



Conservation and development of agricultural biological diversity, the example of Eskişehir Transitional Zone Agricultural Research Institute

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Abstract

Purpose: In this study, it was aimed to evaluate the study and research outputs intended at the protection and development of agricultural biological diversity carried out at the Eskişehir Transitional Zone Agricultural Research Institute from its establishment (1925) until today.

Method: In the preparation of this article, annual research reports and literature information regularly published by the Institute every year were taken as basis.

Findings: Eskişehir Transitional Zone Agricultural Research Institute; Its works for the protection and development of agricultural biological diversity started on December 13, 1925 and it still continues its activities in a total area of 646 hectares in 3 separate campuses, including the Central Campus in Eskişehir Karagözler neighborhood Karabayır Bağları location. The study area of the institute is a basin (region) research institute and covers a total of 12 provinces, including Eskişehir, Kütahya, Afyonkarahisar, Uşak, Burdur, Isparta, Denizli, Bilecik, Bursa, Kocaeli, Sakarya and Yalova. As a result of the studies carried out at the institute, 181 plant varieties and Türkiye's first broiler chicken breed, "Anadolu T", were registered. Seeds of high-yielding varieties developed through breeding studies were produced and delivered to seed producers. In addition, the Institute has completed many projects on the collection, preservation and use of genetic resources as genetic resources in breeding studies. Since our institute was founded, cool climate grains, edible legumes, oilseed plants, medicinal and aromatic plants, meadow-pasture and forage plants, biodiversity and genetic resources, vegetable growing, soil and water resources, Türkiye's brood broiler chicken breeding project II. It continues its activities in the fields of meat brood breeding, education and extension activities.

Conclusion: As a result, Eskişehir Transitional Zone Agricultural Research Institute continues its efforts to ensure the sustainable use of agricultural biodiversity and food security, and to produce solutions to nutritional problems in the country and around the world, with its studies.

Keywords: Transitional Zone Agricultural Institute, breeding, biodiversity, plant breeding, genetic resources

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Özet

Amaç: Bu çalışmada, Eskişehir Geçit Kuşağı Tarımsal Araştırma Enstitüsünde, kuruluşundan (1925) günümüze kadar yapılan tarımsal biyolojik çeşitliliğin korunması ve geliştirilmesine yönelik çalışma ve araştırma çıktılarının değerlendirilmesi amaçlanmıştır.

Metod: Bu makalenin hazırlanmasında Enstitü tarafından her yıl oluşturulan yıllık araştırma raporları ve literatür bilgileri esas alınmıştır.

Bulgular: Eskişehir Geçit Kuşağı Tarımsal Araştırma Enstitüsü; tarımsal biyolojik çeşitliliğin korunması ve geliştirilmesine yönelik çalışmaları 13 Aralık 1925 yılında başlamış olup, halen çalışmalarını Merkez Yerleşkesi Eskişehir Karagözler Mahallesi Karabayır Bağları Mevkiinde olmak üzere 3 ayrı yerleşkede toplamda 646 hektarlık

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alandada sürdürmektedir. Enstitü çalışma alanı, havza (bölge) araştırma enstitüsü niteliğinde olup, Eskişehir, Afyonkarahisar, Kütahya, Isparta, Uşak, Burdur, Denizli, Bursa, Bilecik, Kocaeli, Sakarya ve Yalova illerini içeren toplam 12 ili kapsamaktadır. Enstitüde yapılan çalışmalar sonucunda, 181 bitki çeşidi ve Türkiye'nin ilk etlik tavuk ırkı olan "Anadolu T" tescil ettirilmiştir. İslah çalışmaları ile geliştirilen yüksek verimli çeşitlerinin tohum üretimi yapılarak tohum üreticilerine ulaştırılmıştır. Ayrıca Enstitüde genetik kaynakların toplanması, muhafazası ve ıslah çalışmalarında genetik kaynak olarak kullanılması konusunda çok sayıda bilimsel çalışma yapılmaktadır. Enstitüde serin iklim tahılları, yemlik tane baklagiller, yağlı tohumlu bitkiler, tıbbi ve aromatik bitkiler, çayır- mera ve yem bitkileri, biyolojik çeşitlilik ve genetik kaynaklar, sebzeçilik, toprak ve su kaynakları konularında saha ve laboratuvar çalışmaları yapılmaktadır. Ayrıca Türkiye Damızlık Tavuk İslah Projesi II. etçi damızlık ıslahı, eğitim ve yayım çalışmaları konularında faaliyetlerini sürdürmektedir.

Sonuç: Eskişehir Geçiş Bölgesi Tarımsal Araştırma Enstitüsü, yaptığı çalışmalarla tarımsal biyoçeşitliliğin ve gıda güvenliğinin sürdürülebilir kullanımının sağlanması, ülke ve dünyadaki beslenme sorunlarına çözüm üretilmesi amacıyla çalışmalarını sürdürüyor.

Anahtar kelimeler: Geçit Kuşağı Tarımsal Araştırma Enstitüsü, ıslah, biyoçeşitlilik, bitki ıslahı, gen kaynakları

1. Introduction

Biological diversity (biodiversity); They are living worlds consisting of genetically different living species, rich in number and species, spread across various ecosystems with different functions [1]. Biodiversity indicates the richness of living things in a region in terms of species and number. Biological diversity has three basic elements: ecosystem diversity, genetic diversity and species diversity. Accordingly, biological diversity in its most basic sense refers to the diversity of living organisms and their habitats. Agricultural biodiversity; It covers all elements of biodiversity related to agriculture and food, and includes genetic resources, all grain species, farm animals, fish species and all non-domesticated resources within water, field, pasture and forest ecosystems [2].

