# Evaluating The Effect of Field Dodder Infestation on Productivity Indicators of Different Tomato Varieties

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DOI: 10.29322/IJSRP.14.01.2024.p14509
https://dx.doi.org/10.29322/IJSRP.14.01.2024.p14509

Paper Received Date: 14th November 2023
Paper Acceptance Date: 27th December 2023
Paper Publication Date: 6th January 2024

**Abstract:** Field dodder is a parasitic weed that causes significant damage to agricultural crops. In this research, the susceptibility of three tomato varieties (Koy, F1 pembe, and Bursa) to field dodder infection was tested under field conditions. The infection rate was determined at different stages of tomato growth, also the fresh and dry weight of field dodder parasitized on the tested tomato varieties were calculated. The decrease in the average weight, length and width of fruits of different tomato varieties due to field dodder infection was also determined. The decrease in the number of tomato fruits and production for each tomato variety was also calculated. The results showed that the infection rate of tomato varieties ranged between 91.5% for the Bursa variety and 73.8% for the Koy variety. Field dodder was able to form a large biomass on different tomato varieties, ranging from 537.7 to 945.2 g/m$^2$ of fresh weight. The infection led to a significant decrease in the fruit and production characteristics of tomato varieties. The highest loss in production was in the Bursa variety, at a rate of 76.3%, while the lowest loss was in the Koy variety, at a rate of 61.7%. In addition, the infestation of field dodder had a significant impact on the quality of production by reducing its nutrient content in different proportions. Despite the variation in the sensitivity of the varieties used in this experiment, the results showed that these varieties are sensitive to field dodder infection, so effective control must be carried out to limit the decline caused by this weed in tomato production.

**Key words:** field dodder, tomato varieties, sensitivity

## 1. Introduction

Turkey is one of the most important countries in the world in tomato production and take third place with a production of 13.1 million tons in 2022. (FAO, 2022). There are many tomato varieties spread in Türkiye, differing in appearance, quality and productivity (Guvenc, 2016). Tomato production is exposed to many biological factors, such as weeds, which lead to a decrease in production, both quantitatively and qualitatively. Field dodder (*Cuscuta campestris* Yunck.) is one of the most important challenges in tomato production and can lead to a significant decrease in production if not controlled. Field dodder is an obligate parasitic plant that does not contain chlorophyll or leaves. Its yellow-orange stems continue to grow endlessly until the end of summer, when white flowers appear. The field dodder depends on the host plant to meet its needs for water, minerals, and organic nutrients. As soon as the dodder comes into contact with the host plant, special structures called haustorium form the stems of the dodder, which penetrate the phloem and xylem of the host and transfer nutrients to the parasitic plant (Yuncker, 1932; Dawson et al., 1984; Tennakoon et al., 2016). It was reported that the damage rate caused by field dodder to some cultivated plants (such as tomatoes, eggplants, potatoes, and peppers) varies between 50-90% (Lanini and Kogan, 2005; Ustuner, 2020; Lian et al., 2006; Almhemed, 2023). Ashton and Santana (1976); Hutchinson and Ashton (1979); Nir et al. (1996) found that all commercial tomato varieties were sensitive to dodder. While field dodder reduces tomato vegetative growth and fruit number, it was reported to be ineffective on tomato fruit diameter and ripening time (Lanini, 1992). Tomato plants infected with dodder lost 50-75% of yield (Davis et al., 1998; Goldwasser et al., 2012). Under greenhouse conditions, tomato yield loss rate due to *C. chinensis* infection varied between 20 and 72% (Marambe et al., 2002). The damage caused by field dodder to pepper plants according to its stages of development was 100% at the seedling stage, 53% at the flower stage, and 28% at the fruit stage (Ustuner, 2020). The loss of sugar beet root yield was 31% due to 50% of plants being infected with field dodder (Ustuner and Ozturk, 2018). The loss rate in chickpeas due to infection with this weed varied between 86-88% (Dal, 2020). It was determined that field dodder caused 20-57% yield loss in forage crops (Aly et al., 2003) and 38% yield loss in parsley (Ustuner, 2022). Field dodder reduced the nutrient content and total chlorophyll II of eggplant fruits at different rates between infected and uninfected eggplant plants. Total carbohydrate reduction rate was determined as 59.25%, nitrogen 60.42%, phosphorus 51.85%, potassium 38.37%, calcium 35.67%, boron 17.17%, protein 60.20%, vitamin C 65.53%, total soluble solids 29.76% and total chlorophyll II 67.25% (Al-Gburi, 2021). Almhemed (2023) reported that the field dodder infection led to significant losses in eggplant plants. The eggplant variety (Adana) used was considered susceptible to weed damage. The infestation rate of dodder on eggplant branches was 93.8%. The dodder formed a large biomass amounting to 1774 g/m$^2$ of fresh weight. The percentage of decrease in the number of fruits was 59%, while the percentage of decrease in production was 82.17%.

