) [4].

It appears that the crossability genes overcome incompatibility probably by facilitating fertilization through letting a foreign pollen tube enter the embryo sac [17], which is mainly related to the female parent. Therefore, the use of *T. aestivum* as female is necessary in any investigation which aims to locate the genes of *T. aestivum* that is associated with crossability.

Information is available showing that the 'Chinese Spring'-*Ae. variabilis* addition lines G and O carry genes conferring resistance to stem rust and cereal cyst nematode, respectively [9]. Recently, [26] succeeded in transferring root knot nematode resistance from *Ae. variabilis* into bread wheat.

In order to effectively exploit these useful traits in wheat, it is necessary to overcome extra difficulties with the introgression process, including a hybridization barriers, incompatibilities/hybrid abnormalities, sterility of F_1s and, reduced meiotic chromosome pairings. Despite these obstacles, many Aegilops genes have been transferred to wheat and have been heavily utilized over the last 60 years [5; 8].

Dengcai Liu (2011) reported that, in their study, a dominant gene for resistance to stripe rust was apparently transferred from *Ae. variabilis* 13E to bread wheat breeding line TKL2(R). An attempt to tag the resistance gene was in progress while it was being transferred into the bread wheat cultivars Sichuan and Qinghai.

In previous studies (Liu et al., 2003; Xiang et al., 2005), the haploid F_1 hybrid between bread wheat cultivar KL and *Ae. variabilis* (genom ABDUS) showed a high level of homologous chromosome pairing [20]. However, it is not clear whether translocations were produced by homologous pairing in these F_1 hybrids and then transmitted to their progenies. To answer this question, it will be necessary to testcross the primary hybrid and analyze the progeny for translocations.

The present investigation was initiated to examine the crossability of bread wheat with *Ae. variabilis* by intergeneric hybridization

Material and methods

For the material of the study were used 4 common wheat lines 171 and 172ACS ({Aegilotriticale [(*T. durum* Desf. × *Ae. tauschii* Coss.) × *Secale cereale* L. ssp. segetale Zhuk.] × *T. aestivum* L. 'Chinese Spring', N500 [(*T. aestivum* var. *graecum* Syria × Ch. Spring) × cv. Bezostaya-1], cv. Asakaze komugi var. *erythrospermum* (Japan) and *Ae. peregrina* k-539384 (Israel accession).

The emasculation and pollination in the field were carried out during the months of April-May in 2017 at the Absheron Research Base of Genetic Resources Institute of the NAS of Azerbaijan. No embryo rescue or hormone treatment was applied for the production of F_0 seeds. The spikes were harvested and number of seed-set per spike was counted about 20 days after pollination. Crossability was expressed as the percentage of the number of seed set to the total number of florets pollinated. The crossability of each test line was represented by the average percentage of seed set of all the spikes pollinated for that line.

For meiotic studies, young spikes at the appropriate stages were fixed in Carnoy's fixative for 24 h and then stored in 70% ethanol. Pollenmother-cells were stained and squashed in 1% acetocarmine. Meiotic observations were made and documented with Motic (China) microscope.

Results

Seed setting of hybrid combination between bread wheat line 171ACS and *Ae. variabilis* was 1.25 % and obtained single hybrid seed. This seed was germinated in Petri dish and the obtained seedling was transplanted into

the experimental field for further investigations. However, these intergeneric hybrid plants were completely sterile due to the difference of ploidy level of parent forms, so that we could not get any seed from 584 and 1046 spikelet florets. F_1 hybrid plants obtained was exhibited good tillering ability and manifested traits from both parents. The shape of plants was resembled the wild parent. The F_1 hybrid spikelets had a morphology similar to wheat. The leaf length, and peduncle length were intermediate between two parents. Metaphase I analysis of the pentaploid hybrids revealed the number of ring and rod bivalents for each PMCs was 0.56 and 3.36, respectively, the number of univalent was 26.90, the amount of trivalents was 0.06 and chiazma frequency was approximatedly 4.65. Driscoll (1968) and Sears (1977) informed that chromosome pairing in the hybrid between the common wheat cultivar Chinese Spiring and line TKE02 of *Ae. peregrina* is very low (0.5 chiasmata/cell), similar to the our results.

Table 1. Crossability and height of *T.aestivum-kotschyii* hybrids

№	**Hybrid combination**	**Seed setting, %**	**Fertility, %**	**Height, cm**
10/17	171ACS × *Ae. peregrina*	1.25	steril	60
33/18	172ACS × *Ae. variabilis*	18.06	destroyed	
34/18	N500 × *Ae. variabilis*	10.94	0.19	102
29/19	F2 N500 × *Ae. variabilis* fr1 fr2		steril steril	100 75
35/18	*Ae. variabilis* × Asakaze komugi	11.11	destroyed	

Table 2. Study of the meiosis process in F_1 hybrids between common wheat lines and *Ae. Variabilis*

Hybrid combina-tions	ATH	Bivalents	Ring bivalents	Rod bivalents	Univalents	Trivalents	Chiazma frequency
171ACS × *Ae.variab-ilis*	134	3.92±0.40	0.56±0.26	3.36±2.22	26.90±0.93	0.06±0.08	4.65±0.06
172ACS × *variabilis*	116	4.16±0.50	0.19±0.09	3.97±2.36	26.65±0.84	0.01±0.09	4.37±0.48

Regarding to the next hybrid combination, between bread wheat line 172ACS and *Ae. variabilis* was 18.06 % and obtained 9 hybrid seeds. Athough, these seeds gave F_1 plants, they could not comlete their vegetation period and destroyed. During the study of meiosis process of F_1 plants, the number of ring and rod bivalents for each PMCs was 0.19 and 3.97, respectively, the number of univalent was 26.65, and chiazma frequency was approximatedly 4.37.

The genome of F_1s between wheat and Aegilops in haploids causes sterility until doubling the chromosome numbers. One option is to conduct direct backcrossing of F_1s with wheat as a pollen donor. Even though the rate of seed set is extremely low, it is possible to obtain BC_1 plants [17; 30]. From this considerations, we used back-ross hybridization and F_1 hybrids crossed with common wheat parents (171 and 172ACS), however crossing was failure.

a. **b.**

Figure 1. a. Spike of of F_1 hybrid 171ACS × *Ae.variabilis* (center), bread wheat parent (left) and wild parent (right); b. Meiotic behaviour of its plant

Seed setting of N500 × *Ae. variabilis* combination was 10.94% and 7 hybrid seeds obtained. These seeds gave F_1 plants. The height of hybrid plants was 102 cm and fertility was 0.19%. Despited of, these plants were partially fertile, F_2 hybrid was completely sterile. Thus, it was not possible to get any seed from 2 fractions of hybrids.

For resiproc hybridization cv. Asakaze komugi used as male parent. Seed setting of this combination was 11.11 %. 3 of the 4 obtained seeds germinated and gave F_1 plants. But these hybrids also could not complete their vegetation period and destroyed. If it is too difficult to produce F_1 hybrids in wheat × certain Aegilops species (wheat as females), pollination in the opposite cross direction (Aegilops as females) may be more successful. Dale et al. (2017) reported 0% seed setting in bread wheat × *Ae. tauschii* crosses (probably due to a crossability problem of the bread wheat parents), while it was 30% in *Ae. tauschii* × bread wheat. The seed-setting rate with Aegilops as female parents is variable across these species. It must be cautioned that the seed setting does not always mean success in obtaining F_1 plants.

Discussion

Experimental hybrids between *Ae. variabilis* and *T. aestivum* have been described [6; 12; 22]. They reported a low level of pairing in F_1 hybrids between hexaploid wheat and *Ae. variabilis*, with 0–5.0 bivalents per cell, depending on the accession of *Ae. variabilis.* The low value of bivalents and sterility in the pentaploid hybrid indicates that the genomes of this hybrid are not related to each other as was expected, since *Ae. variabilis* brings the S^v and U genomes and *T. aestivum* the A, B and D genomes. A recent observation involving regenerated F_1 hybrids of *T. aestivum* × *Ae. variabilis* demonstrated seed set on an otherwise anticipated self-sterile population [27].

A. Mujeeb-Kazi (2007) informed bread wheat/*Ae. variabilis* cross combinations are examples of fairly simple intergeneric crosses as embryo formation frequencies were between 23.8 to 48.4% over all cultivars. All F1 hybrids were cytologically normal. Univalency at meiotic metaphase I was dominant. F_1 spike morphology was of intermediate expression and differed from both parents of the combination. This results are similar with our experiment. We consider F_1 hybrid phenotype modification a function of alien genetic expression that forms an initial selection sieve for advancing such F_1 combinations for agricultural practicality. Similar phenotypic observations are of common occurrence in intergeneric crosses [3] and specifically reported earlier for wheat/*Ae. variabilis* [1; 29]. Earlier [15] had

reported resistance in the same accession and here when it has been combined with various cultivars that resistance has shown desirable expressivity thus adding strength to its future usage for wheat improvement. Since all the bread wheat / *Ae. variabilis* amphiploids express satisfactory resistance to bunt, each source can be utilized for further breeding targets.

Aegilops variabilis line TKE02 has a good crossability with hexaploid wheat [4; 16]. Thus, F_1 hybrids between this line and the common wheat cultivar Chinese Spiring are easily obtained. F_1 hybrids of *Ae. variabilis* × polyploid wheat exhibit very low homoeologous pairing in the presence of Ph1 and any elevation in the pairing level is easily detectable. The F_1 hybrids of *T. aestivum* × *Ae. variabilis* reported by Ozkan (2001) had the expected chromosome number (2n=35). In all hybrids involving the substitution lines chromosome pairing was classified as low intermediate, which was significantly higher than the low level characteristic of the hybrid with CS.

Hybrids between polyploid wheat and *Ae. variabilis* [11; 22], are often the preferred material for studying genetic effects on homoeologous pairing. In such intergeneric hybrids pairing between homoeologous chromosomes is easily analyzed since it is not complicated by homologous pairing and a large number of pairing configurations. Sharma and Gill (1986) hybridized one accession of *Ae. variabilis* and seven accessions of other polyploid Aegilops species with the wheat cultivar Chinese Spring and did not find any increase in chromosome pairing in the respective hybrids.

Han et al. (1996) suggested that any hexaploid wheat line should have a crossability of at least 10% with *Ae. variabilis* and that wide crosses between hexaploid wheat and *Ae. variabilis* should be insensitive to the inhibitory effect by *Kr* genes of wheat. Our data agreed with these conclusions. *Ae. variabilis* is also phylogenetically distant enough from bread wheat to have their chromosome unpaired in their hybrids

Driscoll et al. (1979), analyzing meiotic behavior of Chinese Spring x *Ae. variabiIis*, found an excess of ring bivalents at the expense of the number of multivalents expected under their mathematical model. The discrepancy between observed and expected closed bivalents was numerically greater when chromosome 5B was lacking. This is probably due to the existence of preferential pairing, i.e., those genomes that were

more closely related would produce ring bivalents more frequently than those less related. Thus, A and D, or U, S, and B chromosomes form more ring bivalents when meiotic pairing increases.

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MULTIFACTOR DEVELOPMENT MODEL OF ICT SECTOR

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ABSTRACT. This research explores the information and communication technologies (ICT) and their individual components. An augmented production function is employed to estimate the total ICT effect on labor productivity growth as well as the impact exerted by its components (hardware, software, and communications).

KEYWORDS: e-government, Internet, computer, e-business, forecast, model, multifactor

The “e-government” project may seem a bit insipidly without the implementation of mental changes in people and the ability of citizens to access the Internet based on the use of possibilities of the Information Communication Technologies. Though change is possible by providing access to the Internet for individuals, enterprises and companies. In this sense, access to the Internet resources of society should be more complete so that the “e-government” project could provide citizens’ satisfaction. The purpose of our research was to analyze the dynamics of economic indicators in this area and identify some directions for future development. Successful implementation of the e-government project depends on the solution of two sub-issues:

a) individuals;

b) provision of access to the Internet by companies and enterprises.

By examining the 16 macroeconomic indicators of the ICT sector for the period of 2013-2018, we succeeded to identify the ICT destination region.

№	Name of Indicator	**2018** in%
1	ICT development Index* - 6,33	63,3%
2	Proportion of individuals who used a computer, in percentage	72,5%
3	Broadband Internet users per 100 population, person	75,0%
4	Internet users per 100 population, person	79,8%
5	Age distribution of users the Internent, as % to total under 24 years old	40,4%
6	Distribution of Internet users by educational attainment,secondary education, in percent	58,6%
7	Proportion of households with Internet access at home, in percentage	69,1%
8	Computers per 100 inhabitants, unit	72,4%
9	Frequency of using the Internet, in percent every day	81,8%
10	Proportion of enterprises using the Internet, in percentage	52,9%
11	Proportion of enterprises with a Web presence, in percentage	12,3%
12	Proportion of businesses receiving orders over the Internet, in percentage	5,4%
13	Distribution of computer users by use of applied program packages, in percent	47,8%
14	Volume of International Internet bandwidth per capita, kbit/s	83,5%
15	Share of schools with Internet access in total number of schools, percent	57,4%
16	Proportion of enterprises using computers, in percentage	67,2%

The first hemisphere of this region characterizes companies' access and the second hemisphere characterizes individuals' access to the Internet resources (see Figure 1). As can be seen, the activities of our companies over the Internet are not so hopeful.

