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Vegetable cultivation and importance of irrigation in production

In order to meet the food needs of the growing population in the world and in Turkey, people continue to produce crops intensively. Vegetables are preferred more than other plants in crop production areas due to their high economic value and their advantages in terms of health and nutrition. Increasing the amount of product in agricultural production in order to meet the need for food is only possible by increasing the factors that ensure plant growth. Irrigation is one of the main factors affecting production in plant development. The efficient utilization of water resources, which are diminishing as a result of population growth and climate change, has become a critical issue. In particular, the strategic and economical use of irrigation water for agricultural purposes is of paramount importance. This necessitates the application of water resources in crop production according to scientifically designed programs and techniques to optimize efficiency and sustainability. In this study, vegetable production in the world and in Turkey is briefly discussed and some irrigation practices and their effects in vegetable cultivation, which is of great importance in terms of production, are tried to be compiled and evaluated. As a result, considering the inadequacy of water resources, it is recommended that pressurized and smart irrigation technologies, which also ensure the sustainability of natural resources, should be developed and disseminated.

Keywords: Vegetables, vegetable cultivation, irrigation

Uprawa warzyw i znaczenie nawadniania w produkcji

Aby zaspokoić potrzeby żywnościowe rosnącej populacji na świecie i w Turcji, ludzie nadal intensywnie produkują rośliny uprawne. Warzywa są preferowane bardziej niż inne rośliny na obszarach produkcji roślinnej ze względu na ich wysoką wartość ekonomiczną oraz zalety pod względem zdrowia i odżywiania. Zwiększenie ilości produktów w produkcji rolnej w celu zaspokojenia zapotrzebowania na żywność jest możliwe tylko poprzez zwiększenie czynników zapewniających wzrost roślin. Nawadnianie jest jednym z głównych czynników wpływających na produkcję w rozwoju roślin. Najbardziej efektywne wykorzystanie zasobów wodnych, które zmniejszają się zarówno ze względu na wzrost liczby ludności, jak i zmiany klimatyczne, w obszarach, w których są one potrzebne, stało się poważnym problemem. Szczególnie ważne jest ekonomiczne wykorzystanie wody do nawadniania do celów rolniczych wykorzystywanej w produkcji roślinnej zgodnie z określonym programem i zgodnie z techniką. W niniejszym opracowaniu pokrótce omówiono produkcję warzyw na świecie i w Turcji oraz podjęto próbę zestawienia i oceny niektórych praktyk irygacyjnych i ich skutków w uprawie warzyw, która ma ogromne znaczenie pod względem produkcji. W rezultacie, biorąc pod uwagę niewystarczające zasoby wodne, zaleca się opracowanie i rozpowszechnianie technologii nawadniania ciśnieniowego i inteligentnego, które zapewniają również zrównoważony rozwój zasobów naturalnych.

Słowa kluczowe: warzywa, uprawa warzyw, nawadnianie

Introduction

Vegetables occupy a significant position in agricultural production due to their versatility for consumption in both raw and cooked forms, their prominence in promoting healthy nutrition, and their substantial economic value in domestic and international markets.

Although more than 10 000 plant species are consumed as vegetables worldwide, the number of traded species is reported to be 50[1]. The number of species subject to trade under Turkish conditions is 54 according to the Turkish Statistical Institute (TUIK) figures[2]. Turkey's advantage in this regard is considered to be that the country has nine different vegetable production regions with different ecological conditions[3]. Based on the data officially obtained from all countries by the Food and Agriculture Organization of the United Nations (FAO), it was reported that in 2021, an average of 2 billion tons of fresh fruits and vegetables were produced on a total area of 124.5 million hectares worldwide. Among these

1 D.R. Decoteau, *Classifying vegetable crops*, in: *Vegetable Crops*. NJ: Prentice Hall, 2020, pp. 32–38.

2 TUIK, www.tuik.gov.tr [access: 4.12.2020].

3 E. Alas, E. Akalp, *Status of Vegetable Production in Turkey*, "Healthy Living and Nutrition" 2023, pp. 246–253.

products, fresh vegetable production amounted to 1.1 billion tons in the world and the total vegetable production area was 58 million hectares[4]. When the reports were analysed, it was determined that the amount of vegetables produced was higher than the amount of fruits[5].