The aim of this research was to test the sensitivity of three important varieties (Koy, F1 pembe, and Bursa) of tomatoes to field dodder infection. This is done by determining the growth and development of field dodder on these varieties and reflecting the severity of the infection on the characteristics of the fruit and the production of tomatoes quantitatively and qualitatively.

## Materials and methods

### 2.1. Materials

The experiment was carried out in Agricultural Research Institute fields in Kahramanmaras Province in 2021, and laboratory work was also implemented at Kahramanmaras Sutcu Imam University (KSU), Faculty of Agriculture, Department of Plant Protection. Chemical analysis were cunducated in University Industry Public Cooperation Development, Application and Research Center (USKIM). Climatic data for the experiment area during growing seasons were obtained from the Kahramanmaras Meteorology Station (Table 1).

Table 1. Climatic data of Kahramanmaras Province during the experiment months.

| Month | Minimum temperature (°C) | Maximum temperature (°C) | Average temperature (°C) | Average relative humidity (%) | Total precipitation (mm) |
|---|---|---|---|---|---|
| | 2021 | 2021 | 2021 | 2021 | 2021 |
| April | 0.4 | 30.9 | 15.5 | 66.1 | 33.0 |
| May | 7.5 | 41.2 | 21.2 | 54.4 | 23.0 |
| June | 11.4 | 41.0 | 25.2 | 50.2 | 0.0 |
| July | 18.5 | 44.6 | 30.8 | 46.4 | 0.0 |
| August | 15.9 | 45.0 | 29.7 | 40.9 | 0.0 |
| September | 17.1 | 45.5 | 28.8 | 42.9 | 0.0 |

Three tomato varieties were used: Bursa, F1 pembe, and Koy. These varieties differ in the characteristics of the shaped fruit. The Bursa variety has an oval shape, while F1 pembe and Koy varieties are characterized by a disc shape (Figure 1). In addition, these varieties differ in the speed of their growth, production, and fruit quality. The Bursa variety is characterized by high productivity, relatively smaller fruit size, and rapid growth compared to other varieties, but its fruits are of lower quality and low price in the markets compared to other varieties. The F1 pembe variety is characterized by high productivity and high-quality fruits with an attractive pinkish-red color and a delicious taste. Therefore, its prices are relatively high in the local and international markets, and it is one of the exportable varieties. The Koy variety is a desirable local variety in Turkey because of the large size of the fruit, its dark red color, and its richness in nutrients, but its production is less than the previous varieties (Figure 1).


Figure 1. Fruits of tomato varieties used in the experiment. a: Koy, b: F1 pembe, and c: Bursa.

Seeds of tomato varieties were obtained from Teta Tohumculuk -Seed Company and the seedlings were produced in the laboratories of the College of Agriculture, KSU. There was no need to conduct field dodder infection because the experimental area was infested with weeds. At the end of April, the land was prepared for cultivation through two perpendicular cultivators, and the soil was ready for planting seedlings with the addition of fertilizers.

Seedlings of tomato varieties were planted at the beginning of May at a distance of 40 x 60 cm. After that, all irrigation, pest control and fertilization operations were carried out. The harvesting process was carried out 9 times during the season, which continued until the end of September.