In our opinion, the resolution of some of the following issues is very important:

- ensuring more complete access of the population to computers and the Internet;

- improvement of ICT skills and knowledge of public administration officials;

- organization of more innovative training and education in this area;
- attracting discounts of activity on the Internet;
- creation of databases distributed on all levels of management;
- creation of electronic "citizen-family-enterprise-government" model.

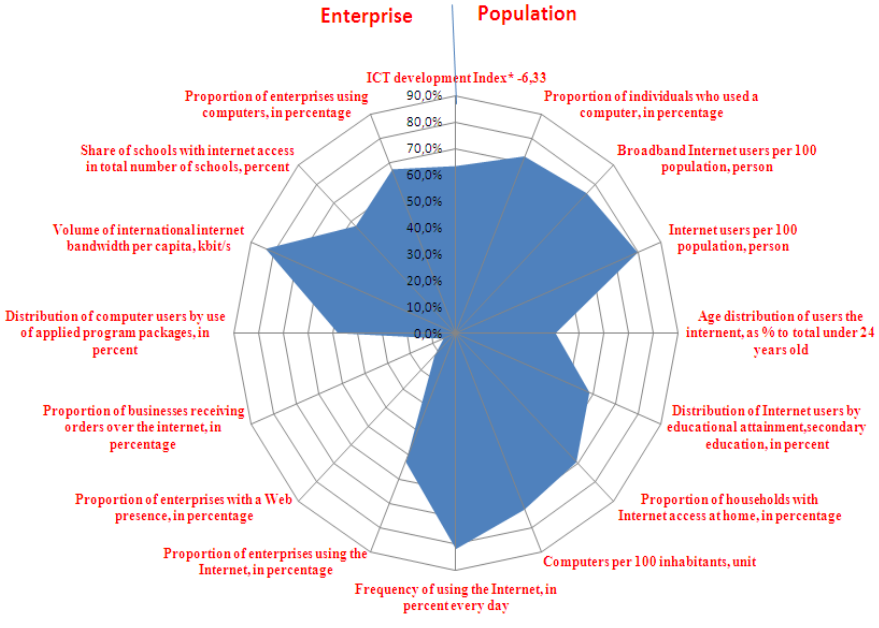

Figure1. Multifactor destination region of ICT – 2018 (in %)

By predicting the 6-year dynamics of the indicators with simple interpolation, we can obtain the destination region of the ICT sector for 2024. If we conduct an analysis of this forecast, we can see that the resolution of a number of issues in realizing of the e-government project is waiting for us:

- provision of public access to the Internet from the apartments of the population of the country;
- increasing government care through electronic procurement and business application taxes;

- creation of management information base and virtual connection;
- creation of motivation to use Internet resources - online payments and application of interest discounts to the business parties. While it is desirable to unify a citizen with documents when registering on electronic government portal, the issue does not end there. The main issue is to ensure the security of citizens' information, because the transfer of citizen information into the hands of another personon an electronic portal as a result of cyberattack can lead to unfaithfulnessof the system, which reduces the citizen's confidence in the electronic government project.

№	Name of Indicator	2024 in %
1	ICT development Index* -6,9	69.0
2	Proportion of individuals who used a computer, in percentage	76.7
3	Broadband Internet users per 100 population, person	87.0
4	Internet users per 100 population, person	86.5
5	Age distribution of users the Internet, as % to total under 24 years old	41.9
6	Distribution of Internet users by educational attainment,secondary education, in percent	64.2
7	Proportion of households with Internet access at home, in percentage	83.6
8	Computers per 100 inhabitants, unit	86.5
9	Frequency of using the Internet, in percent every day	81.6
10	Proportion of enterprises using the Internet, in percentage	60.1
11	Proportion of enterprises with a Web presence, in percentage	14.2
12	Proportion of businesses receiving orders over the Internet, in percentage	5.9
13	Distribution of computer users by use of applied program packages, in percent	46.7
14	Volume of International Internet bandwidth per capita, kbit/s	94.1
15	Share of schools with Internet access in total number of schools, percent	59.2
16	Proportion of enterprises using computers, in percentage	75.8

Result. Let's analyze the predicted values obtained as a result of the study:

- as can be seen from the tables and the figure above, Internet access in the country is still weaker than that of apartments. For the e-government project to become popular, it is necessary to expand the access of the population to the Internet;

- as shown above, the opportunities in e-business need to be further enhanced. The share of businesses with a website should be significantly increased by 14.2%, while the share of companies and businesses with e-business should be up 5.9%. For this reason, introduction of special tax breaks by the government for companies and enterprises doing business on the Internet will lead to better results.

- the creation of large databases in the field of management and services and the improvement of virtual relations would make the e-government project more useful.

- to motivate the use of Internet resources - programs, databases, inquiry systems, electronic payments and accounts, as well as apply percentage discounts for all participants would be more effective - ensuring the security of personal data of all participants of the e-government project - the population, companies, services, producers and consumers, the absence of a cyber attack of information related to each subject and object on the electronic portal increases confidence in the e-government project, and at the same time we can observe a rapid increase in the number of users of the system, which can increase the efficiency of the project.

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INFLUENCE OF FERRIC OXIDE NANOPARTICLES ON THE ACTIVITY OF ASCORBATE PEROXIDASE IN WHEAT SEEDLINGS

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ABSTRACT. During life, plants are constantly or periodically exposed to adverse, environmental factors, which leads to an increase in the generation of reactive oxygen species (ROS), the level of which in plant cells is controlled by the antioxidant system of protection (AOS). This article considers the change in the activity of one of the high molecular weight components of the AOS – ascorbate peroxidase (APO), in two-week seedlings of soft wheat varieties under the influence of trivalent ferric oxide nanoparticles (NPs). According to obtained data, it was found that the activity of APO under the influence of trivalent ferric oxide NPs in wheat seedlings depends on varietal characteristics. In seedlings of tested wheat varieties, ferric oxide NPs led to a sharp or insignificant increase in the activity of APO Dagdash and Gobustan varieties, respectively, while in the seedlings of Sheki-1 and Mirbashir-128 varieties a decrease in the enzyme activity was observed. Thus, our findings can serve as the basis for selection of wheat varieties more resistant to abiotic stressors.

KEYWORDS: agriculture, nanoparticles, soft wheat varieties, antioxidants

1. Introduction

Antioxidant system of protection (AOS) is a multicomponent multilevel self-regulating system, represented in plant cells by high-molecular-weight enzymes and a number of low-molecular-weight components. To ensure the most effective protection, all elements of the system must be in constant interaction, and maintaining their balance is important to preserve the viability of plants under stress conditions [1, 2].

One of the antioxidant enzymes of a plant cell is ascorbate peroxidase (APO; EC 1.11.1.11), a heme-containing enzyme localized mainly in chloroplasts, which has a high affinity to hydrogen peroxide, reducing it to

water, using as a donor of electrons ascorbic acid, thereby regulating the rate of oxidation of ascorbic acid in cells [3, 4]. Today, the study of the problem of plants' resistance to adverse environmental factors is one of the central problems of modern biology. On the other hand, with an increase in the rate of consumption of agricultural products, and to ensure food security of the population, agricultural production requires constant integration of science in the agro-technological process [5]. In this regard, in recent years, interest to the study of the influence of nanoparticles (NPs) of various metals entering the environment, both as a result of natural processes and as a result of the activity of an anthropogenic factor on biological systems, has increased [6, 7].

Thus, environmental pollution with high concentrations of NPs of inorganic materials with altered structural and physicochemical properties has a negative effect on the physiological and biochemical characteristics of living organisms' cells. For example, one of the most frequently reported toxic effects of nanoparticles by researchers is the generation of reactive oxygen species (ROS) in cells, leading to oxidative stress [8, 9]. The high reactivity of ROS and free radicals lead to an acceleration of oxidation reactions that disintegrate the molecular basis of cells, which, in turn, causes damage of cellular structures. In the case of using nanoparticles in low concentrations, on the contrary, there is a positive effect of their impact on biological objects. Thus, the effects of NPs on living organisms depend on the concentration of NPs [10]. Studying, the accumulated experimental material we come to the conclusion, that there are various theories of the effect of NPs on living systems, at the same time, the mechanisms of their biological activity have not been sufficiently studied, which requires their further more complete study [11].

In recent years, it has been, established, that oxidative stress can be caused by nanoparticles, based on iron, copper and nickel, which are the most used by industrial enterprises worldwide [12]. It is assumed, that the intensity of development of biological effects of highly dispersed metals differs from the effects of their oxide forms, and mainly depends on the presence in its composition of variable valence metals. The last are capable to release toxic ions from their colloidal matrix and stimulate the production of reactive oxygen species [13]. Nano-powders quite easily penetrate the cells

of seeds prepared for sowing and actively influence the enzymatic system of physiological and biochemical reactions [14].

In general, numerous experimental and review articles are devoted to the study of the effect of NPs of metals on plant organisms [15; 16]. However before, no studies have been carried out, to study the effect of different concentrations of ferric oxide NPs on the functioning of AOS components in wheat seedlings.

Therefore, the aim of our work was to study the effect of ferric oxide NPs on the activity of ascorbate peroxidase in two week seedlings of soft wheat varieties to assess their tolerance to the influence of nanoparticles.

2. Materials and Methods

The objects of the study were four varieties of soft (Triticum aestivum L.) – Gobustan, Dagdash, Mirbashir-128 and Sheki-1 wheat purchased from the Research Institute of Agriculture under the Ministry of Agriculture of Azerbaijan.

First, all seeds were disinfected with 0.01% KMnO4 solution for 5 minutes and after washing three times with distilled water, control and experimental seeds were germinated in pots with soil within 14 days, under 12-hour illumination, temperature 24±1 °C and humidity 80±5%, avoiding drying of seedlings in a climatic chamber (Taisite GZX-300E, China) [17]. The plants were divided into three groups:

1. Control series (without soil treatment with iron NPs)

2. 1st series (soil treatment with Fe2O3 at the concentration of 15 mg per 1 kg)

3. 2nd series (soil treatment with Fe2O3 at the concentration of 30 mg per 1 kg)

The size of ferric oxide NPs is 20x40 nm (Skyspring Nanomaterials Inc, USA). Treatment of soil with NPs, was carried out once, taking into account their maximum permissible concentration (MPC): the applied amount exceeded MPC 2-4 times, respectively. Each series included 30 seeds of the studied wheat varieties.

The method of determination the activity of ascorbate peroxidase (APO, EC 1.11.1.11) was based on determining the rate of decomposition of hydrogen peroxide by ascorbate peroxidase of tested samples with the for-

mation of water and dehydroascorbate [18]. Optical density was recorded on a spectrophotometer (MRC, model UV-200-RS, Israel) at 290 nm.

For this, a sample of the plant material (1g) was homogenized in a chilled mortar with 10 ml of 0.06 M phosphate buffer, pH 7.6, with addition of 0.3 g polyvinylpyrrolidone. The ground mass, was transferred to a 50 ml volumetric flask, which was filled by the same buffer till the mark, mixed well, and left for 15 min. This homogenate was centrifuged at 8000g for 10 min at 4°C. The reaction mixture consisted of 50 µl 0.1 mM EDTA (Biochemica), 50 µl 0.05 mM ascorbic acid (Sigma-Ultra), 50 µl 0.1 mM hydrogen peroxide, 2.25 ml phosphate buffer, and 300 µl plant extract obtained after centrifugation of the homogenate. Activity was expressed in nmol per gram of wet weight per unit of time [nmol•g-1•min-1]. The calculation of the activity of ascorbate peroxidase was carried out on the basis of molar extinction coefficient (E = 2.8 mM-1cm-1).

The experiments, were carried out in three biological replicates and each was reproduced independently three times. Statistical processing of the results, was carried out, using the licensed IBM SPSS Statistics software package. The assessment of the reliability of differences in arithmetic means was carried out on the basis of the Student's coefficient. Differences between groups were considered significant at a two-tailed level of significance $p \leq 0.05$. The diagram was constructed using the GraphPad Prism 8 software.

3. Results and Discussion

According to the obtained results, the activity of ascorbate peroxidase in the control and experimental samples of studied wheat varieties differ from each other, the numerical values of which are presented below.