According to FAO, China is the leading country with 853.9 million tons of fresh fruit and vegetable production in 2021. After China, India (245.8 million tons), Turkey (51.6 million tons), the USA (50.7 million tons) and Brazil (48.3 million tons) follow in second, third, fourth and fifth place, respectively. Turkey produces 51.6 million tons of fresh vegetables and fruits, ranking third in the world with 2.5%. Tomatoes were the most produced vegetable crop worldwide with 189 million tons. The People's Republic of China (67.5 million tons) was the largest producer of tomatoes, followed by India (21 million tons), Turkey (13 million tons) and the USA (10.4 million tons).

After tomatoes, watermelon is the most produced vegetable crop worldwide (101.6 million tons). The People's Republic of China ranks first among countries in world watermelon production (60.8 million tons). In the world, Turkey (3.4 million tons) and India (3.2 million tons) ranked second and third, respectively. The People's Republic of China accounts for 60% of the world's watermelon production, while Turkey ranks second with 3.3%.

In 2022, Turkey's export value of fresh vegetables and fruits amounted to 8,124.7 million USD. This figure is projected to increase to 8,413.9 million USD in 2023 and 9,400.8 million USD by 2027. Turkey ranks among the top three global producers of vegetables. According to official 2021 statistics, a total of 2 million hectares of land were dedicated to the production of fresh fruits and vegetables in the country, yielding 51.6 million tons. Tomatoes emerged as the leading crop in Turkey's fresh produce sector, with a production volume of 13 million tons[6].

Vegetable Production in Turkey and Importance of Irrigation

According to 2019 data, vegetable production area in Turkey is 790 thousand hectares and has a share of 2.1% in total agricultural areas[7]. Vegetable production in our country is carried out in the form of open field and greenhouse vegetable production depending on ecological conditions. Open field vegetable farming is practiced in all regions of our country in the form of small family enterprises or in large field areas for table and industrial production without any protection measures. High rates of damage are observed in this cultivation without protection measures.

Our vegetable production was over 31 million tons in 2020. Vegetables are the main product group cultivated under cover. Approximately 8 million tons of the total vegeta-

4 FAO, https://www.fao.org/faostat/en/#home, 2021 [access: 19.07.2023].

5 V. Pirinç, E. Akalp, op. cit., p. 29.

6 Ibidem; General Secretariat of Mediterranean Exporters' Associations. Fresh fruit and vegetable sector Turkey-wide evaluation report: June 2023.

7 Ministry of Agriculture and Forestry, https://www.tarimorman.gov.tr/Konular/Bitkisel-Uretim/Tarla-ve-Bahce-Bitkileri/Urunler-ve-Uretim, 2020 [access: 4.12.2020].

ble production in our country was realised under cover[8]. It is observed that approximately 23 million tons of vegetables remaining from greenhouse production are produced under open field conditions. Our vegetable production increased by an average of 65% between 2019 and 2020, and the unit area yield value increased by approximately 36%[9].

When the vegetables produced are considered as product groups, approximately 80–82% of the total vegetable production is composed of vegetables whose fruits are eaten (mainly tomatoes, watermelons, melons, cucumbers and peppers). The production of green vegetables, especially those with high vitamin and mineral content, and vegetables whose leaves are eaten, is 6–7%. The share of tuber and root vegetables in total vegetable production is around 12–13%[10].