Agricultural biodiversity deals with and examines the processes of utilizing human nature in sustainability performance. Agricultural biodiversity includes genetic resources of plants, animals, fungi and microorganisms that are important for food and agriculture; ecology-related services such as organic matter decomposition, nutrient cycling, pollination, pest and disease management, carbon sequestration, maintenance of the hydrological cycle, and the organisms participating in these processes; It includes abiotic factors such as soil and water, traditional knowledge and other socio-economic factors [3]. Spreading agricultural biodiversity over a wider area makes it possible to sustainably provide a safer food supply. The conservation of biodiversity affects social-ecological systems throughout the food chain within the scope of food processing and consumption and healthy living. Agricultural biodiversity is a concept that focuses on the interaction between nature and humans. Both the development and loss of agricultural biological diversity depend significantly on socioeconomic conditions and the factors affecting it.

There are 49 research institutes in our country affiliated with the General Directorate of Agricultural Research and Policies of the Ministry of Agriculture and Forestry, which carry out scientific research and studies within the scope of agricultural biodiversity. They work on plant and animal breeding and breeding, soil, water, food, feed, plant and animal diseases and pests, agricultural education, and protection of biological diversity.

The first research on plant breeding in Türkiye began on December 13, 1925, under the name "**Sazova Seed Breeding Station (İslah-ı Buzr)**", in an area of 139,4 hectares in Sazova, Eskişehir. Thereupon, citrus and rice seed breeding stations were established in Adana, İstanbul, Yeşilköy, Adapazarı, Nazilli and Antalya.

At Sazova Seed Breeding Station; Celalettin Emcet YEKTAY, who is considered the "Pioneer of Plant Breeding" in Turkey, has provided great services in registering many varieties as a result of the first breeding studies and in developing the infrastructure facilities of the organization and agricultural research.

Within the Sazova Seed Breeding Station campus, in 1929, with the appointment of Ali Numan KIRAÇ by Mustafa Kemal ATATÜRK, studies in the field of cultivation techniques were started under the name of "**Dry Farming Trial Station**".

With the addition of pathological studies in 1951, these two stations (Sazova Seed Breeding Station and Dry Farming Trial Station) were merged under the name of "**Eskişehir Breeding and Trial Station**" and became a single organization. Later, the institute was named "**Eskişehir Agricultural Research Institute**" in 1969.

In 1986, the institute; It was first named as the Legume Research Institute and then as the "**Transitional Zone Agricultural Research Institute**".

In order to improve research and working conditions, the institute was moved to a new campus on October 24, 1996 and its name was changed to "**Anatolian Agricultural Research Institute**".

During the restructuring of the Ministry of Agriculture in 2011, the **Anatolian Agricultural Research Institute** merged with the **Eskişehir Soil and Water Resources Institute** and the institute was also given the task of developing a broiler chicken breed. In 2011, the name of Anatolian Agricultural Research Institute was changed and the Institute currently; It continues its work under the name **Eskişehir Transitional Zone Agricultural Research Institute**.

The institute is a regional research organization and its work area covers the provinces of Eskişehir, Afyonkarahisar, Kütahya, Uşak, Denizli, Isparta, Burdur, Yalova, Bilecik, Sakarya, Kocaeli and Bursa.

The Institute continues its studies in three different campuses: Central Campus, Poultry Campus and Soil-Water Campus.

The central campus is 6 km away from Eskişehir centre. The central campus of our institute is at 39° 46' north latitude, 30° 36' east longitude and its altitude is 780 m above sea level [4]. Institute Central Campus Ziraat cad. It is located at Tepebaşı address No:396 (Karabayır road 6th km). The institute has a working area of 285 hectares in this campus.

The Institute's Soil-Water Campus is located “71 Evler Mahallesi, Gülertan Sk. No:51”. This campus has an area of 51 hectares.

The Poultry Campus is within the borders of Hamidiye village of Eskişehir Mahmudiye district, its size is 310 hectares and the Institute has a total working area of 646 hectares [5].



Figure 1. General view of Eskişehir Transitional Zone Agricultural Research Institute Central Campus [4]



Figure 2. Eskişehir Transitional Zone Agricultural Research Institute central campus, administrative buildings and laboratories (<https://www.google.com/maps/place/GKTAEM>) [6]

Conducting specialized research and studies in the field at Eskişehir Transitional Zone Agricultural Research Institute; There are a total of 7 departments: Field Crops, Soil and Water Resources, Plant Health, Horticulture, Laboratory, Broiler Chicken Breeding and Feeding, Production and Management departments.

Department of Field Crops; It covers the units of Cool Climate Cereals, Edible Grain Legumes, Cultivation Techniques and Physiology, Industrial Plants, Medicinal and Aromatic Plants, Meadow Pasture and Forage Plants.

Within the Soil and Water Resources Department, there are Soil and Plant Nutrition, Agricultural Irrigation and Land Reclamation Unit, Agricultural Mechanization and Information Technologies, Climate Change and Basin Management Units.

Within the scope of the Laboratory Department, there are Quality and Technology and Biotechnology Units. Apart from these departments, the Education and Publication Unit continues its activities on the promotion of the varieties bred at the Institute, the "Anatolian T" broiler chicken breed and the research and studies carried out. The institute employs a total of 215 personnel, 73 of whom are researchers, 26 of whom are doctoral graduates and 35 are master's degree graduates.

A total of 52 projects are carried out at the institute, 1 international and 3 TÜBİTAK. As a result of breeding studies since 1925, 181 plant cultivars have been registered at the Institute. In addition, seed production is carried out to monitor the field performance of the varieties and to increase agricultural production. For example, 133.440 kg of seeds were produced in 2025 alone. In addition, seed production contracts were made with 153 seed producing organizations for 27 plant varieties such as bread wheat, barley, durum wheat, triticale, chickpeas, dry beans, green lentils, black cumin, saffron, anise, safflower, poppy, and Hungarian vetch [7, 8].

Among the duties of the institute; Development of cultivars, new cultivars, in line with market demands through breeding and breeding techniques, seed production of cultivars developed as a result of breeding studies, alternative product research to increase product diversity, collection and identification of plant genetic resources in order to protect and sustain biological diversity, and culture them when necessary. taking and using it in the breeding program, developing appropriate methods and technology for the effective use of water in agriculture, producing Turkey's first and only broiler chicken breed "Anadolu T" breeders and distributing them to contracted organizations, and carrying out studies on broiler chicken breeding. To date, approximately 300.000 breeding chicks of the Anatolian T broiler chicken breed have been delivered to producer companies.