### 2.2. Methods

2.2.1. Experiment design

The experiment was designed using a completely randomized block method. Each block contained 6 treatments, two treatments for each variety, one uninfected and the other infected with the field dodder. The distance between the experimental plots was 1 m and the distance between the blocks was 2 m and the number of blocks (replicates) was four. In the uninfected treatments, all weeds were removed, including the field dodder, while in the infected treatments, all weeds were removed except the field dodder.

2.2.1. Infection rate of field dodder

The rate of dodder infection on tomato varieties was calculated in three stages: the flowering stage, the fruit ripening stage (first harvest), and the last harvest stage. The number of total tomato branches and infected branches was calculated for 8 plants in each infected experimental plot, and then the infection rate was calculated using formula (1).

Infection rate % = number of infected branches/total number of branches x 100 (1)

To determine the susceptibility of the varieties to dodder infection, samples were taken from the stems of the various infected tomato varieties during the flowering stage, and slices were prepared in the area of infection and observed through a microscope (15 times agnification).

2.2.2. Fresh and dry weight of field dodder

After the last harvest of the tomato varieties, the infected tomato plants were collected from 1 $m^2$ of each treatment, the dodder was separated from the plants in the laboratory, and the fresh weight was determined using a sensitive balance (error rate of 1 g). After that, the dodder samples were dried in room conditions at a temperature of 28 ±3. °C for a month and the dry weight was determined.

2.2.3. The effect of field dodder infestation on tomato fruit characteristics

The effect of dodder infection on tomato fruit characteristics was determined by calculating the percentage reduction in fruit weight, fruit length, and fruit width.

The weight of 10 uninfected and 10 infected fruits was calculated individually for each tomato variety in each harvest. The general average fruit weight was calculated, after which the percentage of fruit weight reduction was calculated through formula (2).

Reduction rate of the studied trait = [1- (value of the studied trait for infected plants/value of the studied trait for uninfected plants)] x 100 (2)

The width of the fruit was considered to be the diameter between the point of contact of the fruit with the mother plant and the floral tip. The length of the fruit is the diameter perpendicular to the width of the fruit. An electronic ruler was used to calculate the length and width of 10 fruits of uninfected and infected plants for each variety after each harvest, and the arithmetic average of the length and width of the fruit was calculated. Using the formula (2), the percentage of reduction in length and width of fruits of the studied tomato varieties due to dodder infection was calculated.

2.2.4. The effect of field dodder infestation on tomato production

The number of fruits obtained from 1 $m^2$ was counted using plastic string and four wooden posts in each experimental plot to determine the number of fruits from the same place in each harvesting process. After that, the rate of reduction in the number of tomato fruits for each variety was calculated using the formula (2).

The production of different tomato varieties in the uninfected and infected treatments was calculated by summing the production of all harvesting operations, and then the production reduction rate was calculated using the formula (2).

2.2.5. The effect of field dodder infestation on the nutritional content of tomato fruits

In the middle of the season (fifth harvest), 2 kg of tomato fruits from non-infected and infected plants were collected and sent to Iskim to analyze their content of glucose, fructose, protein, fat, and moisture (% of dry matter). In addition to the content of potassium, calcium, magnesium, phosphorus, and iron (g/kg of dry matter). The color depth was also determined using scales L (brightness; 100 white, 0 black), a (+ red; – green), and b (+ yellow; – blue).

2.2.6. Data analysis

Differences between means were tested by MNOVA and LSD test using Excel and SPSS (version 26) programs. P values ≥ 0.05 were considered significantly different.

**3. Results and Discussion**

3.1. Infection rate of field dodder

The severity of field dodder infection varied according to tomato varieties and growth stage. The severity of the infection increased from the beginning of the growing season to its end. The infection rate at the last harvest stage ranged between 73.8 and 91.5% according to the variety (Figure 2). There were significant differences between the percentage of dodder infection between the varieties on the one hand and the growth stages on the other hand (with the exception of the flowering stage, there was no significant difference between the F1 pembe and Bursa variety). The Bursa variety was more susceptible to field dodder infection, and the infection rate ranged between 53.1% in the flowering stage and 91.5% in the last harvest stage. While the Koy variety was the least susceptible, the infection rate ranged between 36.8% in the flowering stage and 73.8% in the final harvest stage (Figure 2). The results of this research are consistent with many studies that have shown that widespread commercial varieties of tomatoes are sensitive to field dodder infection (Ashton and Santana, 1976; Hutchinson and Ashton, 1979; Nir et al.,1996).