Tomatoes have the largest share (41–42%) in vegetable production. According to the latest data, the total amount of tomatoes produced in Turkey is 12.8 million tons. Tomatoes are followed by watermelon with 3.9 million tons, pepper with 2.6 million tons, onion with 2.2 million tons, cucumber with 1.9 million tons and melon with 1.8 million tons.

The Mediterranean Region has the largest share in vegetable production in Turkey. Approximately 26% of total vegetable production is realised in the Mediterranean Region. In terms of total vegetable production, the Aegean Region is the second most important production region with a share of 22%. The Marmara Region contributes 20%, the Central Black Sea Region 12%, the Central Anatolia Region 10% and the Southeastern Anatolia Region 9% of the total vegetable production in Turkey[11].

Open field vegetable production activities are carried out in all our geographical regions, although they vary according to vegetable types and production season. However, especially the Eastern Mediterranean, Aegean, Marmara, Central Black Sea, Central Anatolia and Southeastern Anatolia regions rank first in terms of open field vegetable production. Vegetable production in open field conditions in our country is carried out for table (domestic consumption and fresh export) and industrial sector[12].

When the types of vegetables produced in Turkey and their production amounts are analysed, tomatoes, peppers, melons, watermelons, cucumbers, eggplants and green beans among vegetables whose fruits are eaten; carrots among vegetables whose roots are eaten; onions among vegetables whose bulbs are eaten; and spinach, lettuce and white head cabbage among vegetables whose leaves are eaten have the highest production amount and production area values. This production is generally carried out under open field conditions[13].

8 TUIK, www.tuik.gov.tr [access: 4.12.2020].

9 Z. Bayramoğlu, Z. Karakayacı, K. Ağızan, S. Ağızan, M. Bozemir, 2*019. Fresh Fruit and Vegetable Workshop. June 12–13*, Atlas Academy, Konya 2019, p. 113.

10 TUIK, www.tuik.gov.tr [access: 4.12.2020].

11 A. Şalk, L. Arın, M. Deveci, S. Polat, *Special Vegetable Production*, Namık Kemal University Faculty of Agriculture Publications, 2008, 488; H. Demir, İ.H. Akgün, *Variety Selection in Tomato Cultivation and Considerations in Seedling Planting*, "Hasad Bitkisel Üretim" 2014, no. 351, pp. 54–60.

12 H. Vural, D. Eşiyok, İ. Duman, *Cultivated Vegetables (Vegetable Cultivation)*, Ege University Faculty of Agriculture, Department of Horticulture, Ege University, Basımevi 2000, p. 440.

13 TUIK, www.tuik.gov.tr [access: 4.12.2020].

According to 2022 data, the total agricultural area in Turkey is 238 639 481 decares (tab. 1). The vegetable production area in Turkey is 718 thousand hectares and the total production amount is 31 589 309 tons[14].

Table 1. Agricultural areas in Turkey and their distribution in different areas (decares)

Fruits, Beverage and Spice Crops	36 714 091
Fallow Area	29 595 607
Vegetable Area	7 176 802
Ornamental Plants Area	56 723
Area of Cereals and Other Crops	165 096 258
Total area	238 639 481

Depending on the ecological conditions, vegetable production in Turkey is carried out in open field and under cover vegetable production. Vegetables produced in the open field are mostly supplied by small family enterprises or by production in large fields. Vegetables produced in the open field are mostly table vegetables, but industrial production has also increased in recent years. Turkey is among the top four countries in the world with its potential for greenhouse cultivation[15]. In greenhouse cultivation in Turkey, vegetable production is carried out under simple or high tunnels. The products obtained from these tunnels are largely intended for table consumption.

While the types and varieties of vegetables produced in Turkey are generally produced for commercial purposes, according to TUIK[16], 56 different types of vegetables (species or different varieties within species) are produced in Turkey. According to 2022 TUIK[16] total production data, tomato (tomato paste and table) ranks first in total vegetable production with 42% (13 million tons). Tomato is followed by watermelon with 9.8%, onion with 7.4%, cucumber with 6.9%, pepper (tomato paste, capia) with 4.9%, melon with 4.5%, eggplant with 2.5%. The vegetables with the lowest production in 2022 are pomegranate, pepino, asparagus, celery (stalk), turnip, cabbage (brussels), radish (white), chard, cress, dill, red beet and purslane[17].