In this study, it was aimed to determine the study and research outputs aimed at the protection and development of agricultural biological diversity, conducted since the establishment of the Eskişehir Transitional Zone Agricultural Research Institute (1925) until today.

2. Materials and methods

The history of Eskişehir Transitional Zone Agricultural Research Institute has been tried to be presented in a chronological order by making use of scientific studies, projects, breeding studies, production activities, relevant reports and literature, and internal correspondence from its establishment (1925) to the present.

In the preparation of this compilation article, the institute project development and result reports, which are prepared regularly every year, were taken as basis. In addition, very few published studies were also used.

3. Results

3.1. Breeding and conservation studies

3.1.1. Cool climate grain breeding

Cool climate grain breeding studies at Eskişehir Transitional Zone Agricultural Research Institute; Wheat breeding started with the establishment of the Institute in 1925, and it still continues with original seed production of newly improved cultivars. Our country's first domestic durum wheat variety, "Sarı 710", consisting of two lines collected from the Eskişehir region, was registered in 1929, and later, eincorn wheat "Ak 702" was registered by the Institute in 1931. In the **Cool Climate Cereals** unit of the institute, breeding studies of bread and durum wheat, triticale, barley and oats and conservation and production of local varieties are continuing. To date, 69 cultivars have been developed and registered, including 40 bread wheat, 8 durum wheat, 1 eincorn wheat, 14 barley, 3 triticale and 3 oat varieties.

The cool climate grain cultivars developed by Eskişehir Transitional Zone Agricultural Research Institute are as follows:

- 40 bread wheat cultivars (*Triticum aestivum*); Sertak 52, Yayla 305, Melez 13, 4-9, 4-11, P8-8, P8-6, Yektay 406, Bolal 2973, Kırış 66, Porsuk-2800, Gerek 79, Atay-85, Es14, Es86-7, Kutluk 94, Kırgız 95, Sultan 95, Süzen 97, Aytın 98, Yıldız 98, Harmankaya-99, Çetinel 2000, Altay 2000, İzgi 2001, Sönmez 2001, Alpu 2001, Soyer-02, Müfitbey, Nacibey, ES 26, Yunus, Mesut, Reis, Aksungur, Beyhan, Ramisbey, Karaduman, Kanatlı, Gündüzalp.
- 8 durum wheat cultivars (*Triticum durum*); Sarı 710, 185-1 (Fata'sel), Kunduru 1149, Altıntaş 95, Kümbet 2000, Yelken 2000, Dumlupınar, Leventbey.
- 1 eincorn wheat (*Triticum monococcum*); Ak 702.
- 14 barley cultivars (*Hordeum vulgare*); Güzak, Cumhuriyet 50, Yerçil-147(Franken gerste), Hamidiye 85, Erginel 90, Bilgi-91, Kalaycı-97, Çıldır02, İnce-04, Özdemir, Keser, Ünver, Sabribey, Yüksel.
- 3 triticale cultivars (*Triticosecale wittmack*); Presto, Karma 2000, Sarp.
- 3 oat cultivars (*Avena sativa*); YI-5 (Bozkır), I-3 (Apak), Checota.

3.1.2. Edible legumes

Legume breeding studies at Eskişehir Transitional Zone Agricultural Research Institute started in the mid-1960s. After 2003, the studies were gathered under one roof again and carried out under the name of national breeding research. The purpose of implementing these projects is to develop high-yield varieties that are tolerant to diseases that cause yield losses in our country, grain types that comply with Turkish Standards Institute standards and good quality values, and to deliver these varieties to farmers. The Institute has been serving as the National Edible Grain Legumes Coordinator since 2008. Since the day the breeding works began; A total of 29 varieties, 12 of which are common beans, 2 pinto beans, 1 runner bean, 10 chickpeas, 3 green lentils and 1 red lentil, have been developed and offered to the producers.

The distribution of registered edible legume varieties by species is as follows:

- Common beans (*Phaseolus vulgaris*) çeşitleri; Eskişehir 855, Yunus-90, Şehirali 90, Karacaşehir 90, Akman 98, Göynük 98, Bulduk, Akın, Karaman 2016, Topçu, Canipek, Gündoğan.
- Runner bean (*Phaseolus coccineus*) cultivar; Bahçıvan.
- Pinto bean (*Phaseolus vulgaris var. pinto*) cultivars; Önceler 98, Atmaca.
- Chickpea (*Cicer arietinum*) cultivars; Canitez-87, Işık-05, Yaşa-05, Hisar, Azkan, Çakır, Akça, Nihatbey, Çiftçi, Borsa 20.
- Mercimek (*Lens culinaris ssp. macrosperma*) cultivars; Sultan I, Kayı-91, Sazak 91.
- Red Lentil (*Lens culinaris ssp. microsperma*) cultivar; Emre 20.

A significant part of these varieties is still in the production chain. Azkan chickpea variety is a variety that covers 70% of our country's chickpea production areas.

3.1.3. Industrial plant breeding

Safflower and poppy breeding studies are carried out in the Industrial Plants Unit of Eskişehir Transitional Zone Agricultural Research Institute. Safflower (*Carthamus tinctorius*) studies at the institute were started in 1930, and

poppy breeding studies were started in 1983. The aim of safflower studies is to develop safflower varieties with high grain yield and oil content. "Yenice" safflower variety is Türkiye's first registered safflower variety and was registered by the Institute in 1939. "Dinçer", "Remzibey", "Balcı" and "Yektay" safflower varieties have been registered by the Institute. Balcı variety is one of the superior varieties today in terms of oil content and "Yektay" in terms of oil yield per unit area. Demonstrations were carried out in 33 provinces and 150 locations to popularize the safflower plant in our country [7].