Analysis of the data shows that the highest enzyme activity was observed in treated seedlings of Dagdash variety, the lowest in the control seedlings of the same variety. In the samples of Gobustan variety, seed treatment with ferric oxide NPs, led to an increase in the activity of ascorbate peroxidase, in both, first and second series by (15%, 37%), respectively in comparison with the control. In first series of samples Sheki-1 and Mirbashir-128 an increase in the enzyme activity was observed, while in the se-

cond series of samples, the activity of ascorbate peroxidase under the influence of NPs of ferric oxides, decreased by 10% and 8% respectively, compared with the control (Fig. 1).

Thus, considering the obtained data, we find that less ROS is formed in the first series of samples therefore they have a lower intensity of free radical oxidative processes than the second series of samples, with the exception of two varieties Mirbashir-128 and Sheki-1.

Our studies demonstrate a positive or negative effect of NPs of ferric oxide on the activity of ascorbate peroxidase in two-week seedlings of various soft wheat varieties, which has important implications for many industries of agriculture. As it is known, NPs are distinguished, by unusual physicochemical properties and specific effects, on living organisms [19].

The literature contains data regarding the effect of iron NPs and its oxides on physiological and biochemical processes in plants [20].

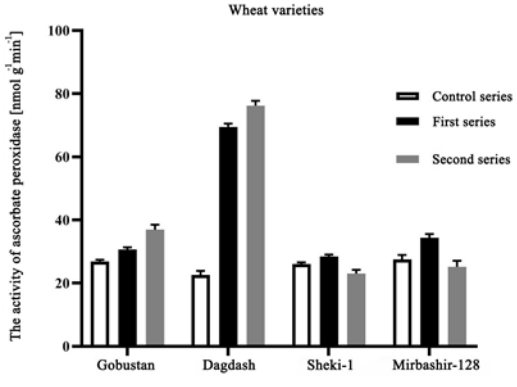

Fig. 1 The activity of ascorbate peroxidase in control and treated seedlings of soft wheat varieties

It has been shown that in vivo •OH is formed mainly as a result of the iron-catalyzed Haber-Weiss reaction, which is a combination of two elementary processes: the Fenton reaction and the reduction of ferric O2 ◌̄•[21].

$$H2O2 + Fe2+ \rightarrow \bullet OH + -OH + Fe3+$$
$$Fe3+ + O2◌̄\bullet \rightarrow Fe2+ + O2$$

Thus, the increase of the activity of ascorbate peroxidase in our experiments is the evidence of the protective function of plants aimed to reduce hydroxyl radicals.

A positive effect of nano-preparations of microelements, on the chlorophyll content, the activity of antioxidant enzymes of chloroplasts and the yield of wheat, was revealed in the works of Sokolovskaya-Sergienko [22]. According to some authors, silver NPs in low concentration increased the germination energy and the ability of seeds to germinate, their growth and development, respiration rate and the activity of enzyme system [23]. In the studies of Egorov and Shafronov, iron nanopowders increased the yield and grain quality of crops [24].

Thus, the results of studies carried out with NPs are contradictory, and further studies in this direction are expedient. Apparently, the suppressive effect of NPs of trivalent ferric oxides on the activity of ascorbate peroxidase, in the second series of samples of Mirbashir-128 and Sheki-1 is associated with high concentration of NPs. Differences in the levels of enzyme activity of studied wheat varieties can be associated with their different resistance to high concentration of trivalent ferric oxide NPs.

So, as a result of the experiments, it was revealed that the activity of ascorbate peroxidase in wheat seedlings under the influence of NPs of trivalent ferric oxides depends on the varietal characteristics. In this regard, the study of the mechanisms of the effect of metal oxides NPs on the rate of oxidation of ascorbic acid in various varieties of wheat deserves further work in this direction.

4. Conclusion

Based on the obtained data, we conclude that in the first series of all tested wheat varieties NPs of ferric oxides led to an increase in the activity of ascorbate peroxidase, while in the second series of soft wheat varieties a decrease of the enzyme activity was observed in the seedlings of Sheki-1 and Mirbashir-128, contradictory a sharp increase in the activity of APO under the influence of ferric oxide NPs was observed in the seedlings of Dagdash.

Thus, the obtained data make it possible to distinguish the varieties Dagdash and Gobustan as resistant to the influence of NPs of ferric oxide, which has importance in breeding work for obtaining resistant varieties.

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OPTIMIZATION OF THE CATALYTIC CYCLOALKYLATION REACTION OF PHENOL WITH METHYLCYCLOHEXANES

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ABSTRACT. The developed mathematical model of the processes of interaction of phenol cycloalkylation with methylcyclohexenes in the form of a regression polynomial made it possible to find the optimal values of the input variables. The calculation results showed good agreement between the experimental and calculated data.

KEYWORDS: phenol, catalytic cycloalkylation reaction, correlation coefficient, regression model

In world practice, in the process of pyrolysis of low-octane gasoline in the oil refining industry, a large amount of C_5- fraction is obtained, which has not yet found its effective use. Involvement of this fraction in the petrochemical synthesis complex is one of the most urgent and important problems from the ecological, scientific and practical points of view [1-6].

It is known that the C_5-fraction contains up to 12-15% of isoprene and piperilen diene hydrocarbons. Up to 65-70% of a mixture of 1- and 3-methylcyclohexanes is obtained from thermal condensation of the C_5-fraction with ethylene under pressure (70-75 atm).

We used cationite KU-23 catalyst for catalytic cycloalkylation reactions of phenol with 1(3)-methylcyclohexanes. The purpose of this research is to study the process of obtaining para- (methylcyclohexyl) phenols, to find the optimal regime parameters and to create a regressive mathematical model.

Experimental part

Phenol, a mixture of 1- and 3-methylcyclohexanes (103-112^oC) was used as the starting material for cycloalkylation reactions.

Phenol is expelled and purified before use.

103-112°C fraction of 1(3) -methylcyclohexene is expelled from C_5-fraction of ethylene with diene synthesis products and has the following physicochemical properties: $T_{boiling}$ = 103-112°C; n_D^{20} – 1.4515; ρ_4^{20} – 0.8175; m.k. – 96.

Cationite KU-23 was used as a catalyst for cycloalkylation reactions.

Catalytic cycloalkylation reactions of phenol with 1(3) -methylcyclohexanes were studied in a three-necked flask: the calculated amount of phenol and catalyst were poured into the flask and heated, and when it reached 45°C it was heated for 40 minutes and drop-by-drop cyclen is added. The reaction temperature is then raised to 80-140°C and mixed at this temperature for 2-6 hours; at the end of the reaction, the experiment is stopped, the alkylate is filtered off the catalyst and rectified.

Physicochemical properties and chemical structures of the obtained products are determined.

The structures of the synthesized substances were confirmed by IR and ^1H, ^{13}C NMR spectra:

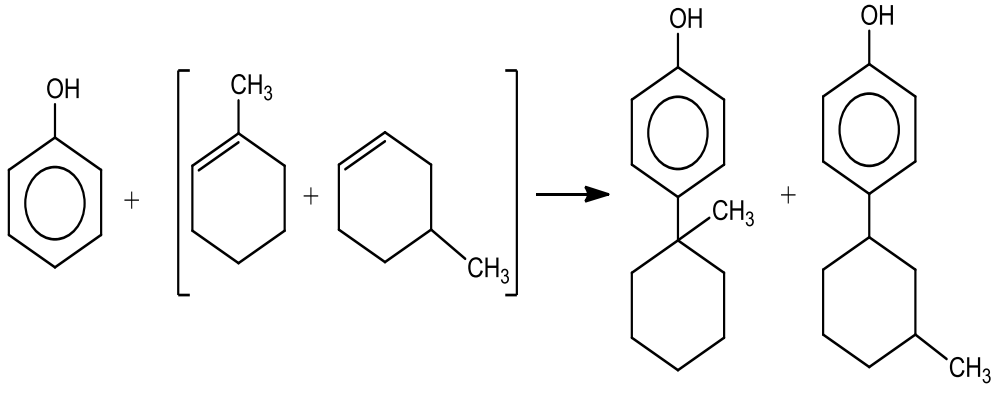
The following sliding strips were observed in the IR spectrum: 814, 878 cm^{-1} - 1,4-substituted benzole ring; 1063, 1124, 1171 cm^{-1} - deformation shift of O–H group in phenol; 1243, 1274 cm^{-1} - C–O bond in phenol; 3496 cm^{-1} - valence shift of O–H bond in OH group; 1500 cm^{-1} - benzole ring; 1603 cm^{-1} - C=C bond of benzole; 1339, 1370, 1403, 1443 cm^{-1} - deformation sliding of CH_3 and CH_2 groups; 2855, 2919, 2964, 2984 cm^{-1} - valence shifts of CH_3 and CH_2 groups.

Results of ^1H NMR spectroscopic study ($CDCl_3$, δ, ppm): 1.38 (singlet, 3H, CH_3); 1.54-2.22 (multiplet, 10H, $5CH_2$); 2.33 (singlet, 3H, CH_3); 4.61 (singlet, 1H, OH); 6.57-6.60 (d, 1H, arom.); 6.90-6.93 (d, 1H, arom.); 7.4 (singlet, 1H, arom.).

^{13}C NMR spectrum results ($CDCl_3$, δ, ppm): 20.9 (CH_2, in a cycle); 22.8 ($2CH_2$, cycle); 25.6 (CH_3, cycle); 26.6 (CH_3, arom. in a ring); 36.9 ($2CH_2$, cycle); 37.8 (C, cycle); 116.8 (CH, arom.); 127.0 (CH, arom.); 128.8 (CH, arom.); 129.6 (C, arom.); 135.2 (C, arom.); 152.0 (C–O, arom.).

Discussion of results

The cycloalkylation reactions of phenol with 1- and 3-methylcyclohexanes (MTSH) follow the following equation:



To find the optimal conditions for the cycloalkylation reaction of phenol with MTSH, the effect of reaction temperature, time, molar ratios of the initial components, the effect of the amount of catalyst on the yield and selectivity of the target product was studied. The reaction temperature was 80-140^{o}C, for 2-8 hours, the mole ratio of phenol to MTSH was 0.5 ÷ 2:1, the amount of catalyst was studied in the range of 5-15%.

The optimization of the process and the construction of a mathematical model were carried out on the basis of the development of experimental indicators at the following stages:

- creating a linear dependence between factors;
- finding the correlation between the output parameters;
- evaluation of the value of the coefficients of the obtained model;
- analysis of the sensitivity of the model to excitement;
- solve the optimization task and create a nonlinear mathematical model.

The initial stage is characterized by the interaction between indicators in statistical analysis. Probable relationships of the calculated sizes X_i, X_j were determined, where X_1 denotes phenol, X_2 – MTSH, X_3 - temperature, X_4 - time, X_5 - amount of catalyst, Y_1 - product yield, %, and Y_2 - process selectivity, % (Table 1).

Table 1.

Dependence of the yield of para-(methylcyclohexyl) phenol and process selectivity on reaction condition

Exp., row number	Phenol, gr.	MTSH, gr.	Temp., °C	Time, hour	The amount of catalyst, %	The yield of the target product, %	Selectivity of the process, %
1	47	48	80	4	7	45.4	88.2
2	47	48	100	4.5	7	60.7	90.8
3	47	48	120	5	7	76.5	95.3
4	47	48	130	2	7	64.9	89.4
5	47	48	140	4	7		
6	47	48	120	6	7	74.3	86.1
7	47	48	130	7	7	70.6	89.7
8	47	24	130	7	7		
9	47	48	120	6.5	7	78.3	94.9
10	47	72	120	3.5	7	61.2	83.6
11	47	96	120	2.5	7	54.7	87.3
12	47	48	110	5.5	7	73.3	91.4
13	47	48	110	6	7	75.5	93.6
14	47	48	120	6.5	5	64.6	92.0
15	47	48	120	6	7	75.1	96.2
16	47	48	120	5.5	10	70.1	93.3
17	47	48	120	5	15	77.9	94.7

The calculation of paired correlation coefficients is carried out by the following formula:

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sqrt{[n\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2][n\sum_{i=1}^{n} y_i^2 - (\sum_{i=1}^{n} y_i)^2]}}$$

The linear correlation coefficient $|r|$ is characterized only by the degree of density of the linear dependence. Correlation coefficient [-1; 1] is important in $-1 \leq r \leq 1$ It differs depending on the degree of approximation of $|r|$ to "1": weak (0… 0.3); relatively weak (0.3… 0.5); selected (0.5… 0.7); fairly dense (0.7… 0.9); quite dense (0.9… 0.99) contact, the closer $|r|$ is to 1, the stronger the bond. The results of the calculations show that the correlation coefficients found are in the range of 0.3-0.8 on the Cheddock scale. corr(1,2)=0.624; corr(2,3)=0.005; corr(3,4)=0.019; corr(5,6)=0.028; corr(4,5)=0.019; corr(1,3)=0.036; corr(1,4)=0.8; corr(1,5)=0.05; corr(2,4)=0.00481; corr(2,5)=0.008; corr(3,5)=0.032.