Vegetables grown under cover in Turkey are very diverse. Cabbage, broad beans, okra, cowpea, artichoke, spinach, cauliflower, leek, radish, fresh garlic, mint, arugula and parsley, which are usually cultivated openly in the field, can also be grown under cover. Tomato, cucumber, watermelon, pepper, melon, squash, salad-lettuce and beans constitute 95.5% of the production. The varieties and production areas to be cultivated under cover may vary

[14] TUIK, https://data.tuik.gov.tr/Kategori/GetKategori?p=tarim-11 l&dil= l [access: 19.07.2023].

[15] V. Pirinç, E. Akalp, *Comparison of Turkey and Diyarbakır Under Cover Potential*, "Garden Journal" 2022, no. 51, pp. 273–280.

[16] Ibidem.

[17] TUIK, https://data.tuik.gov.tr/Kategori/GetKategori?p=tarim-11 l&dil= l [access: 19.07.2023]; R. Özalp, A. Aktaş, *General Status of Vegetable Production in Turkey and Antalya*, "Sesi of Agriculture" 2008, no. 17, pp. 15–18.

from year to year. This is determined by factors such as changing climatic conditions, consumer demand, preferences of vegetable traders and changes in export demand.

In parallel with the development of technology, it is possible to obtain higher quantity and quality products per unit area. In addition, significant yield increases have been recorded both in the world and in our country with the use of hybrid vegetable varieties. It has become the most important issue to generate high income by exporting more vegetables produced in our country than the domestic market needs. However, there are some issues that need to be solved in terms of exports such as product diversity, residue/residue problem, supply of products of the desired quality and in sufficient quantity[18].

In agriculture, the highest product increase can be achieved in greenhouses or under cover where environmental conditions are kept under control. At the same time, it is possible to provide fresh vegetables and fruits to the market continuously and to make use of seasonal labour in agriculture all year round with greenhouse cultivation[19].

In greenhouse plant cultivation, the water required for plant growth is met only by irrigation, unlike in open field cultivation. This situation increases the importance of irrigation practices in greenhouses, which aim to provide high yields in a small area and are realised with high investments. In greenhouse production, many methods are used to apply water to plants.

Today, in addition to surface irrigation methods that are gradually being abandoned, known modern irrigation methods are used, which have found increasing application areas in accordance with the diversity provided by the developing technology and have changed depending on plant production techniques. In producer conditions, the most widely used method today is drip irrigation due to its many superior aspects. Both the production and importation of drip irrigation system elements in our country has increased the rate of spread. On the other hand, irrigation, which increases the efficiency of crop production inputs and is an integral part of high productivity in modern agriculture, is also viewed from the point of view of keeping the water deficient in the root zone at the optimum level for crop production. Therefore, in order to prevent water stress that may cause low yield and quality in the plant, it is necessary to apply the required amount of irrigation water to the plant in the required amount and at the required times during the development process, which is possible with the execution of an effective irrigation program according to the existing conditions. Although many methods for irrigation scheduling using soil, plant and climate-based monitoring techniques have been developed today, scientific methods are not used at the desired level in most of our country. Producers usually program irrigation by visually examining the condition of the plant or soil. This leads to inefficient use of water, fertilizer and energy, as well as environmental pollution, rising ground water and increased drainage problems. In addition, the lack of scientific determination of irrigation water quality, physical and chemical properties of soils and fertility status may result in decreased yield and quality[20].

[18] R. Özalp, A. Aktaş, op. cit., pp. 15–18.