Institute; It is the only research institute in Turkey that has been working on poppy (*Papaver somniferum*) breeding since 1985. The main goal of our poppy breeding studies is to improve poppy varieties with high seed and capsule yield and morphine content. In poppy breeding studies until today; "Kemer kaya", "Anayurt", "Zaferyolu", "Tınaztepe", "İzzetbey", "Ömürçan", "Seyitgazi", "Çelikoğlu", Hüseyinbey" varieties were improved. "Çelikoğlu" and "Hüseyinbey" varieties are superior varieties in terms of morphine yield per unit area [7, 8]. A total of 14 varieties, including 5 safflower and 9 poppy varieties, have been registered by the industrial plants unit.

3.1.4. Meadow, pasture and forage plants breeding

At Eskişehir Geçit Kuşığı Agricultural Research Institute, the Meadow Pasture and Forage Crops unit has been continuing its work since 1996. As a result of the breeding studies carried out in recent years, "Budak" Hungarian vetch, "Balkan" vetch and "Nedimbey" mangel cultivars were registered in 2008 [7]. In 2019, the "Akçalar" Hungarian vetch variety was registered and offered to the country's agriculture. "Nedimbey" is Turkey's first domestic mangel cultivar. Project studies are continuing in the unit on collection from natural areas, characterization and cultivar development of some grassaceae (tall wheat grass, orchardgrass) species.

Research and application projects have been carried out on the use of the fourwing saltbush (*Atriplex canescens*), one of the important forage bush species, in various problem areas for improvement, erosion control and roughage supply. The Meadow, Pasture and Forage Crops Unit collected 2 hungarian vetch, 1 crested wheat grass, 1 intermediate wheat grass, 1 clustered wheat grass, 1 tall wheat grass, 1 alfalfa, 1 hungarian brome, 1 orchard grass, 1 meadow fescue, 1 bulbous canary-grass, 1 false oat-grass, 1 mangel, 1 narbon vetch, 1 sorghum cultivar. a total of 15 plant cultivars have been developed.

The cultivars registered as a result of the work of the Meadow, Pasture and Forage Plants Unit are as follows:

Crested wheat grass	(<i>Agropyron cristatum</i>) cultivar; 2-2 Fairway.
Intermediate wheat grass	(<i>Agropyron intermedium</i>) cultivar; 2-70.
Clustered wheat grass	(<i>Agropyron desertorum</i>) cultivar; 2-34 Karabayır.
Tall wheat grass	(<i>Agropyron elongatum</i>) cultivar; 2-96.
Hungarian vetch	(<i>Vicia pannonica</i>) cultivars; Budak, Akçalar.
Alfalfa	(<i>Medicago sativa</i>) cultivar; Sazova.
Hungarian brome	(<i>Bromus inermis</i>) cultivar; 2-13 Lion.
Orchard grass	(<i>Dactylis glomerata</i>) cultivar; 2-501.
Meadow fescue	(<i>Festuca pratensis</i>) cultivar; 2-139.
Bulbous canary-grass	(<i>Phalaris aquatica</i>) cultivar; 2-61.
False oat-grass	(<i>Arrhenatherum elatius</i>) cultivar; 2-97.
Mangel	(<i>Beta vulgaris var. crassa</i>) cultivar; Nedimbey.
Narbon vetch	(<i>Vicia narbonensis</i>) cultivar; Balkan.
Sorghum	(<i>Sorghum bicolor</i>) cultivar; Yellow sooner.

3.1.5. Breeding of medicinal and aromatic plants

With the breeding studies carried out at Transitional Zone Agricultural Research Institute, varieties such as cumin, saffron, black cumin and fenugreek have been developed and registered to date, and seed production of these varieties is carried out. In cumin breeding studies, two cumin varieties named "Egebir09" and "Türkmen09", which are the first registered varieties in Türkiye, were registered in 2009. "Karaaslan" saffron variety was brought into production as the first and only registered variety in Türkiye. The black cumin variety called "Çameli" is the first and only registered black cumin variety in Turkey. Since this variety has great interest in the sector, seed production continues to increase. The "Çiftçi" variety of fenugreek was registered in 2017 due to its importance as a food additive. Our country's first anise cultivar, "Karabey", developed as a result of the studies carried out at the institute, was registered in 2021 [8]. 6 varieties have been developed by the medicinal and aromatic plants unit.

The registered varieties are:

Cumin	(<i>Cuminum cyminum</i>) cultivars; Türkmen 09, Egebir 09.
Black cumin	(<i>Nigella Sativa</i>) cultivar; Çameli.
Saffron	(<i>Crocus Sativus</i>) cultivar; Karaaslan.

Fenugreek (*Trigonella foenum-graecum*) cultivar; Çiftçi.
Anise (*Pimpinella anisum*) cultivar; Karabey.

3.1.6. Vegetable breeding

Breeding studies on confectionery zucchini, eggplant, onion, carrot, lettuce and arugula species are continuing in the Horticulture Variety development studies are continuing in lettuce using the first mutation breeding method in Türkiye. In the section, from past to present, 8 tomato, 7 pepper, 7 green beans, 6 peas, 4 pumpkin, 3 radish, 2 cucumber, 2 onion, 2 garlic, 2 melon, 1 lettuce, 1 spinach, 1 carrot, 1 watermelon, 1 cabbage, 1 squash. A total of 49 open-pollinated vegetable cultivars have been registered, including 1 for zucchini. Department of Transitional Zone Agricultural Research Institute. Hybrid carrot breeding studies are unique in Türkiye.