The results of the calculation show that a strong correlation occurs between the first and second output variables, the first and fourth output variables. The correlation between other variables is weak.

Statistical development of experimental indicators was carried out to create a regression model of the process. Given that the number of experiments is m = 16 and the output parameters are n = 5, the functional relationship can be expressed as follows:

$$Y_j = a_0 + \sum_{i=1}^{5} a_{ij} x_j \quad j=1,5,$$

where Y_j are output parameters, x_j are input parameters, and a_i are the coefficients of the regression model.

For this purpose, the D = bbdesign (nfactors) function of the MatLab-6.5 program was used, which allowed to find the matrix of the D Box-Benken plan.

To determine the coefficients of the regression equations, the S-plus 2000 professional program was used, which allows to automatically calculate the indicators of statistical analysis, the coefficients of the regression model and the coefficients of double correlation. This application was created by Math Works.

The student limit allows you to calculate the errors of experimental indicators:

$$t_1 = \frac{|a_1|}{\sqrt{S_b^2}}$$

where S_b^2 is the error of experiment.

The coefficient a_i is calculated by the following formula:

$$a_i = \frac{\sum_{i=1}^{n} X_{ij} Y_i}{\sum_{i=1}^{n} X_i^2}$$

where X_{ij} is the adjustment limit of factor i in the planned matrix.

To obtain the values of the coefficients of the a_k regression model, it is important to minimize the sum of the squares of the regression errors:

$$\sum_i (y_i - a_1 - a_2 x_1 - a_2 x_2 - \ldots - a_4 x_2^2)^2 \rightarrow \min$$

The solution of the problem is coordinated with the solution of a system of linear equations relatively to ak. The quality of the obtained regression equations can be inferred by studying the random errors of the experiment $\varepsilon_i = \overline{y_i} - y_i$. Evaluation of variance is calculated by the following formula:

$$S^2 = (\sum (Y_i - \overline{Y})^2)/(N\text{-}P\text{-}1),$$

S is called the standard regression error. The lower S is, the better the regression equation is consistent with the independent Y change.

The S-plus 2000 professional program developed by Math Works was used to determine the coefficients of the equation. These experimental data are important for automated mathematical processing of indicators, statistical analysis, calculation of regression coefficients.

Table 2 shows the experimental and calculated values of the output parameters.

Table 2.

Comparison of experimental and calculated indicators

The output of the target product, %		Selectivity of the process, %	
Experimental	Calculated	Experimental	Calculated
45.4	46.34	88.2	87.68
60.7	61.28	90.8	90.37
76.5	74.42	95.3	94.86
64.9	65.37	89.4	89.13
74.3	72.63	86.1	86.64
70.6	68.86	89.7	89.37
61.2	59.15	83.6	83.08
54.7	55.68	87.3	85.97
73.3	72.11	91.4	90.73
75.5	74.27	93.6	92.18
64.6	64.53	92.0	92.67
70.1	68.95	93.2	93.59
75.8	72.21	96.3	94.24
77.9	76.57	94.7	93.75

The student's acceptance value is tp(f)=3.182 for the p=0.05 price level and the free degree figures f=3. Assessing the significance of the coefficients, the regression coefficients in the form of a system of equations were obtained:

$Y_1 = 13.2+0.00012*X_1 + 0.022276*X_2 + 0.282951*X_3 + 0.0002*X_4 + 0.310636*X_5 + 0.704403*X_4X_5 – 0.05366*X_4\text{^}2 – 0.11665*X_5\text{^}2$

$Y_2 = 131.46+0.00013*X_1 – 0.04215*X_2 + 0.059271*X_3 – 3.56954*X_4 – 13.0335*X_5 + 1.646759*X_4X_5 – 0.51569*X_4\text{^}2 – 0.226704*X_5\text{^}2$

MatLab-6, a modern linear programming algorithm, was used to solve the optimization task [7-12].

Maximum functionality is taken as the optimization limit:

$$F_{max} = f(x_1, x_2, x_3, x_4, x_5).$$

The indicators of the process are taken to the following limits:

$$47 \le X_1 \le 47; \quad 24 \le X_2 \le 96; \quad 80 \le X_3 \le 140;$$

$$2 \le X_4 \le 7; \quad 5 \le X_5 \le 15.$$

The solution of the optimization task showed the highest yield

Y_{1max}=74.42% price is within these limits X_1 = 47; X_2 = 48; X_3 = 120.48; X_4 =4.98; X_5 = 7.28;
Y_{2max}=94.86% price is within these limits X_1 = 47; X_2 = 48; X_3 = 120.48; X_4 =4.98; X_5 = 7.28

The obtained results are consistent with the experimental indicators.

Results. The optimal conditions for the reaction of phenol cycloalkylation with methylcyclohexenes - temperature 80-140oC, duration 2-8 hours, molar ratio of phenol to MCH 0.5 ÷ 2: 1, catalyst content 5-15% were studied. Under these conditions, the yield of the target product, para-(methylcyclohexyl)phenol, is 76.5% of the phenol taken, and the selectivity for the target product is 95.3%. Correlation coefficients were calculated to optimize the process and build a mathematical model, and statistical processing of experimental indicators was carried out to create a regression model of the process. To solve the optimization problem, the MatLab-6 program was used, which solves the linear programming problem with a modern algorithm.

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EXAMINING THE PURPOSE OF HIGH SCHOOL STUDENTS' USE OF SOCIAL MEDIA ACCORDING TO THEIR PARTICIPATION IN SPORTS

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ABSTRACT. The aim of this research is to investigate the use of social media in high school students according to the participation in sports. The population of the research consists of students researching at different types of high schools in Kahramanmaras, South-East Turkey, in the 2019-2020 academic year. The sample of the research consists of 394 students in the 9th, 10th, 11th and 12th grades of different types of high schools in Kahramanmaras in the 2019-2020 academic year. The personal information form and the "Use of Social Media Scale" developed by Esra Sisman Eren were used in the research. The reliability coefficient of the scale used in the research was calculated as a = 0.751. The information about the demographic characteristics of the students was obtained in a personal form. According to the students' participation in sports, the aims of using social media were reached with the scale of the aims of using social media. According to the results, the distribution of the data was found to be normal and made suitable for statistical analysis.

KEYWORDS: high school, sports, social media

1. Introduction

Cognitive, physical, sexual and social development in adolescents is a process that is in a very rapid change. Adolescents may have difficulties in accepting and adapting to changes in themselves. In this period, young people want to belong to a group, to be popular, to gain prestige, to be accepted in the society, to be an independent individual. When their needs are met, social adaptation is achieved and the socialization process takes place successfully. The family, teacher and friend relationships of the adole-

scent in this period are the most crucial factors. Some of the adolescents may have difficulty in adapting to the social environment and establishing friendships. In this process, adolescents' starting to search for a new area in their lives may be problematic for their families and friends. Adolescents whose family relations are not sincere enter the process of independence and it is observed that these individuals tend to social media (Aksak, 2017: 53).

Communication on social media is provided by some posts such as audio files, words, photos. Social media is also a platform where sharing takes place at the highest level, where individuals share their own experiences and stories (Bat ve Vural, 2010: 3351). In this platform, all kinds of information are transported to the environment with interconnected computer networks, it is inexpensive, fast, accepted, and used, easy to use popular entertainment, and communication tool. In this way, it is possible to reach information and different cultures all over the world easily and quickly. Social media environments also provide individuals with the opportunity to exchange significantly high amounts information. On social media forums and platforms, it is possible for everyone to freely share their own thoughts and ideas, to communicate with countless people and to have fun by playing games according to their interests. Today, sports is a universal structure that can include all people without any discrimination in the cultural and social infrastructure of the society. The concept of sports, which has shown a rapid change in many areas, has caused changes in many areas besides itself. Sport, which cannot be accepted as an individual phenomenon, is a member of a social structure that can include all segments of society (Yıldırım vd., 2006: 49). According to a definition, sport is a tool that can enable individuals to develop mentally, physically, socially and emotionally, and to improve their knowledge and skills and leadership abilities (Ekici vd., 2011: 110). Sports is a tool that can make a positive contribution to the lives of individuals and be beneficial for their development (Ekici vd., 2011: 110).

In order to keep children, adolescents and young people away from harmful habits and to ensure their mental, physical and social health in their daily lives, it is important to ensure that individuals participate in sports from a young age (Göksel ve Caz, 2016: 5).

It can be stated that young people freely use the Internet in different

areas such as doing homework in their free time, chatting with friends, spending time, researching topics they are curious about. Adolescents' correct use of the internet affects the development process positively, and abuse of adolescents may cause some risks by making negative effects on his/her life. In today's conditions, it is difficult for young people to find the opportunity to come together with friends who have common interests. For this reason, they try to meet their needs in social media groups and virtual chat rooms with people who have the same interests and whose ideas agree (Karaca, 2007: 15).

In addition to these features, social media has important features such as being easy and fast, no space and time constraints. In addition to the effect of strengthening the interactions of individuals in the social field, these may, on the contrary, cause the social interaction to be weakened due to the decrease in face-to-face interaction (Düşünceli, 2016: 14). Social media also consists of sites that contain personal information and friendship profiles made up of unique pages.

The duration, number and intensity of communication that high school students establish with each other over the internet is increasing day by day. As reported in the literature, it is stated that young people use information technologies in their general lives and the internet extensively and intensively in their private lives (Weinstein ve Lejoyeux, 2010).

Physical and sports activities attract more people's attention day by day. This is based on the positive effects of physical activities on people's mental and physical health (Şimşek, 2016: 182). With the increase in technological developments, factors such as the widespread use of the internet and the more interest in social media reduce the movement of individuals. Inactivity can also bring health problems to the agenda in later ages (Saygın,2015: 380). In this context, the mental, physical and social benefits of young people in sports, as well as their participation in sports and physical activity, have an important effect on their socialization and communication skills, and the development of skills such as leadership, gentlemen, self-discipline and team work (Şişko ve Demirhan,2002: 205).

In a study conducted on internet users, it was determined that a significant portion of internet users are under the age of 25 (Bradford, 2004: 2). The use of technology by individuals defined as the digital generation or

net generation is carried out for communication with friends with whom they share the same ideas and thoughts at national and global level. Studies show that girls mostly use the internet for online shopping and chatting, while men use it for surfing and playing online games (Gross, 2004: 633). In another study, the internet use was used for games, chat and homework at the age of 10-15, for games and chat purposes between the ages of 16-19, for games, chat, e-mail between the ages of 20 and over, and the common activity for users was It was determined to be a chat (Binark ve Sütçü, 2007: 6). Individuals, the majority of which are young people, continue to carry the results of the communication they have established in the virtual world to the virtual environment in schools or schools (Tüzün, 2002: 23).

2. Method

Purpose of the Study: This study aims to examine high school students' use of social media according to their participation in sports.

- What are the students' views on social media use?
- Does social media show a significant difference according to the variables of students' purposes of using social media, school type, gender, class level, whether they do sports or not?
- What are the students' purposes of using social media?

The Importance of the Study: It is important in terms of making the necessary arrangements to reach the goals of education and to solve communication problems that may be reflected in the school if school administrators and education supervisors have knowledge about the social media usage habits and purposes. Determining to what extent students 'participation in sports affects the tendency to use social media and how they will contribute to the development of students is important in terms of encouraging students' participation in sports in educational institutions. In the study, what the students' purposes of using social media are, how often and for what purposes, the time, duration, location of their usage habits, their views on social media, raising awareness of education administrators, teachers and families, determining the supporting aspects of social media and internet education and participation in sports It is thought that it will enable the acquisition of important data. On the other hand, it is thought that the research will be an important data source for new researches and will

contribute to the literature.

Population and Sample: The population of the study consists of the students studying in 12 high schools of different types in Kahramanmaras in the 2019-2020 academic year. The sample consists of 394 students studying in the 9th, 10th, 11th and 12th grades of different types of high schools in Kahramanmaras in the 2019-2020 academic year.

Data Collection Tool: In addition to the personal form prepared by the researcher, the "Social Media Usage Purposes Scale" developed by Esra Şişman Eren was used as the data collection tool in the study. The reliability coefficient of the scale used in the study was calculated as a = 0.751.

Data Analysis: The demographic information of the students, their participation in sports, their level of use of social media and the purpose of using social media were obtained through the personal information form. The SPSS 21 program was made the analysis of the data and the significance level was taken as $p < 0.05$. Descriptive statistics, frequency, and percentage distributions, and normality tests were used to determine the general characteristics, while non-parametric tests Mann-Whitney U and Kruskal Wallis tests were used for non-normally distributed data.