[19] A.N. Yüksel, *Greenhouse Construction Technique*, Trakya University Faculty of Agriculture Publications, Publication No: 86, Textbook No: 1, Tekirdağ, 1989, p. 10.

[20] http://www.zmo.org.tr/resimler/ekler/0192e936ba11d0a_ek.pdf?tipi, 8 July 2013.

The amount of water needed by plants varies considerably from sowing the seed to harvesting the crop, depending on the type of plant and its development. In case of overwatering after transplanting, the plants grow thin, tall and coarse. In tomatoes, the first inflorescences remain small and fruits may not form. In eggplants and peppers, it causes the flowers to fall off[21].

In greenhouse cultivation, suitable climatic conditions are created by artificial devices. This causes the system to be more complex than in open field cultivation. Outdoor air relative humidity and temperature, greenhouse relative humidity and temperature, wind direction and speed, solar radiation, evaporation, soil temperature and similar factors all interact with each other. A perfect automation system should be able to perceive and evaluate these factors well and should have a structure that can draw a correct conclusion. Automation systems used in greenhouses can be examined in two parts: climate control and irrigation-fertilization automation. All these processes are carried out by a computer unit that constitutes the brain of the automation and a program installed on it[22].

Since vegetables contain about 85–90% water in their composition, they have a great interest in water. The water requirement of plants grown in greenhouses is higher than that of plants grown in the open due to their faster growth and longer harvesting time. Drip irrigation is the most widely used irrigation system in greenhouse cultivation. The drip irrigation system is based on the delivery of water to the root zone without creating too much water demand in the plant together with plant nutrients. The operating pressure is generally low, around one atmosphere. For vegetables grown under cover, dripper flow rates of 2–4 litres per hour are sufficient. Drippers are usually located 20–33 or 40 cm apart on laterals (dripper pipes). Drippers spaced 20 cm apart may be preferred as they allow for a more homogeneous distribution of water over the rows. The dripper spacing is generally kept narrower in light textured (sandy) soils and wider in heavy textured (clayey) soils. Fertilization is absolutely necessary to increase yield and quality in greenhouse cultivation. Vegetables grown in greenhouses need more nutrients compared to other plants. Since the plants are high-yielding hybrid varieties with a longer growing period, they remove more nutrients from the unit area compared to open cultivation. These nutrients taken from the soil must be returned to the soil. The application of fertilizers together with water is called fertigation[23].

The most common and widely applied irrigation methods in modern greenhouse technology are sprinkler and drip irrigation methods[24]. Drip irrigation systems have been increasingly used in Turkey, especially along the Mediterranean coastline, since the end of the 1970s[25].

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21 A.N. Yüksel, op. cit.

22 A. Kürklü, N. Çağlayan, *A Study on the Development of Greenhouse Automation Systems*, "Akdeniz University Faculty of Agriculture Journal" 2005, no. 18(1), pp. 25–34.

23 TSE. Shade Vegetable Growing, General Directorate of Agricultural Research and Policies, Department of Horticultural Research, Turkish Standards Institute, tse.org.tr/Standard/Ekonomic and Technical Magazine, Year: 51, Issue: 599, April 2012.

24 F. Macit, K. Turhan, S. Yaşar, *Research on the Comparison of Sprinkler and Drip Irrigation Methods in Autumn Greenhouse Tomato Production*, "Ege University Yearbook" 1980, pp. 1–9.

25 H. Gürgülü, *Determination of Water Consumption, Yield and Some Fruit Quality Parameters in Pepper (Capsicum annuum L.) Grown by Applying Different Salinity and Washing Rates in Soilless Agriculture – Eva-*

Conclusion

Turkey ranks first among the world countries in terms of fresh vegetable production and consumption. Turkey's advantage in this regard is that the country has different ecological conditions, agricultural production potential, suitable soil and climate conditions, which enable the production of different vegetable varieties. In addition, the fact that the country is surrounded by seas on three sides and its location between different continents and its location suitable for import and export makes vegetable cultivation and trade advantageous. In addition, with these features, it is also advantageous compared to other countries in the production and export of different types and varieties of vegetables. Since the country is an agricultural country, the production and export of vegetables develops the country's economy and contributes to its being among the developed countries.