The varieties registered in the Department of Horticulture are:

Tomato (*Lycopersicon lycopersicum*); Wisconsin, Es 24 F, Es 58 F (2989), Red Top (VF) (11D-227), Koral (11D-644), H-2274, A-184, İ-40.
Biber (*Capsicum annuum*); Dolma Biber 11B-14, Ata 100 (11B-198), Eskişehir Çarliston, İncesu 118 (11B-118), Çetinel 150, Ilıca 256, Başmak Çarliston (190-1-7-2).
Green beans (*Phaseolus vulgaris*); 4F-89 Fransız, Sazova 1949, Karasu, Sarısu, Kırk günlük, Ferasetsiz, Pazaryeri Boncuğu.
Peas (*Pisum sativum*); Lancet, Mira, Sprinter, Summette (4B2-204), Universal, Safir Tofto S-1953.
Seeds Pumpkin (*Cucurbita pepo*); Fidan (F1 hybrid), Cihan (F1 hybrid), Beyza (F1 hybrid), Türkmen.
Radish (*Raphanus sativus*); 8TR-17, 8 Tr -14, 8TR-18.
Cucumber (*Cucumis sativus*); Beith Alpha, Dere.
Onion (*Allium cepa*); Valanciana, Tuncay.
Garlic (*Allium sativum*); Üçbaş, Germiyan.
Melon (*Cucumis melo*); Kuşçular, Sarı dilimli.
Lettuce (*Lactuca sativa*); Golden State.
Spinach (*Spinacia oleracea*); Universal.
Carrot (*Daucus carota*); Nantes.
Watermelon (*Citrullus lanatus* (Thumb.) Matsum et Nakai); Halep Karası.
Cabbage (*Brassica oleraceae capitata* var. *alba*); Bayraklı.
Squash (*Cucurbita pepo*); Sakız.

3.1.7. Breeding for disease resistant varieties

Disease studies in wheat started at the Eskişehir Transitional Zone Agricultural Research Institute shortly after its establishment, and in addition to testing the breeding material against diseases under artificial conditions, studies were also carried out to determine rust races. For the first time in Eskişehir, "Race 129-130" and "131" belonging to stem rust, which were described by Dr Scheibe in 1932-1933, were included in the international literature. Dr. Turhan ATAY, who worked at the Institute in the 1960s, entered the international literature as the first describer of the "number 300" race of stem rust disease.

Projects of the plant health department of the institute; Wheat, triticale, barley and oat breeding studies continue in parallel with the program. Studies; For bunt disease, it is carried out on the institute land, for yellow and stem rust, it is carried out under natural and artificial conditions in the institute and soil water campus, and for soil-borne wheat mosaic virus, it is carried out in disease-contaminated fields in Alpu district and central Turgutlar Village. Every year, approximately 1500 lines in the preliminary yield, yield and advanced yield levels in breeding programs are tested for the disease.

The aim of disease studies is to test the lines and varieties developed within the scope of breeding studies against wheat diseases under controlled and field conditions, and to ensure the development of resistant varieties and their introduction into production. The most important wheat diseases seen in the Central Anatolia and Transition Regions are "yellow rust", "stem rust", "bunt", root and crown rot diseases, soil-borne "wheat mosaic virus" and cereal root lesion and cyst nematodes that cause damage in wheat.

Many varieties have been developed through special crosses against these diseases, and studies are still ongoing. But in fungi, gene flow, recombination, mutations, sexual reproduction, migration from another place, etc. Virulence differences occur with these methods and resistant varieties may react sensitively to new virulent pathotypes that emerge as a result of these changes. For this reason, disease resistance breeding must be continued. Product losses due to diseases vary from region to region, from year to year, from field to field, from variety to variety, and can vary up to 40%.

"Nacibey" bread wheat variety, developed within the scope of disease resistance breeding studies, has shown resistance to yellow rust and black rust diseases since it was registered in 2008, and with these features, it has become one of the most sought-after and popular varieties of the Institute in Eskişehir and its surroundings.

3.1.8. Quality and technology laboratory studies

Eskişehir Transitional Zone Agricultural Research Institute, Quality and Technology Unit Laboratory; It has equipment to evaluate grain physical properties, protein quality properties, gluten properties in detail, as well as a laboratory-type experimental bread making unit where final product properties can be evaluated. In the nutritional quality section of the laboratory, analyzes can be made to develop genotypes with high nutritional quality for both animal and human nutrition.

These researches are very important for our country today, where healthy nutrition as well as technological quality comes to the fore. Analyzes performed in this context: crude fiber, ADF, NDF amounts, beta glucan analysis, amylopectin/amylose ratio, starch amount, amino acid contents, total dietary fiber amounts, in vitro digestion analyses, phenolic substance and antioxidant activity analyses, ascorbic acid, lutein, lactucopicrin and lactucin analyses. In addition to morphine in poppy, the laboratory also analyzes other alkaloids such as codeine, thebaine, papaverine, nescopine, safranal and crocin analyzes in saffron, and active ingredient analyzes such as thymoquinone in black cumin. The data of the analyzes specified in breeding studies are used as selection criteria.

3.1.9. Biotechnology

Eskişehir Transitional Zone Agricultural Research Institute, Biotechnology Unit studies on obtaining double haploid lines in wheat using anther culture technique, marker-assisted selection and determination of glutenin proteins using chemical markers. Studies on the subject are also carried out in projects carried out by other units at the institute. The aim of the studies is to shorten the classical breeding period, save time, cost and labor, and ensure the integration of molecular techniques into classical breeding. Contribution is made to the studies carried out in wheat and chickpea breeding programs in the unit.

3.2. Agronomy and plant physiology

At Eskişehir Transitional Zone Agricultural Research Institute, Agronomy and Physiology Unit, are carried out on the effects of plant nutrients on yield and nutrition quality and on drought physiology in wheat. The parameters determined by long-term studies at the institute have been integrated into the breeding program with the support of General Directorate of Agricultural Research and Policies in order to develop drought-tolerant wheat varieties, and the studies are still continuing.

Fallow preparation and soil fertility studies were carried out by the Institute in order to develop the dry farming system and appropriate soil cultivation techniques applied in regions with low rainfall, such as Central Anatolia. In addition, within the scope of precision agriculture technologies, which are widely used in developed countries in order to reduce the production costs of chemical fertilizers widely used in agricultural production and to minimize their damage to the environment; Projects are being carried out on seasonal nitrogen fertilizer management systems.