3. Findings

The findings obtained based on the personal information form in the study are as follows: 56.1% (221) of the 394 students in the sample group of the study are female and 43.9% (173) are male. 25.6% (101) of the students studying at 12 different types of schools are 9th grade, 25.6% (101) 10th grade, 25.1% (99) 11th grade and 23.6% (93) 12th grade. 68.8% (271) of these students do sports while 31.2% (123) do not do sports. The demographic information of the research group and the data obtained from SMPAC, statistical analysis based on independent variables; The results obtained are presented in tables below.

	Gender	**N**	**Mean Rank**	**Z**	**P**
Interpersonal communication	Woman	221	194,35	-621	,534
	Male	173	201,52		
	Total	394			

Lesson preparation	Woman	221	210,40	- 2,547	,011
	Male	173	181,02		
	Total	394			

Table 1. Analysis Results of the Research Group by Gender (Mann Whitney U test)

According to the table, while no significant difference was found in the dimension of interpersonal communication according to the gender variable of the research group, it was determined that there was a significant difference in the lesson preparation dimension. $p < 0.05$

	Your class	**N**	**Mean Rank**	**x^2.**	**P**
Interpersonal communication	9th grade	01	206,62	1,463	,691
	10th grade	01	187,57		
	11th grade	9	196,38		
	12th grade	3	199,58		
	Total	94	**Mean Rank**		
Lesson preparation	9th grade	01	200,31	,405	,939
	10th grade	01	195,71		
	11th grade	9	192,51		
	12th grade	3	201,70		
	Total	94			

Table 2. Social Media Usage Purposes and Dimensions by Classes (Kruskal Wallis H test)

According to the table, it was determined that there was no statistically significant difference in social media usage purpose and interpersonal communication and lesson preparation dimensions according to the class variable of the research group ($p > 0.05$).

Interpersonal communication	Multi-Program High School	27	213,93	8,660	,653
	Anatolian High School	34	191,57		
	Health vocational high School	40	175,20		
	Imam Hatip High School	32	210,64		
	Industrial vocational School	22	204,20		
	Girls' Vocational High School	31	182,18		
	Trade Vocational High School	24	181,10		
	Sports High School	36	216,74		
	Tourism and Hotel Management High School	35	183,99		
	Vocational Technical Anatolian High School	36	181,50		
	Textile Vocational High School	39	202,12		
	Social science High School	38	227,16		
	Total	394			

Lesson preparation	Multi-Program High School	27	239,56	19,387	,054
	Anatolian High School	34	180,47		
	Health vocational high School	40	221,69		
	Imam Hatip High School	32	167,58		
	Industrial vocational School	22	203,77		
	Girls' Vocational High School	31	223,06		
	Trade Vocational High School	24	181,54		
	Sports High School	36	219,00		
	Tourism and Hotel Management High School	35	206,33		
	Vocational Technical Anatolian High School	36	148,25		
	Textile Vocational High School	39	184,59		
	Social science High School	38	199,59		
	Total	394			

Table 3. Social Media Usage Purposes and Dimensions by School Type

	Do you do any sports?	N	Mean Rank	Z	P
Interpersonal communication	Yeah	271	**197,39**	,028	,977
	No	123	197,74		
	Total	394			
Lesson preparation	Yeah	271	188,38	-2,366	,018

Table 4. Social Media Usage Purposes and Dimensions by sport Participation status (Kruskal Wallis H test)

According to the Table, while no significant difference was found in the dimension of communication between individuals by the Sports Participation Status variable of the research group, it was determined that there was a significant difference in the p> 0.05-course preparation dimension (p <0.05).

Result. According to the results of the research, it was determined that there was a statistically significant difference in the course preparation dimension of Social Media Use Purposes Scale according to gender and sports variables of the research group (p<0.05).

According to school type and grade level variables, no statistically significant difference was found in the interpersonal communication and course preparation dimensions of Social Media Use Purposes Scale regardless of class and type of school (p>0.05).

This research was carried out in order to determine how the purposes of using social media are shaped by considering high school students who participate in sports and who do not participate according to some variables. It was concluded in the study that there is a statistically significant difference in the dimension of lesson preparation according to the gender variable of the research group (p <0.05).

When the current study is compared with the literature, Mazman and Usluel (2011); Uslu and Hamarat (2016); Ahn (2011); Boyd (2007); Lenhart et al. (2010); Similar results were obtained in the studies of Lin and Lu (2011), and according to these results, it was determined that female students were more engaged in social media.

In the light of the present findings, we can attribute the difference between girls and boys in favor of girls according to the gender variable in the use of social media with intercultural differences. In our society, the behaviors expected from women are different from those expected from men. Women spend more free time at home than men. In this case, it can be Inferred that girls use social media more intensely during their time at home than men who spend most of their free time outside.

In addition, based on the generalization that female students' academic achievement is higher than boys, it can be said that girls use social media more intensively than boys to achieve success.

It was determined that there is a statistically significant difference in the dimension of preparation for lesson according to the variant of doing sports of the research group ($p < 0.05$; Table 4).

Compared to the current literature, similar results were obtained in terms of the exercise variable in Şenduran's (2006) research, both in the interpersonal communication dimension and the lesson preparation dimension.

According to the variables of school type and grade level, it is deduced that the purpose of using social media did not differ in personal communication and lesson preparation dimensions, regardless of which school and which class the students studied ($p > 0.05$).

The attitudes of students from different schools and different grade levels towards social media use are close to each other and they show partially positive attitudes.

Considering the positive attitudes of students towards the use of social media, social media should be made a part of education and this situation should be transformed into an opportunity. Teachers can share material, assign and control over social media more frequently. Regardless of time and place, teachers and students can create a 24/7 learning environment. In this way, they can learn both inside and outside the classroom.

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IDENTIFICATION OF FACTORS THAT PREVENT PARTICIPATION IN RECREATIONAL ACTIVITIES: BINGOL UNIVERSITY EXAMPLE

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ABSTRACT. The main purpose of this research is to determine the factors that prevent the participation of faculty and students of Bingöl University in recreational activities. The sample group of the study consists of 612 women and 890 men, 1502 participants. In the research, the "Participation Barriers Scale on Recreation Area Use" was used as a data collection tool. For the analysis of the obtained data, the t-test, ANOVA test, and LSD post-hoc tests were used in SPSS 21.0 program.

KEYWORDS: recreation, lecturer, student

1. Introduction

While the working time of people from the past to the present is corrosive, the non-working time has allowed individuals to do something for themselves, to renew and start life again. "Therefore, people have given special importance to the use of free time and the value they place on working time. The use of non-working time, i.e. free time, has revealed the concept of recreation and people have developed and enriched this concept day by day," (Soyer & Can, 2003).

The concept of recreation is of Latin origin and comes from the word "recreatio". It finds a response in the form of renewal, re-creation, or restructuring. The Turkish equivalent of this concept is widely used as "evaluation of leisure time". This definition shows that it intertwines the concept of recreation with the definition of leisure time. In this context, it can be said that the recreation is primarily related to the activities that people with spare time can perform. Leisure time defines the times outside the wor-

king hours of people (Karakucuk, 1997). It includes times that have the potential to be evaluated with no obligation or obligation in the concept of leisure (Shivers & Delisle, 1997).

It has been proven by many studies that recreational activities have beneficial results on individual and public health. However, despite the important and beneficial results of such activities, it was determined that individuals could not participate in such activities that benefit them for different reasons (Karakparmak & Gurbuz, 2007).

With the advancement of technology, there is a shortening in working hours, but individuals' leisure time, education quality and income levels increase. For these reasons, the desire to participate in recreational activities has increased. The outside world provides many opportunities to research and learns about recreational activities (Sabanci, 2016). Many researchers have concluded that there are factors that prevent both university students (Ipek, 2019) and academic staff (Sabanci, 2016) from participating in recreational activities. In this context, this study aims to determine the factors that hinder the participation of faculty members and students of Bingol University in recreational activities.

2. Recreation

Individuals at home or outside, indoor or outdoor for multiple purposes such as being alone, relaxing, sightseeing-observation, weather change, being healthy, spending time together, experiencing different moments and different emotions, held at different times and in various sizes participate in activities carried out in the area, actively and passively, in cities or rural areas outside the city. Recreation is related to the activities that individuals do in their free time and participate in this free time.

Activities express meaning in the direction of individuals' different purposes and wishes. For these and similar reasons, it prevents the definition of recreation from being clearly defined. However, some conceptual definitions have been made by making use of different angles and various ideas (Karakucuk, 1999).

Leisure time and proper use of this time are two words that are not similar. This is the period that the person (free time) is out of work, the flow of life continues and is outside the compulsory duties and the individual can

evaluate with his own choice. The useful use of non-business time appears as the practical equivalent of these two different concepts (Kilbas, 2001). Consequently, the conditions that make up the main characteristics of recreation are as follows (Karakucuk, 1999):

- Continuity and participation in activities should not be mandatory.
- Recreation activities create a sense of freedom in the individual.
- Recreation is carried out in non-business time (free time).
- Recreation activities allow the participation of individuals of different age groups and different genders.
- The freedom to choose in recreation practices should be given to the individual.
- Recreational applications can be performed in all open or closed areas, in all seasons and all climatic conditions. Recreation requires at least one application to be executed. These practices may be
- physical, mental, psychological, sociological, or activities created by combining several of such practices.
- Recreation includes multiple applications and options.
- Recreation is applications that give pleasure and happiness.
- Recreation is performed consciously. Recreational activities create a common idea for all humanity.

3. Method

In this part of the research, information about the research model used for data collection, data collection tools, participants, and the methods used to analyse the data are included.

3.1. Research Model

In this study, a relational screening model was used to examine the relationship between leisure time satisfaction and health perceptions of university students who study sports. In this universe, which consists of a large number of elements, the screening model is the screening arrangements made over the whole universe or a group, sample or sample to be taken from it (Karasar, 2012). In the research, the survey method, one of the quantitative research methods, was used.

3.2. Participants

The data collection tool used in the research was delivered to each participant individually and the necessary information was verbally reported. The participants were contacted within the borders of the Bingol University campus. While the population of the study is 15713 students, academic and administrative staff at Bingol University, the sample of the research consists of a total of 1502 participants, 612 women, and 890 men. The distribution of the contents according to their demographic characteristics is included in Table 1.

Table 1. Distribution of the participants according to their demographic characteristics.

	Groups	**n**	**%**
Gender	Women	612	40,7
	Men	890	59,3
Marital Status	Married	356	23,7
	Single	1146	76,3
Age	19-22 age	698	46,5
	23-25 age	528	35,2
	26-35 age	103	65,9
	36 years and older	173	11,5
Business Groups	Students	1311	87,3
	Academic staff	149	9,9
	Administrative staff	42	2,8
Monthly Income	2000 TL and below	525	35,0
	2001 - 3000TL	360	24,0
	3001-4000TL	360	24,0
	4001 TL and more	257	17,1

Licensed Athlete	Yes	345	23,0
	No	1157	77,0
Frequency of weekly use of parks and recreation areas (days)	1 day and below	823	54,8
	2-3 days	555	37,0
	4 days and more	124	8,3
Frequency of weekly use of parks and recreation areas (hours)	3 hours and below	834	55,5
	4-7 hours	420	28,0
	8-12 hours	103	6,9
	13 hours and more	145	9,7
Finding the recreation facilities in the university sufficient	Not enough	795	52,9
	Partly enough	210	14,0
	Enough	497	33,1

3.3. Data Collection Tools

In the research, two forms were used to collect data. These forms are the Personal Information Form and Participation Barriers Scale for Recreational Use.

Personal Information Form

In the research, "Personal Information Form" was used to access the personal information of the participants. This form was created by the researcher and consists of nine items in total. These items are the participants; It is related to gender, marital status, age, profession group, monthly income, being a licensed athlete, frequency of using parks and recreation areas (days and hours), and finding the recreation facilities in the university.

Participation Barriers Scale for Recreational Use

In 2017, Gumus and Alay Ozgul developed the scale of participation barriers related to recreation use, and reliability and validity studies were carried out. The scale consists of a five-point Likert type (1: strongly disagree, 5: strongly agree) 17 items and 5 sub-dimensions (security barrier, barrier, friend barrier, sports field barrier, and time barrier). High scores in the

scale and sub-dimensions indicate the high perception of obstacles related to recreation areas. In this study, the Cronbach Alpha coefficient of the scale was 0.91; Cronbach Alpha coefficients of sub-dimensions were determined as 0.90/0.83/0.81/0.76/ 0.91, respectively (Gumus & Alay Ozgul, 2017).