Producers are becoming more aware of irrigation and increasingly prefer drip and sprinkler irrigation techniques. This is especially common in the Mediterranean, Aegean and Marmara regions, where vegetable farming is more intensive. It is not possible to say the same thing in terms of plant nutrition. Producers are still largely dependent on traditions and customs in fertilization. By increasing the number of conscious producers who make and implement fertilization programs according to the results of soil and leaf analysis, yield and quality can be increased with techniques and practices that are environmentally friendly and ensure the sustainability of resources in terms of production.

In order to obtain the highest benefit from the agricultural areas, which are gradually shrinking due to industrialization and rapid urbanization, and the decreasing irrigation water, it is necessary to obtain more products from unit area with unit water. For this reason, it is necessary to know the amount of irrigation water required by plants during the growing period and thus their water consumption. In addition, since plant water consumption is largely dependent on plant growth period, soil and climatic conditions, it is important to determine these conditions separately in regions where these conditions differ and to establish irrigation programs that will ensure optimum yield of the plant[26].

The development of plants is closely related to the amount of water in the root zone and within the plant. In order to achieve the expected benefit from irrigation, the time when the plant needs water, the amount of water to be applied in each irrigation and the duration of irrigation should be determined precisely. In other words, planning of irrigation time should be done correctly. Unconscious irrigation without considering the irrigation time and the amount of irrigation water to be applied brings up important problems such as low yield, salinity and sodium.

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potranspiration, Yield and Some Quality Parameters in Pepper (Capsicum annuum) Determination of L.) Under Different Salt and Filtration Fractions in Soilless Culture, Doctoral Thesis, Department of Agricultural Structures and Irrigation, Ege University, Izmir-Türkiye 2015; O. Tekinel, B. Çevik, R. Kanber, A. Author, N. Baytorun, *Research on the Application of Drip Irrigation Technique in Çukurova Conditions*, Seminar on Mechanization of Irrigation in Turkish-German Agriculture, 5–8 May, Izmir. 1987.

[26] A. Ertek, S. Şensoy, M. Yıldız, T. Kabay, *Determination of the Optimum Water Amount and Irrigation Interval for Eggplant Plants in Greenhouse Conditions by Using Open Water Surface Evaporation*, "Kahramanmaraş Sütçü İmam University Science and Engineering Journal" 2002, no. 5(2); H. Gürgülü, op. cit.

Here, vegetable production in the world and in Turkey is briefly discussed and some irrigation practices and their effects on vegetable production, which is of great importance in terms of production, are compiled and evaluated. As a result, considering the inadequacy of water resources, it is recommended that pressurized and smart irrigation technologies, which ensure the sustainability of natural resources, should be developed and disseminated.

In addition, the transition from traditional family farming to modern agricultural enterprises also contributes to the socio-economic status of individuals engaged in agribusiness. In order to make more use of the country's great potential, it is of great importance that both academics, entrepreneurs and farmers in the field of agricultural production, and especially the relevant institutions of the state work in a good coordination, plan and program in order to use new technologies in vegetable production, to encourage the selection of quality seeds/seedlings, to make use of science and technology in cultural processes such as fertilization and irrigation, and to ensure a sustainable production that is friendly with nature in agricultural production. Turkey continues to make progress in this regard.

REFERENCES

Alas E., Akalp E., *Status of Vegetable Production in Turkey*, "Healthy Living and Nutrition" 2023.

Anonymous, http://www.zmo.org.tr/resimler/ekler/0192e936ba11d0a_ek.pdf?tipi, 8.08.2013.

Anonymous, General Secretariat of Mediterranean Exporters' Associations, *Fresh fruit and vegetable sector Turkey-wide evaluation report: June 2023*.