The project studies, which were initiated in 2007 with the Scientific and Technological Research Council of Türkiye 1007 program and continued with the support of General Directorate of Agricultural Research and Policies, have been completed, and demonstration studies in farmers' fields continue to be put into practice. Activities are being carried out to spread this initiative, which was carried out in Eskişehir, which was selected as the pilot region, throughout the country. When the traditional (farmer application) and optical sensor (NDVI) application were compared, it was seen that it used approximately 3,2 kg less nitrogen per decare under the same yield conditions, meaning the economic efficiency aspect of the system came to the fore. System application provided a 6% advantage compared to farmer application. In 2017, demonstration studies including optical sensor and nitrogen fertilizer recommendation were carried out in farmers' fields in an area of approximately 1200 decares in 23 villages in Eskişehir, together with the Provincial Directorate of Agriculture and Forestry.

Within the scope of plant nutrition; The Zinc Fertilization Project (Harvest Zinc project), which has been ongoing for 12 years under the HarvestPlus Program, under the coordination of Sabancı University, with the participation of eight countries (Türkiye, Brazil, China, India, Pakistan, North Africa, Thailand and Zimbabwe), was concluded in 2021. With this project, it is aimed to eliminate the "hidden hunger" problem caused by zinc, selenium and iodine deficiency in human nutrition through soil and leaf fertilizer applications.

3.3. Agricultural mechanization and information technologies

Field studies of the project named "Variable Level Mineral Fertilizer Application in Deep Charts" were carried out at the Institute together with Hisarlar Machinery and Trade Incorporated Company within the scope of Public-Private Sector cooperation TÜBİTAK 1501 Industry R&D projects support program at Eskişehir Geçit Kuşağı Agricultural Research Institute, Agricultural Mechanization and Information Technologies Unit. Within the scope of this project, a machine that can apply variable levels of nitrogen to depth has been developed.

In the unit; Research of Electricity Production and Usage Possibilities from Wind and PV Solar Energy Systems for Agricultural Irrigation (Eskişehir Example), Legume Harvester Design and First Sample Machine, Türkiye's Sustainable Biomass Utilization Project, Chicken Manure and Agricultural Waste Heat Sourced Serpentine and Solar Energy Hot Water Projects to Research the Thermal Energy Efficiency of the Hybrid System are being carried out.

3.4. Plant nutrition and soil science studies

In Eskişehir Transitional Zone Agricultural Research Institute, Plant Nutrition and Soil Unit, studies are carried out to determine the fertilization amounts, times and methods of agricultural products grown according to the nutrient needs of the agricultural products grown by following the country's agricultural policy.

While research projects for the effective use of soil and water resources continue, the Soil, Water and Plant Analysis Laboratory, which serves all public and private institutions, especially farmers, and research projects at the Institute, continues its activities.

At the same time, laboratory personnel; they take part in the authorization and inspection commissions of laboratories belonging to real and legal entities that will be authorized to analyze soil (physical and chemical), plants (macro and micro) and irrigation water for agricultural purposes in the provinces within the responsibility area of the institute.

3.5. Agricultural irrigation and land reclamation works

Eskişehir Transitional Zone Agricultural Research Institute, Agricultural Irrigation and Land Reclamation Unit; In order to develop water and soil resources and ensure their sustainability through rational use, planning of irrigation systems, increasing water use efficiency in irrigated agriculture by using appropriate technologies for management, reclamation of soils, especially sodium and saline soils, and bringing them into agriculture, taking into account the quality of irrigation water, the most appropriate selection of plant varieties and determination of agricultural measures in order to obtain optimum yield, determination of the quality and usability levels of industrial, domestic and waste water as irrigation water, inventory of water quality and irrigation water resources and determination of the use of low quality water for irrigation purposes, use of renewable energy resources, It continues its research activities on determining appropriate techniques and methods in the use of limited water resources.

3.6. Conservation of plant genetic resources

Local wheat varieties collection studies were carried out by the Transitional Zone Agricultural Research Institute in 2010-2011. In these studies, 25 samples from 2 villages of Kütahya, 9 samples from 4 villages of Burdur, 17 samples from 8 villages of Isparta, 9 samples from 5 villages of Eskişehir, 8 samples from 4 villages of Uşak, 4 samples from 2 villages of Afyon. 72 wheat local seed samples were collected from 36 villages of 6 provinces.

Some of the collected samples were sent to the seed gene bank. In the following years, these populations were planted separately and pure lines were selected among them. These selected pure lines were multiplied and characterized in terms of disease, quality and some agronomic features, and some lines were used as parents in hybridization studies. After some lines were propagated in sufficient quantities, they were redistributed to farmers in suitable locations, especially the villages from which they were taken, to ensure in situ production and preservation.

Within the scope of the project of Collecting Some Wheat Forage Plant Species from Natural Areas in Eskişehir and Determining Their Important Characteristics for Breeding, an observation garden was created from 123 populations of *Agropyron cristatum*, *Dactylis glomerata*, *Lolium perenne*, *Agropyron intermedium*, *Koeleria cristata* and *Festuca ovina* species collected in 2009 and 2010, measurements and observations were taken [9].

Within the scope of the Western Transitional Region Forage Crops Genetic Resources Research Project; In 2014, 2015 and 2016, 3160 single plant seeds from 25 genera/species were collected from 111 collection points. As per the project; Since it is not possible to evaluate all of the collected plants by performing morphological characterization, especially since there is a need for both leaning, semi-leaning and medium growth form plants to be used in grassland improvement, as well as semi-upright and upright material to be planted in field agriculture, it was decided to choose sainfoin (*Onobrychis sp.*) has been given. Of the sainfoin genotypes evaluated, 143 genotypes were transferred to breeding studies.