3.3. Data Analysis

Descriptive statistical (mean and standard deviation) analysis was applied for all data obtained within the scope of the research. Independent variables and values related to the perception of obstacles in recreation areas were tested through one-way ANOVA and LSD post-hoc analysis, which are among the parametric tests. Besides, an independent t-test was used for binary comparisons. In addition, because of the analyses, the significance level was taken as "0.05" ($p<0.05$).

4. Results

Table 2. The t-test results of the comparison of participation barrier scores by recreation area by gender.

	Gender	n	X	Sd.	t	P
Security Barrier	Women	612	2,51	1,40	-0,53	0,593
	Men	890	2,55	1,42		
Individual Barrier	Women	612	2,28	1,17	0,65	0,514
	Men	890	2,25	1,14		
Sports Field Barrier	Women	612	4,36	0,85	-0,80	0,421
	Men	890	4,39	0,80		
Time Barrier	Women	612	2,70	1,18	-0,61	0,539
	Men	890	2,74	1,19		
Friend Block	Women	612	3,15	1,17	-0,63	0,526
	Men	890	3,19	1,18		
Total	Women	612	2,93	0,87	-0,44	0,663
	Men	890	2,95	0,86		

According to Table 2, it was concluded that the participants did not show any significant difference ($p> 0.05$) in the sub-dimensions of the participation barriers scale regarding the use of recreation areas depending on the gender variable.

Table 3. The t-test results of comparing the participation barrier scores of the recreation area used by marital status.

	Marital Status	n	X	Sd.	t	P
Security Barrier	Married	356	2,50	1,40	-0,44	0,657
	Single	1146	2,54	1,42		
Individual Barrier	Married	356	2,27	1,16	0,17	0,865
	Single	1146	2,26	1,15		
Sports Field Barrier	Married	356	4,35	0,87	-0,89	0,372
	Single	1146	4,39	0,81		
Time Barrier	Married	356	2,73	1,18	-0,12	0,902
	Single	1146	2,72	1,19		
Friend Block	Married	356	3,14	1,16	-0,56	0,572
	Single	1146	3,18	1,18		
Total	Married	356	2,93	0,88	-0,37	0,709
	Single	1146	2,95	0,86		

According to Table 3, it was concluded that the participants did not show any significant difference ($p > 0.05$) in the sub-dimensions of the participation barriers scale regarding recreation area use depending on the marital status variable.

Table 4. The t-test results of comparing the participation barrier scores regarding the use of the recreation area by being a licensed athlete.

	Licensed Athlete	n	X	Sd.	t	P
Security Barrier	Yes	345	2,48	1,40	-0,78	0,435
	No	1157	2,55	1,42		
Individual Barrier	Yes	345	2,26	1,15	-0,09	0,930
	No	1157	2,26	1,15		
Sports Field Barrier	Yes	345	4,32	0,88	-1,56	0,118
	No	1157	4,40	0,80		
Time Barrier	Yes	345	2,73	1,18	0,14	0,887
	No	1157	2,72	1,19		
Friend Block	Yes	345	3,12	1,18	-0,82	0,412
	No	1157	3,18	1,17		
Total	Yes	345	2,91	0,87	-0,75	0,452
	No	1157	2,95	0,86		

According to Table 4, depending on the variable of being a licensed athlete of participants, it was concluded that there was no significant difference in the sub-dimensions of the participation barriers scale ($p > 0.05$).

Table 5. ANOVA test results for comparison of participation barriers scores for recreation area used by age groups.

	Age Groups	n	Mean	Sd.	F	P
Security Barrier	19-22 age	698	2,51	1,40	0,36	0,779
	23-25 age	528	2,55	1,43		
	26-35 age	103	2,46	1,39		
	36 years and older	173	2,60	1,47		
Individual Barrier	19-22 age	698	2,31	1,18	1,01	0,386
	23-25 age	528	2,21	1,12		
	26-35 age	103	2,17	1,08		
	36 years and older	173	2,30	1,18		
Sports Field Barrier	19-22 age	698	4,37	0,84	0,14	0,936
	23-25 age	528	4,39	0,81		
	26-35 age	103	4,37	0,81		
	36 years and older	173	4,40	0,81		
Time Barrier	19-22 age	698	2,73	1,20	0,24	0,867
	23-25 age	528	2,72	1,17		
	26-35 age	103	2,64	1,14		
	36 years and older	173	2,77	1,20		
Friend Block	19-22 age	698	3,18	1,17	0,16	0,921
	23-25 age	528	3,15	1,17		
	26-35 age	103	3,23	1,20		
	36 years and older	173	3,19	1,17		
Total	19-22 age	698	2,95	0,87	0,25	0,863
	23-25 age	528	2,93	0,87		
	26-35 age	103	2,89	0,86		
	36 years and older	173	2,98	0,86		

It was concluded that there was no significant difference (p> 0.05) in the sub-dimensions of the participation barriers scale regarding the use of the recreation areas depending on the age group.

Table 6. ANOVA test results regarding the comparison of the participation barrier scores by the recreation area by profession.

	Business Group	n	Mean	Sd.	f	P
Security Barrier	Students	1311	2,52	1,41	0,60	0,548
	Academic staff	149	2,65	1,46		
	Administrative staff	42	2,51	1,39		
Individual Barrier	Students	1311	2,26	1,15	0,78	0,460
	Academic staff	149	2,23	1,12		
	Administrative staff	42	2,48	1,29		
Sports Field Barrier	Students	1311	4,38	0,83	1,12	0,328
	Academic staff	149	4,36	0,85		
	Administrative staff	42	4,56	0,40		
Time Barrier	Students	1311	2,72	1,18	1,20	0,302
	Academic staff	149	2,75	1,23		
	Administrative staff	42	3,00	1,18		
Friend Block	Students	1311	3,16	1,18	0,15	0,858
	Academic staff	149	3,19	1,17		
	Administrative staff	42	3,25	1,12		
Total	Students	1311	2,93	0,87	0,67	0,512
	Academic staff	149	2,97	0,86		
	Administrative staff	42	3,08	0,82		

According to Table 6, it was concluded that the participants were not significantly different in the sub-dimensions of the participation barriers scale (p> 0.05) depending on the occupational status variable.

Table 7. ANOVA test results for comparing participation barrier scores for recreational area use by household monthly income.

	Monthly Income	n	Mean	Sd.	f	P
Security Barrier	2000 TL and below	525	2,49	1,40	0,40	0,750
	2001 - 3000TL	360	2,53	1,39		
	3001- 4000TL	360	2,54	1,44		
	4001 TL and more	257	2,61	1,45		
Individual Barrier	2000 TL and below	525	2,29	1,18	0,81	0,491
	2001 - 3000TL	360	2,29	1,18		
	3001- 4000TL	360	2,18	1,08		
	4001 TL and more	257	2,27	1,15		
Sports Field Barrier	2000 TL and below	525	4,36	0,85	0,53	0,665
	2001 - 3000TL	360	4,40	0,79		
	3001- 4000TL	360	4,36	0,85		
	4001 TL and more	257	4,42	0,78		
Time Barrier	2000 TL and below	525	2,75	1,18	0,97	0,405
	2001 - 3000TL	360	2,64	1,17		
	3001- 4000TL	360	2,73	1,17		
	4001 TL and more	257	2,79	1,23		
Friend Block	2000 TL and below	525	3,15	1,17	0,88	0,452
	2001 - 3000TL	360	3,19	1,16		
	3001- 4000TL	360	3,11	1,20		
	4001 TL and more	257	3,26	1,16		
Total	2000 TL and below	525	2,94	0,87	0,51	0,675
	2001 - 3000TL	360	2,94	0,87		
	3001- 4000TL	360	2,91	0,87		
	4001 TL and more	257	3,00	0,85		

According to Table 7, it was concluded that there was no significant difference (p> 0.05) in the sub-dimensions of the participation barriers scale regarding the use of recreation areas depending on the monthly income status variable of the participants.

Table 8. ANOVA test results for comparing the participation barrier scores of recreation area usage according to the weekly usage frequency (days) of the park and recreation areas.

	Weekly usage frequency (days)	N	Mean	Sd.	f	P
Security Barrier	1 day and below	823	2,52	1,40	0,33	0,718
	2-3 days	555	2,53	1,43		
	4 days and more	124	2,63	1,43		
Individual Barrier	1 day and below	823	2,31	1,19	2,45	0,087
	2-3 days	555	2,18	1,09		
	4 days and more	124	2,32	1,18		
Sports Field Barrier	1 day and below	823	4,37	0,83	0,29	0,752
	2-3 days	555	4,38	0,84		
	4 days and more	124	4,43	0,69		
Time Barrier	1 day and below	823	2,71	1,18	2,05	0,129
	2-3 days	555	2,71	1,17		
	4 days and more	124	2,93	1,29		
Friend Block	1 day and below	823	3,15	1,17	0,61	0,543
	2-3 days	555	3,18	1,18		
	4 days and more	124	3,27	1,17		
Total	1 day and below	823	2,94	0,87	1,07	0,344
	2-3 days	555	2,92	0,86		
	4 days and more	124	3,04	0,84		

According to Table 8, it was concluded that the participants did not show a significant difference (p> 0.05) in the sub-dimensions of the participation barriers related to recreation area usage depending on the weekly usage frequency (day) status variable.

Table 9. ANOVA test results of comparing the participation barrier scores of recreation area use according to weekly usage frequency (hours) of park and recreation areas.

	Weekly usage frequency (hours)	n	Mean	Sd.	F	P
Security Barrier	3 hours and below	834	2,53	1,41	0,07	0,977
	4-7 hours	420	2,51	1,41		
	8-12 hours	103	2,58	1,47		
	13 hours and more	145	2,53	1,42		
Individual Barrier	3 hours and below	834	2,31	1,18	1,40	0,240
	4-7 hours	420	2,17	1,08		
	8-12 hours	103	2,23	1,13		
	13 hours and more	145	2,29	1,18		
Sports Field Barrier	3 hours and below	834	4,38	0,83	1,12	0,339
	4-7 hours	420	4,37	0,83		
	8-12 hours	103	4,52	0,68		
	13 hours and more	145	4,34	0,86		
Time Barrier	3 hours and below	834	2,73	1,19	0,19	0,906
	4-7 hours	420	2,71	1,17		
	8-12 hours	103	2,81	1,20		
	13 hours and more	145	2,73	1,21		
Friend Block	3 hours and below	834	3,16	1,17	1,32	0,265
	4-7 hours	420	3,15	1,19		
	8-12 hours	103	3,39	1,17		
	13 hours and more	145	3,14	1,14		
Total	3 hours and below	834	2,95	0,87	0,57	0,632
	4-7 hours	420	2,91	0,87		
	8-12 hours	103	3,02	0,85		
	13 hours and more	145	2,94	0,86		

According to Table 9, it was concluded that the participants did not show a significant difference ($p > 0.05$) in the sub-dimensions of the participation barriers related to recreation area usage depending on the weekly usage frequency (hour) status variable.

Table 10. ANOVA test results for comparing the participation barrier scores regarding the use of recreation areas according to the availability of the recreation facilities in the university.

	Facility Status	n	Mean	Sd.	f	P
Security Barrier	Not enough	795	2,51	1,40	0,55	0,574
	Partly enough	210	2,50	1,41		
	Enough	497	2,59	1,44		
Individual Barrier	Not enough	795	2,31	1,18	1,60	0,202
	Partly enough	210	2,16	1,09		
	Enough	497	2,23	1,12		
Sports Field Barrier	Not enough	795	4,36	0,84	0,55	0,576
	Partly enough	210	4,40	0,81		
	Enough	497	4,40	0,80		
Time Barrier	Not enough	795	2,71	1,18	0,33	0,719
	Partly enough	210	2,72	1,17		
	Enough	497	2,76	1,21		
Friend Block	Not enough	795	3,15	1,17	0,38	0,683
	Partly enough	210	3,18	1,17		
	Enough	497	3,20	1,18		
Total	Not enough	795	2,93	0,87	0,30	0,741
	Partly enough	210	2,91	0,87		
	Enough	497	2,96	0,86		

According to Table 10, it was concluded that there was no significant difference ($p > 0.05$) in the sub-dimensions of the participation barriers scale regarding the use of recreation area, depending on the variable of finding the adequate level of recreation facilities in the university.

5. Discussion and Conclusions

In the study of Emir (2012), where his students examined the barriers to participation in recreational activities, he found that the individual, sports field, and friend barriers did not differ significantly by gender. In the study where Oktem et al. (2016) investigated the obstacles to university students' participation in leisure activities, it was found significant in favour of women in the lack of friends. Onal (2017), in his study in-

vestigating the factors that prevent the participation of university students in recreational activities, concluded that individual, sports field, lack of friends, and time barriers do not differ significantly by gender.