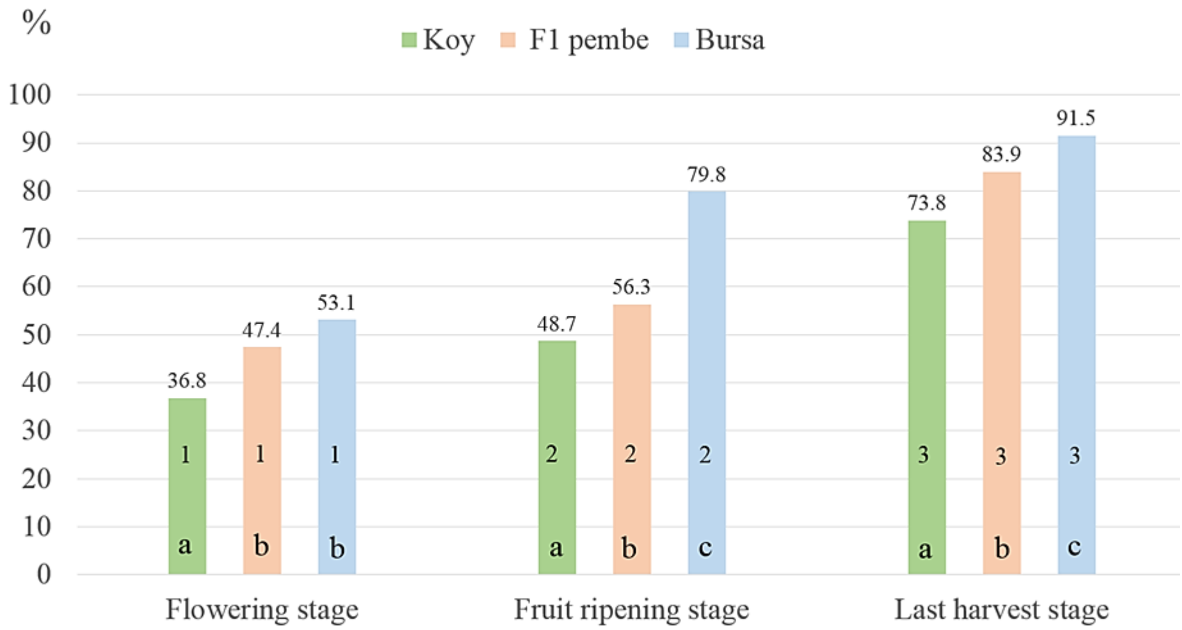


Figure 2. Infection rate of tomato branches with field dodder according to growth stages.

Despite the difference in varieties, the haustorium of the field dodder was able to penetrate the tissues of the tomato plant easily. Figure (3) shows the penetration of haustorium into the stems of different tomato varieties during the flowering stage. Also shows the success of the parasitic plant in establishing a close bond with the host plant such that it reaches the xylem tissue. Dodder species differ in their ability to penetrate the host plant. Goldwasser et al., 2001 showed that *C. pentagona* successfully wrapped around tomato stems and attached to them, but in most cases failed to penetrate the stem. Dodder penetration was 70% lower in tolerant cultivars compared to susceptible cultivars.