In the Possibilities of Using Shrub and Shrub Plants in Pastures project carried out between 2007 and 2014, shrub and shrub plants were collected from the provinces of Eskişehir, Kütahya, Uşak, Afyon, Burdur, Bolu, Bilecik and Denizli. *Buxus sempervirens.*, *Clematis viticella.*, *Cotoneaster horizontalis*, *Globularia trichosantha*, *Crataegus marginatus*, *Colutea cilicica.*, *Cistus creticus.*, *Colueta silica*, *Crataegus monogyna*, *Elaeagnus angustifolia.*, *Gypsophila sphaerocephala*, *Gonocytisus angulatus*, *Jasminum fruticans*, *Jasminum fruticans*, *Mahonia aquifolium*, *Rhus coriaria*, *Rosa domestica*, *Rosa pulverulenta*, *Rubus caesius*, *Paliurus spina-cristi*, *Pyracantha coccinea*, *Phyllirea latifolia*, *Pistacia terebinthus*, *Rosa canina*, *Salvia wiedemannii*, *Sambucus ebulus*, *Smilax excelsa*, *Sorbus*

domestica, *Sorbus aria*, *Vitex agnus-castus* cultured fresh grass and dry grass yields, height measurements, nutrition substance content analyses, ADF, NDF, ADL analyzes were performed.

Within the scope of the Transitional Region Vegetable Genetic Resources Research project, 93 seed samples were collected from Afyonkarahisar, Uşak, Denizli and Kütahya provinces in 2014, 184 seeds in 2015 and 225 seed samples in 2017. 320 seed samples collected were sent to the National Seed Gene Bank within the Aegean Agricultural Research Institute. In 2022, seed propagation and characterization of 320 vegetable genetic resources were carried out. Seeds of genetic resources collected during the project; It has been preserved in the gene bank for a long time and is available to those who request it, along with its characterization information.

Within the scope of the Collection and Characterization of Local Minor Vegetable Genetic Resources project, 220 materials have been collected from 23 provinces since 2021. 82 of the collected materials were characterized.

In 2007-2011, within the scope of the Northwest Transitional Region Genetic Resources Project, studies were carried out to determine the growing areas of medicinal and aromatic plants growing in Eskişehir, Kütahya and Bilecik provinces and to collect herbarium and seed samples. In the studies carried out, the growing places of 1200 medicinal plants belonging to 56 families were determined, 816 herbarium samples and 131 seed samples belonging to 24 families were collected and sent to the National Seed Gene Bank within the Aegean Agricultural Research Institute. In the collection garden of the Institute's Medicinal and Aromatic Plants Unit, *Foeniculum vulgare*, *Origanum sipyleum*, *Melissa officinalis*, *Atropa belladonna*, *Datura innoxia*, *Digitalis ferruginea*, *Asparagus officinalis*, *Oenothera biennis*, *Agrimonia eupatoria*, *Peonie peregrina*, *Physalis alkekengi*, *Salvia triloba*, *Salvia tomentosa* plants. taken.

Within the scope of the research project of Ornamental Plants Genetic Resources in the North West Transitional Region, a study was carried out in 2007-2011 to determine the growing places of ornamental plants in Eskişehir, Kütahya and Bilecik provinces and to collect herbarium and seed samples. In the project, the habitats of 350 plants belonging to 33 families were recorded, 232 herbarium and 17 seed samples were collected and sent to the National Seed Gene Bank within the Aegean Agricultural Research Institute. *Tulipa slyvestris*, *Tulipa armana*, *Tulipa orphanide*, *Fritillaria pinardii*, *Fritillaria pontica*, *Fritillaria serpenticola*, *Fritillaria flecheriana*, *Fritillaria emperyalis*, *Galanthus elwesii*, *Galanthus gracilis*, *Gladius atroviyolaceus* ve *Leucojum aestivum* plants were taken to the conservation garden of the Medicinal and Aromatic Plants Unit.

Within the scope of the Transitional Region Medicinal and Aromatic Plants Genetic Resources Research project, which started in 2012 and continued until 2017, the places where 722 medicinal plants belonging to 64 families from Denizli, Uşak, Afyonkarahisar, Eskişehir and Bilecik provinces grow were determined, 631 herbariums and 25 seed samples belonging to 14 families were collected, It was sent to the National Seed Gene Bank within the Aegean Agricultural Research Institute. Among the collected plants, *Asparagus officinalis*, *Origanum sipleum*, *Acios alpinus*, *Sideritis dictoma*, *Digitalis ferruginea*, *Atropa belladonna*, *Agrimonia eupatoria*, *Onethera biennis*, *Peonia peregria*, *Salvia officinalis*, *Origanum vulgare* ve *Viburnum opulus* species were taken to the collection garden of the Medicinal Plants Unit.

3.7. Broiler chicken breeding

Broiler chicken breed breeding studies were started in 2015 at Eskişehir Transitional Zone Agricultural Research Institute with 5 pure broiler lines. As a result of the breeding studies, trial production of Türkiye's first local and national broiler chicken, whose name was "ANADOLU-T", was registered as a brand patent in 2019 and as a local breed by the Ministry of Agriculture and Forestry in 2020, and started in 2020. 215,176 breeding chicks of the "Anadolu T" broiler chicken breed have been produced and released to the market, and the evaluation of the field results continues.

Through studies carried out with pure lines in the institute, grandparents and parents were obtained for the purpose of producing commercial broiler chickens. It has been determined that the 42-day live weight values of the broiler chicken Anadolu-T, which was developed for the first time in Türkiye in the Hamidiye campus of the Institute, is at a level that can compete with its equivalents in the market. It is planned that the target is to reach 10% of the market in the near future and to produce parents according to demands in the following periods.

4. Conclusions and discussion

The production of plant and animal products, improving their quality and efficiency, preserving, processing, evaluating and marketing these products under appropriate conditions is called agriculture [9]. Agricultural activities consist of two main branches of production: plant and animal. While agricultural production meets the need for nutrition, one of the most fundamental problems of humanity, it also effectively supports various sectors. Directing agricultural activities in a way that protects productivity and the environment in the long term, ensures economic development, and improves the quality of rural life forms the basis of sustainability in agriculture. [9,10]. Accordingly, the main purpose of sustainable agriculture is to protect resources in the agricultural sector and leave them to future

generations in terms of ecological, social and economic aspects. Achieving sustainability in agriculture is possible by protecting and developing agricultural biological diversity.