Bayramoğlu Z., Karakayacı Z., Ağızan K., Ağızan S., Bozemir M., *Fresh Fruit and Vegetable Workshop*, June 12–13, Atlas Academy, Konya 2019.

Decoteau D.R., *Classifying vegetable crops*, in: *Vegetable Crops*, NJ: Prentice Hall, 2000.

Demir H., Akgün İ.H., *Variety Selection in Tomato Cultivation and Considerations in Seedling Planting*, Hasad Bitkisel Üretim, 2014, 351.

Ertek A., Şensoy S., Yıldız M., Kabay T., *Determination of the Optimum Water Amount and Irrigation Interval for Eggplant Plants in Greenhouse Conditions by Using Open Water Surface Evaporation*, "Kahramanmaraş Sütçü İmam University Science and Engineering Journal" 2002, no. 5(2).

FAO, https://www.fao.org/faostat /en/#home, 2021.

Gürgülü H., *Determination of Water Consumption, Yield and Some Fruit Quality Parameters in Pepper (Capsicum annuum L.) Grown by Applying Different Salinity and Washing Rates in Soilless Agriculture – Evapotranspiration, Yield and Some Quality Parameters in Pepper (Capsicum annuum) Determination of L.) Under Different Salt and Filtration Fractions in Soilless Culture*. Doctoral Thesis, Department of Agricultural Structures and Irrigation, Ege University, Izmir-Türkiye 2015.

Kürklü A., Çağlayan N., *A Study on the Development of Greenhouse Automation Systems*, "Akdeniz University Faculty of Agriculture Journal" 2005, no. 18(1).

Macit F., Turhan K., Yaşar S., *Research on the Comparison of Sprinkler and Drip Irrigation Methods in Autumn Greenhouse Tomato Production*, "Ege University Yearbook" 1980.

Ministry of Agriculture and Forestry. https://www.tarimorman.gov.tr/Konular/Bitkisel-Uretim/Tarla-ve-Bahce-Bitkileri/Urunler-ve-Uretim, 2020.

Özalp R., Aktaş A., *General Status of Vegetable Production in Turkey and Antalya*, "Sesi of Agriculture" 2008, no. 17(15–18).

Pirinç V., Akalp E., *Comparison of Turkey and Diyarbakır Under Cover Potential*, "Garden Journal" 2022, no. 51.

Pirinç V., Akalp E., *2023. The Potential of Vegetable Production in Turkey and World*, "Euroasia Journal of Mathematics, Engineering, Natural & Medical Sciences International Indexed and Refereed" 2023, no. 10.

Şalk A., Arın L., Deveci M., Polat S., *Special Vegetable Production*, Namık Kemal University Faculty of Agriculture Publications, 2008.

Tekinel O., Çevik B., Kanber R., Author A., Baytorun N., *Research on the Application of Drip Irrigation Technique in Çukurova Conditions*, Seminar on Mechanization of Irrigation in Turkish-German Agriculture, 5–8 May, Izmir, 1987.

TSE, *Shade Vegetable Growing, General Directorate of Agricultural Research and Policies*, Department of Horticultural Research, Turkish Standards Institute, tse.org.tr/Standard/Ekonomic and Technical Magazine, Year: 51, Issue: 599, April 2012.

TUIK, www.tuik.gov.tr, 2020.

TUIK, https://data.tuik.gov.tr/Kategori/GetKategori?p=tarim-11 l&dil= l, 2022.

Vural H., Eşiyok D, Duman İ., *Cultivated Vegetables (Vegetable Cultivation)*, Ege University Faculty of Agriculture, Department of Horticulture, Ege University Basımevi, Bornova 2000.

Yüksel A.N., *Greenhouse Construction Technique*, Trakya University Faculty of Agriculture Publications, Publication No: 86, Textbook No: 1, Tekirdağ 1989.