Ayhan (2017), in her study where active athletes examined the barriers to participation in recreational activities, found that individual, sports field, friends, and time barriers did not differ according to age groups. Yasarturk (2013) stated in this context that university students researched that access to recreational activity participation areas, such as schools, workplaces, and sports facilities, is more accessible than other learning areas. Ok (2019), on the other hand, found that university administrative staff did not show any significant difference according to age groups in their study, which examined the factors that prevented their participation in recreational activities.

While Sabanci (2016) examines the factors that hinder the participation of academic staff in recreational activities, the findings of the time, lack of sports field and lack of friends do not differ significantly with marital status, while Ozkan (2018) with similar results; In his study, which examined the factors that prevent public personnel from participating in such activities, he found that the individual, sports field, time and friend deficiency barriers do not differ significantly according to the marital status and finding the recreational space sufficient.

Ozsoy (2018) found in his study that physical education, music, and visual arts teachers study leisure barriers, and that individual, sports field, lack of friends, and time barriers do not differ significantly from income level. Kalkay (2019), in his study examining the factors that prevent university students from participating in recreational activities, found that individual, sports field, lack of friends, and time barriers did not differ significantly according to age groups as well as income levels. In his study, in which his students examined the barriers to participation in recreational activities, Guler (2017) found that individual, sports field (facility), friends, time barriers do not differ significantly according to gender, age groups, and being a licensed athlete.

Result. As a result of the studies of Karadeniz et al. (2019) investigating the attitudes and barriers of university students towards leisure time activities, they found a significant difference in cognitive, affective,

and behavioural attitude sub-dimensions. In the same study, the lack of facility/service differs significantly between the factors preventing the research group from participating in leisure activities. In this context, in the study conducted by Turkmen et al. (2013) with the accommodation operators, they concluded that the necessity of recreational activities of individuals is related to the educational situation and education area and not to factors such as age, gender, material income status.

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DIAGNOSTICS OF THE MAIN THREATS TO AGRO-FOOD INDUSTRY AND FOOD SAFETY

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ABSTRACT. This article analyzes the development of agriculture in Azerbaijan in 2003-2019 and the need for the transition of agricultural sector to the path of innovative development at the present stage.

KEYWORDS: **a**gro-food market, food security, agrarian sector, food products, food supply, subsidies

The agro-food market characterizes many specific features of the economic security system of the Republic of Azerbaijan.

The agro-food market provides food to different groups of the population, and this process is regulated by market relations.

The main component of the agro-food market is the economic sector, which is an important part of the national economy. Agriculture, food production, and processing is a complex system that depends on the effects of many external and internal factors. The provision of the agro-food market with sufficient food products is an important part of the state's agrarian policy.

The main goal of Azerbaijan's macroeconomic and financial policy in the field of food security is to ensure structural change and growth [1, p.2].

As the Republic of Azerbaijan pays great attention to food security, the agrarian policy is mainly aimed at creating an abundance of products by increasing the volume of production through the efficient use of existing potential and land resources.

The agrarian sector is the main sector of the country's national economy, and according to 2018 statistics, it accounts for 5.3% of GDP, and 36.3% of the employed population work in this sector. If we take into acco-

unt that more than 47% of the country's population live in rural areas, we can see that the agricultural sector is of great social importance.

The total volume of agricultural products increased 9.6 times in actual prices during 1995-2018, and 3.8 times during 2005-2018. In particular, the actual growth in crop production in the agricultural sector was 7.6 and 3.2 times, respectively, and in the livestock sector 12.4 and 4.5 times, respectively.

Agriculture provides two-thirds of the country's consumer fund, and therefore food security depends directly on the sustainable development of the agricultural sector.

Given the rapid population growth and intensive climate change in the world, we see the importance of an efficient agrarian sector. An efficient agricultural sector means producing more and better agricultural products at a lower cost in agriculture. For this, it is necessary to implement an effective agrarian policy of the state that will meet the consumer needs of the population at the maximum level with the minimum use of financial, agricultural lands, and labor resources. An effective agricultural unit can be formed as a result of such an agrarian policy.

Despite the high level of per capita consumption of basic foodstuffs in the Republic of Azerbaijan, today our country is dependent on food imports.

The recent improvement of many basic indicators of socio-economic development in our country allows us to positively assess food security. The positive growth trend of the main macroeconomic indicators of socio-economic development and the measures taken to ensure food security have shown their effectiveness in this area.

Purposeful and sustainable reforms in the field of food security in the Republic of Azerbaijan have created great opportunities for the improvement of existing regulations and the material and technical base of the agricultural sector, the development of the agro-food market.

Due to "Food Security Program of the Republic of Azerbaijan" covering 2001-2010, the "State Program on Reliable Food Supply of the Population in the Republic of Azerbaijan for 2008-2015", "The Republic of Azerbaijan State Program on Ensuring Food Security for 2019-2025, State Program on Poverty Reduction and Economic Development in the Republic

of Azerbaijan for 2003-2005, State Program on Development of Small and Medium Enterprises in the Republic of Azerbaijan (2003-2005)", "State Programs of socio-economic development of the regions of the Republic of Azerbaijan (2004-2008, 2009-2013, 2014-2018, 2019-2023)", "Implementation of measures defined in the Strategic Road Map on production and processing of agricultural products" (2016/06.XII) and other adopted documents, including financial and technical assistance to farmers, development of agro-food market, implementation of infrastructure projects in the regions, the share of local production in the consumption of food products of the population is increasing.

Despite all these measures, the replacement of imports of basic foodstuffs at the expense of local agricultural products has not yet been ensured in the country.

On the other hand, the instability observed in the world food market also affects the prices of food products in Azerbaijan. The current situation requires a comprehensive approach to minimizing the dependence of the domestic food market on imports and the creation of food reserves [2, p.1].

I.G.Ushachev notes that ensuring food security requires addressing the following key issues:

- technical support of agriculture, consumer service sphere, and food industry of AEC implementation of technological modernization;
- human resources with the ability to master the innovations of the industry formation;
- large-scale work on the restoration of agricultural production;
- creation of a modern social infrastructure in rural areas [3, p.8].

In a sense, this is stated in the "Food Security Program of the Republic of Azerbaijan, the State Program for Reliable Food Supply in the Republic of Azerbaijan for 2008-2015" and the "State Program for Food Security in the Republic of Azerbaijan for 2019-2025".

The main objectives of the Food Security Program of the Republic of Azerbaijan are to increase the production of local agricultural products and to implement measures aimed at reducing food prices to an acceptable level and to create a system to prevent acute food shortages.

The solution of the following issues was noted as the main issues in the State Programs adopted on the reliable provision of the population with

food products in Azerbaijan:
- increase in production and import of basic agricultural products to stimulate food production in order to replace it;
- supporting the development of agro-food market infrastructure;
- improving the system of sales of agricultural products, seasonal increasing its marketability by creating the necessary conditions for storage;
- material and technical and technological bases of selection and seed production modernization;
- support for small farms;
- efficiency of regulation of agricultural, raw materials and food markets raising;
- regulation of agricultural products, raw materials and food markets and agriculture the effectiveness of the work of government agencies in the development of the economy raising;
- in the AEC to ensure sustainable development of agriculture increase the level of profitability;
- support of financial sustainability of agricultural enterprises;
- raising the living standards of the rural population;
- stimulation of innovation activity and innovative development of AEC;
- development of biotechnologies;
- conditions for efficient use of agricultural lands formation;
- development of agricultural land reclamation;
- land, water, and other renewable natural resources in agricultural production ecologically regulated, use, as well as soil fertility increase;
- trade facilities and to improve the food supply of the population construction, reconstruction and modernization of logistics infrastructure;
- agriculture to replace the import of basic foodstuffs increase production.

Numerous studies conducted in our country show the fragmentation of the agro-food market. The agro-food market consists of large and small producers and sellers of similar products. In the agro-food market, no producer or seller has a share of more than 10% in the food segment. The combination of various factors, including the type of product, the segment of activity, the presence in the market, and the size of the company, has a significant impact on the assessment of the market situation.

Table 1. Grouping of agriculture by land area in Azerbaijan

	All farm categories		Enterprises engaged in agriculture		Individual entrepreneurs, family farmers and households	
	The number is one	Area hectare	The number is one	Area hectare	The number is one	Area hectare
Farm with a plot of land	1352121	2362024	1385	314.455	1350,736	2047.569
Including:						
- <0.1 ha	360733	18115	101	2	360632	18113
0.1 <0.2 ha	119080	15540	15	2	119065	15538
0.2 - <0.5 ha	183446	60458	25	7	183421	60451
0.5 - <1 ha	216855	153591	27	18	216828	153573
1.0 - <2 ha	227796	321005	54	66	227742	320938
2 - <3 ha	107889	260622	42	94	107847	260528
3 - <4 ha	54126	185187	31	97	54095	185090
4 - <5 ha	27003	119416	17	71	26986	119345
5 - <10 ha	37553	249258	99	659	37454	248599
10 - <20 ha	9857	124116	169	2374	9688	121742
20 - <50 ha	4426	126497	276	7633	4150	118864
50 - <100 ha	1716	108179	160	10569	1556	97610
100 - <200 ha	891	114877	147	19357	744	95520
200 - <500 ha	556	157611	136	41406	420	116205
500 - <1000 ha	114	71215	35	23476	79	47738
1000 - <2500 ha	53	72754	30	45513	23	27241
2500 and more	27	203584	21	163111	6	40472

Source: Statistical indicators of the Republic of Azerbaijan

Research shows that the dependence of companies in agro-food markets on large buyers is moderate. Most of the revenues of companies importing and producing agro-food products come from small buyers as well as large buyers. It should be noted that a quarter (1/4) of companies say they

depend on large buyers, and this dependence is reflected in all segments of the agricultural sector - crop production, livestock, and processing.

Research shows that small farms dominate in the structure of producers of agricultural products currently operating in the country. According to the State Statistics Committee, 81.9% of agricultural producers are farms with up to 2 hectares of land.

Based on the data of the State Statistics Committee, let's group agriculture by country by land area.

As can be seen from Table 1, the share of small farms in the total number of farms is higher. The land area of more than 80.0% of the total farms is less than 2.0 hectares, and the sown area of these small farms is 24.1% of the total land area.

As can be seen from the table, farms with 2-5 hectares of land have a share of 13.9% of the total number of farms, accounting for 23.9% of the total land area. The number of farms with more than 200 hectares of land is 750, which is 26.3% of the total land area, although they have a 0.05 share in the total number of farms.

As can be seen from the table, although the average size of land owned by agricultural producers is 3.4 hectares, the arable land owned by the majority of producers is below average.

The same situation is observed in livestock farms. According to the Ministry of Agriculture, the average number of cattle per farm is 7.7, and 82% of farms have about 10 head of cattle.

Table 2. Agriculture in the Republic of Azerbaijan in 2010-2018, the share of expenditures and direct subsidy expenditures in budget expenditures

YEARS	The share of riculture in GDP %-with	Budget expenditures Total mln	Agricultural expenditures		Direct subsidies to agriculture		Agricultural Focus Index	The gross agricultural output at current prices is mln
			Total mln man	Share in the budget in%	Total mln man	Budget share in%		
2010	5.5	11765.9	363.4	3.1	111.2	0.95	0.56	3877.7
2011	5.1	15397.5	435.4	2.8	97.6	0.63	0.55	4525.2

2012	5.1	17416.5	458.2	2.6	120.2	0.69	0.52	4844.6
2013	5.4	19143.5	477.5	2.5	118.0	0.62	0.46	5244.6
2014	5.3	18709.0	494.0	2.6	112.9	0.60	0.50	5225.8
2015	6.2	17784.5	537.1	3.0	156.3	0.88	0.49	5635.3
2016	5.6	17751.3	574.1	3.2	183.3	1.03	0.58	5632.4
2017	5.6	17594.5	484.6	2.8	205.6	1.17	0.49	6580.0
2018	5.3	22731.5	718.6	3.2	342.8	1.51	0.60	7010.0
TOTAL:		158294.2	4542.9	2.9	1447.9	0.9		48575.6

Source: Statistical indicators of the Republic of Azerbaijan

Food Security Program of the Republic of Azerbaijan adopted for the development of agriculture and agro-food market of the country, State Program on the reliable provision of the population with food products in the Republic of Azerbaijan in 2008-2015, Food security in the Republic of Azerbaijan for 2019-2025 To stimulate the national agro-food market and support agricultural producers within the State Program and other state documents, 4542.9 million manats was spent on agriculture in 2010-2018 and subsidies were allocated for various areas of agriculture 1447.9 million manats.

As can be seen from Table 2, agricultural expenditures in 2010-2018 amounted to 4542.9 million manats, and its share in budget expenditures during this period was 2.9%. In 2018, agricultural expenditures increased by 2.0 times compared to 2010 and amounted to 718.6 million manats, and compared to 2017 increased by 48.3%. During this period, the gross agricultural output increased by 1.8 times in actual prices, and the growth rate compared to 2017 was 6.5%.