Agricultural biodiversity is a component of biological diversity that refers to all the diversity within and between species found in crop and domesticated livestock systems, including wild relatives, interacting pollinator species, pests, parasites, and other organisms. [11]. Agricultural biodiversity is key to food production and regular access to food. Agricultural biodiversity has an impact on the functioning and productivity of the agricultural ecosystem, both in terms of ecological and resource economy. [12]. Therefore, preserving a certain level of agricultural biodiversity is vital for food security and preventing hunger. The ever-increasing food demand continues to be a major problem for humanity. In agricultural food production processes, both biodiversity and arable lands must be protected. Agricultural biodiversity is the first link in the food chain, developed and protected by indigenous peoples around the world, and makes a significant contribution to the world's nutrition. [13]. Agricultural biodiversity is an important resource in achieving sustainability [14]. Overcoming the challenges of global change, such as population growth and adaptation to changing climatic conditions, may be possible with adequate nutrition. With global warming, the population in a warmer world will have to benefit from a much wider range of product diversity than now. This means valuing wild genes and protecting agricultural biodiversity. Broader dissemination of agricultural biodiversity is an important component in sustainably ensuring a safer food supply [15].

Eskişehir Transitional Zone Agricultural Research Institute, one of the first agricultural research institutes of the Republic of Türkiye, has been continuing its activities on plant breeding, soil and water resources, biodiversity conservation, and broiler chicken breeding since 1925.

Since its establishment, the Institute; It has met the needs of Turkish farmers for high-yield, disease-resistant, cold and drought-tolerant, high-quality plant varieties. Varieties developed at the institute; Although it has spread to very wide areas, except for the coastal regions of Türkiye, it has also been delivered to farmers outside Türkiye, thus making great contributions to Turkish farmers and the Turkish economy, and to some extent to the world economy.

Institute; It has registered the first varieties of wheat, safflower, poppy, runner bean, cumin, saffron, anise and fenugreek plants and the first breed of broiler chicken, "Anadolu T", in Turkey. A total of 181 plant varieties and the "Anatolian T" broiler chicken breed have been developed at the institute.

In order to protect biological diversity, local seeds from nature and from farmers were collected by the Institute within the scope of projects. From genetic resources collected; It has been used as a genitor in breeding studies to increase disease resistance, increase quality, and resistance to cold and drought. In addition, the collected local varieties were produced and distributed to farmers, thus providing on-site protection. Collected genetic resources were preserved by delivering them to the National Seed Gene Bank within the Aegean Agricultural Research Institute and to the Turkish Seed Gene Bank within the Central Agricultural Research Institute of Field Crops.

As a result, Eskişehir Transitional Zone Agricultural Research Institute continues its efforts to ensure the sustainable use of agricultural biodiversity and food security, and to produce solutions to nutritional problems in the country and around the world, with its studies.

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References

- [1] Çepel, N. (2008). *Ekolojik sorunlar ve çözümleri*, Popüler Bilim Kitapları: 180, Ankara: TÜBİTAK.
- [2] Arvas, Y. E., & Kaya, Y. (2019). Genetiği değiştirilmiş bitkilerin biyolojik çeşitliliğe potansiyel etkileri. *Yüzüncü Yıl University Journal of Agricultural Sciences*, 29(1), 168-177.
- [3] Arslan N., (2010). Tarımsal biyoçeşitlilik yerel çeşitlerin/ekotiplerin önemi. *Ziraat Mühendisliği*, (354), 4-9.
- [4] Şenol H., Kızılaslan F., 2021. Doğrusal Kombinasyon Tekniğiyle Eskişehir Geçit Kuşağı Tarımsal Araştırma Enstitü Topraklarının Kalite İndeksinin Belirlenmesi, *Türk Bilim ve Mühendislik Dergisi*, 3(2): 62-68.

- [5] Çakır, S. (2018). Tohumdan toprağa, topraktan tavuğa, Geçit Kuşağı Tarımsal Araştırma Enstitüsü. *Eskişehir Ticaret Odası Dergisi*, 35(122), 56-59.
- [6] <https://www.google.com/maps/place/GKTAEM> (Erişim tarihi; 5.04.2024).
- [7] Anonim. (2018). *Geçit Kuşağı Tarımsal Araştırma Enstitüsü Tanıtım Kitapçığı*. Eskişehir: TAGEM.
- [8] Anonim. (2024). *Geçit Kuşağı Tarımsal Araştırma Enstitüsü Tanıtım Kitapçığı*. Eskişehir: TAGEM.
- [9] İkincikarakaya, S. Ü., Beyaz, K. B., & Rezaei, F. (2013). *Doğal kaynaklar ve tarım. Türk Bilimsel Derlemeler Dergisi*, (1), 104-109.
- [10] Turhan, Ş. (2005). Tarımda sürdürülebilirlik ve organik tarım. *Tarım Ekonomisi Dergisi*, 11(1 ve 2), 13-24.
- [11] Di Falco, S. (2012). On the value of agricultural biodiversity. *Annu. Rev. Resour. Econ.*, 4(1), 207-223.
- [12] Allen, T., Prosperi, P., Cogill, B., & Flichman, G. (2014). Agricultural biodiversity, social–ecological systems and sustainable diets. *Proceedings of the Nutrition Society*, 73(4), 498-508.
- [13] Nakhauka, E. B. (2009) ‘Agricultural biodiversity for food and nutrient security: The Kenyan perspective’, *International Journal of Biodiversity and Conservation*, 1, 208– 214.
- [14] Heywood, V. H. (2013). Overview of agricultural biodiversity and its contribution to nutrition and health. In *Diversifying food and diets* (35-67). Routledge.
- [15] Frison, E. A., Chérifas, J., & Hodgkin, T. (2011). Agricultural biodiversity is essential for a sustainable improvement in food and nutrition security. *Sustainability*, 3(1), 238-253.