According to Table 2, the number of subsidies allocated to agriculture in various areas in 2010-2018 amounted to 1447.9 million manats. The number of allocated subsidies during this period amounted to 0.9% of budget expenditures, and in 2018 compared to 2017, the number of subsidies increased by 66.7%. Although budget expenditures increased by 29.2% in 2018 compared to 2017, the growth rate of agricultural expenditures during this period was 48.3%, and the growth rate of subsidies was 66.7%, 1.4 times ahead of the growth rate of budget expenditures.

As can be seen from Table 3, due to the implementation of the above-mentioned State Programs in the field of increasing food supply in our country, the level of demand for basic food products in 2018 will be 125.1% for meat and meat products, milk and dairy products 102.5%, 99.5% for eggs, 144.2% for sugar and sugar products, 153.1% for vegetable oil, 94.8% for fish and fish products, 47.8% for butter, potatoes 144.1%, 115.6% for all types of vegetables, 160.0% for fruits and berries.

Table 3. Status of meeting the demand for basic food products in 2018
(population in 2018 was 9898.1 million people)

The name of the product	Annual consumption rate per capita kq	Total demand (tone)	Produced in 2018 tone	It is stored for food		Status of demand satisfaction%
				Total (100 tone)	Per capita kq	
1. All kinds of meat and meat products	31,5	311790,1	326024,0	390531,0	39,4	125,1
2. Milk and dairy products	232,4	2300318,4	2080437,0	2358911,0	238,3	102,5
3. Eggs (thousand pieces)	153,0	1514409,3	1676213,0	1507205,0	152,3	99,5
4. Sugar and sugar products	17,4	172226,9	280983,0	248769,0	25,1	144,2
5. Vegetable oils	9,8	97001,2	71143,0	148517,0	15,0	153,1
6. Fish and fish products	7,7	76215,3	61879,0	72799,0	7,3	94,8

7. Butter	6,7	66317,3	23638,0	32046,0	3,2	47,8
8. Bread and bakery products	126,1	1248150,4	1235000.0			
9.Kartof	50,6	500843,9	898914,0	721435,0	72,9	144,1
10. All kinds of vegetables	97,0	960115,7	1521931,0	1109021,0	112,0	115,5
11. Fruits and berries	46,0	455312,6	1010816,0	728641,0	73,6	160,0

Table 4. Various directions of agriculture in the Republic of Azerbaijan, total amount of subsidies allocated

	State support	2017		2018	
		Total thousand man	%	Total thousand man	%
1	Subsidy for fuel and motor oils (1ha – 50 man)	51295.8	25.0	60555.1	17.7
2	Subsidies to wheat and paddy producers (1ha-40man)	17125.9	8.3	23330,0	6.8
3	Subsidies to producers of 1st and 2nd reproduction seeds and seedlings	5938.6	2.9	7738.8	2.3
4	Reimbursement of research institutes for the production of original, elite and superelite seeds	518.7	0.4	905.1	0.3
5	70% reimbursement of the cost of mineral fertilizers and biohumus	60075.3	29.2	102257.0	29.8
6	70% reimbursement of pesticides	1645.2	0.8	5743.0	1.7
7	Amount of discount applied to agricultural machinery sold and leased by “Agroleasing” OJSC	31570.8	15.4	88000,0	25.7

8	The amount of discounts applied to the sale of breeding animals through "Agroleasing" OJSC	8429.16	4.1	15970,1	4.7
9	Subsidy of 100 manat for each calf obtained by artificial insemination	3929.6	1.9	6905.1	2.0
10	Subsidy of 0.1 manat per kg of raw cotton	20719.3	10.1	23038.1	6.7
11	Subsidy of 0.05 manat per kg of dry tobacco and 10.05 manat per 10 kg of wet tobacco	201.1	0.1	247.4	0.1
12	Subsidy of 5 manat per kg of all types of wet cocoons	1199.0	0.6	2490.5	0.7
13	Subsidy of 4 manat for each ton of sugar beet	1584.6	0.8	1106.6	0.3
14	For repeated plantings (50 manat per hectare)	917.0	0.4	1431.2	0.4
15	Granting beekeepers a subsidy of 10 manat per bee family (hive)	-	-	3106.0	0.9
	TOTAL	205550,0	100.0	342824,0	100.0

Source: Statistical indicators of the Republic of Azerbaijan

It is a positive thing that in 2010-2018, the total amount of funds allocated to the agricultural sector will double, and subsidies will increase 4 times. All this is the result of the state's agrarian policy to make the development of the agricultural sector one of the priority areas.

With the increase of allocated state resources and other organizational and economic factors, there has been an increase in agricultural production. Thus, in 2018, the gross agricultural output in actual prices increased by 3132.3 million manats or 80.8% compared to 2010 and amounted to 7010.0 million manats, including an increase in crop production in the corresponding period by 1186.6 million manats or 59.4%, and on livestock products, it was 1945.5 million manats or 103,6%.

According to Table 4, in 2018, 219.1 million manats or 63.9% of subsidies allocated to the agricultural sector will be provided directly to far-

mers on preferential terms for the production of agricultural machinery, mineral fertilizers and bio humus, pesticides, and livestock products. This means that the funds allocated for subsidies in these areas are highly targeted and effective. 33.6 million manats or 9.8% of the total subsidies were allocated for cotton, tobacco, cocoons, sugar beet, and calves obtained by artificial insemination. 26.3% of the total amount of subsidies or 90.2 million manats was given to fuel and motor oils, wheat, paddy, and other areas.

Subsidies provided to farms in the country's agricultural sector within the framework of the state's agrarian policy have reduced the cost of each ton of various crop products by 10-48%.

Also, it should be noted that the sale of 40% of the cost of agricultural machinery sold and leased by Azerleasing OJSC on preferential terms increases the provision of farms with agricultural machinery on the one hand, and on the other hand with the help of these machines. It also reduces service fees by 25-30%. Thus, the reduction of the cost of agricultural machinery at the expense of subsidies reduces depreciation costs, as a result of which entrepreneurs providing agricultural services provide services at lower prices.

Thus, agricultural subsidies, which have accounted for about 3.0% of agricultural production over the past 10 years and accounted for 0.9% of total budget expenditures over the same period, play a significant role in reducing the cost of agricultural products and increasing price competitiveness.

As a result of the subsidy policy, which is a continuation of the country's agrarian policy, progress has been made in many areas in recent years in terms of developing the agricultural sector and improving the country's food security. Thus, agricultural products in actual prices for all categories of farms in 2018 increased by 6.5% compared to 2017 and by 80.8% compared to 2010 and amounted to 7010.0 mln. The manat has shown positive growth dynamics every year.

Over the past three years, the dynamics of growth in exports of agricultural products has shown itself. In 2018, exports of agricultural products have increased by 33.6% compared to 2016 and by 7.3% compared to 2017 and amounted to 626.9 million.

In 2013-2018, the number of people engaged in agriculture and fisheries increased by 5.6% and reached 1770.8 thousand people. The share of agricultural workers in total employment increased from 2.9% to 3.3%. and according to FTMMS 2018 data, the ratio of unpaid family labor and paid labor in the agricultural sector has changed from 30/70 to 45/55.

Among the most expected results in the implementation of the State Programs adopted in connection with the development of the agro-food market and food security in agriculture in 2000-2019, compared to 2013, the total volume of food products in 2018 (taking into account the volume of stocks) local food products. Let's pay attention to the dynamics of the change in the share of production. Thus, the volume of production of all meat and meat products in 2013 was 286.6 thousand tons, in 2015 - 258.6 thousand tons, in 2016 - 302.2 thousand tons, in 2017 - 316.8 thousand tons. tons, and in 2018 amounted to 326.0 thousand tons, and in 2018 compared to 2013, 39.2 thousand tons or 13.6% more products were produced. Meat and meat products accounted for 89.1% of total reserves in 2013, 91.7% in 2015, 86.8% in 2016, 83.6% in 2017 and 80% in 2018.

The volume of production of milk and dairy products in 2013 was 1796.7 thousand tons, in 2015 - 1524.5 thousand tons, in 2016 - 2009.9 thousand tons, in 2017 - 2024.1 thousand tons, in 2018 - In 2018, it amounted to 2,080.4 thousand tons, and in 2018 compared to 2013, 293.7 thousand tons or 15.8% more products were produced. In the total composition of stocks of milk and dairy products, 71.2% in 2013, 78.4% in 2015, 86.6% in 2016, 85.3% in 2017, and 86 in 2018.

The volume of egg production in 2013 was 1401.5 million units, in 2015 - 1552.9 million units, in 2016 - 1609.8 million units, in 2017 - 1714.0 million units, and in 2018 - 1676, 2 million units and 2018 compared to 2013, 274.1 million units or 19.6% more products were produced. It should be noted that egg products accounted for 98.2% of total stocks in 2013, 97.7% in 2015, 98.4% in 2016, 99.5% in 2017 and 2018.

The volume of production of fish and fish products in 2018 compared to 2013 increased by 10.8 thousand tons or 21.4%. Fish and fish products accounted for 69.4% of total reserves in 2013, 74.5% in 2015, 81.4% in 2016, 77.8% in 2017 and 79% in 2018.

Vegetable oils were produced in 2018 compared to 2013, 29.5 thousand tons, or 29.1% less. The share of vegetable oil in total reserves was 42.8% in 2013, 42.0% in 2015, 32.3% in 2016, 31.1% in 2017 and 28% in 2018.

The volume of butter production in 2018 compared to 2013 increased by 1.7 thousand tons or 7.8%. The volume of butter in total reserves was 41.9% in 2013, 54.7% in 2015, 71.5% in 2016, 67.3% in 2017 and 66.9% in 2018.

The volume of wheat production in 2018 compared to 2013 increased by 150,000 tons or 8.2%. The volume of wheat in total reserves was 28.5% in 2013, 42.6% in 2015, 42.1% in 2016, 54.6% in 2017 and 53.9% in 2018. organized.

Gross agricultural output in enterprises of various forms in 2018 compared to 2013 increased by 33.7% in actual prices.

The volume of investments in fixed assets in 2018 amounted to 764.4 million manats, an increase of 33.1% compared to 2013 and 23.7% compared to 2017.

The profitability of agricultural sales increased from 50.2% in 2013 to 56.2% in 2018, from 4.4% to 27.5% in potatoes, fruits, and vegetables, respectively. on berries from 15.8% to 28.5% and in crop production as a whole from 35.1% to 40.4%. As for livestock products, the level of profitability in agricultural enterprises fell from 16.5% to 5.9% in the corresponding period. The profitability of sales of products of individual entrepreneurs increased from 34.7% in 2013 to 36.6% for crop products, and from 45.3% to 61.6% for livestock products in the corresponding period.

Net profit on agricultural enterprises increased from 52283.0 thousand manats in 2013 to 96917.0 thousand manats in 2018 and increased by 44634.0 thousand manats or 46.1%.

Revenues from sales of agricultural enterprises increased by 39044.0 thousand manats or 69.0% in 2018 compared to 2013 in crop production and lost 8485.0 thousand manats or 44.5%.

Net profit on individual entrepreneurial farms decreased from 8676.0 thousand manats in 2013 to 6234.0 thousand manats in 2018 and decreased by 2442.0 thousand manats or 39.2%. Revenues from sales of individual en-

trepreneurial farms in crop production decreased by 511.0 thousand manats or 13.1% compared to 2013, and in livestock decreased by 222.0 thousand manats or 11.8%.

Looking at the main priorities of the adopted state programs, it should be noted that there is a sustainable course of improving food security.

The analysis shows that in the current conditions of the economy, the integration or related diversification of production is becoming one of the main directions in the development of agro-food market entities. Processing of agricultural products is becoming one of the top priorities in expanding the activities of campaigns. Poultry, dairy, and meat, livestock are more interested in the campaigns, which are the subjects of the agro-food market.

One of the main factors hindering the development of the local agro-food market is the shortage of skilled labor. This situation is the migration of the able-bodied population as a whole from rural areas to cities and other places. Another obstacle from the point of view of ensuring the economic security of agriculture is the misuse of budget funds allocated for targeted programs to increase the efficiency of the AEC and the development of the village.

Diagnosis of the agro-food market in the context of economic security shows that many local producers are not ready enough to increase competition, as well as reduce government support. The low profitability of activities, the lack of state attention to many regions - such as the fact that business is reasonably focused on more developed and useful regions; low qualification of the staff; lack of sufficient funding; low efficiency of agricultural production, etc.

Result. The article focuses on the diagnosis of the main threats to the agri-food market and food security of the country. In 2019, agriculture in Azerbaijan continued to grow against the backdrop of complex processes in the global economy, demonstrating stability and sustainability. The implemented agrarian reforms made it possible to adequately respond to risks and problems in the field of food security of the country.

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