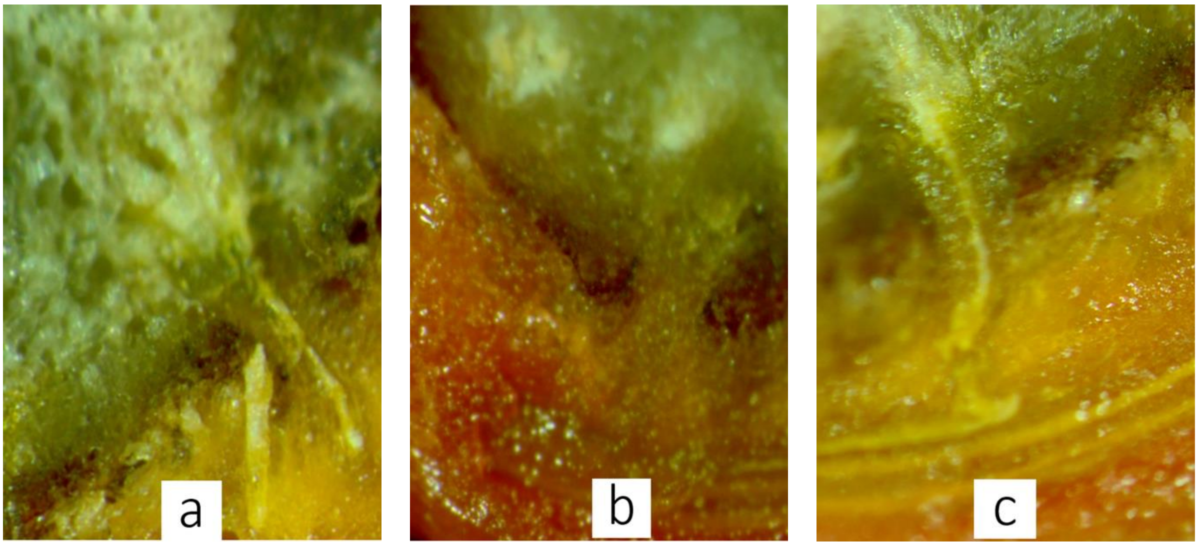


Figure 3. Haustorium penetration into tissues of tomato varieties. a: Koy, b: F1 pembe, C: Bursa.

The density of the field dodder was large at the end of the season, and the dodder was able, through its unlimited growth, to cover a large area of the infected experimental plots, as shown in the Figure (4).


Figure 4. Infection of tomato varieties with field dodder during the last harvest stage. a: Koy, b: F1 pembe, and c: Bursa.

2.2.2. Fresh and dry weight of field dodder

The results show that dodder growth on tomato varieties was different. The dodder established a greater biomass on the Bursa variety (945.2 fresh weight and 236.3 g/m$^2$ dry weight) compared to the Koy variety, on which dodder growth was weaker (537.7 g/m$^2$ fresh weight and 127.6 g/m$^2$ dry weight). The dry and fresh weight of the dodder growing on the three tomato varieties differed significantly (Figure 5).

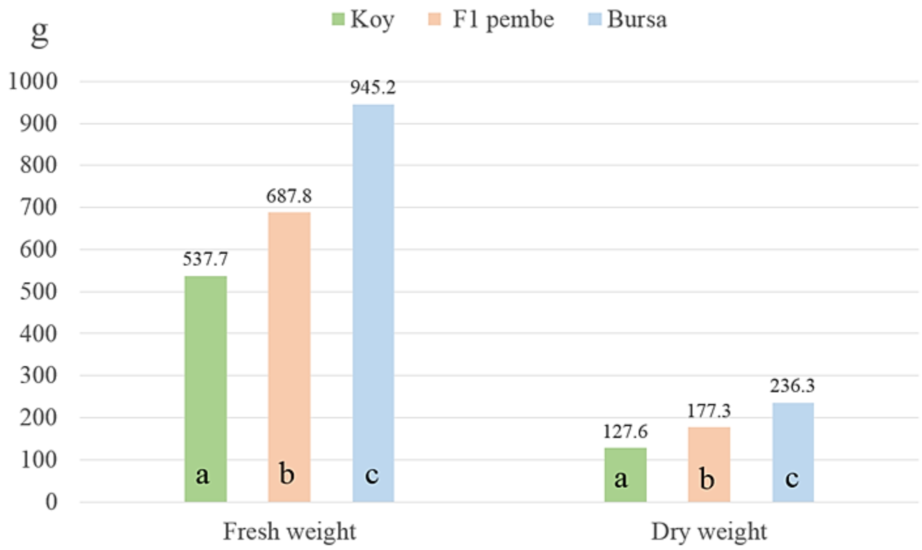


Figure 5. Fresh and dry weight of field dodder growing on tomato varieties.

2.2.3. The effect of field dodder infestation on tomato fruit characteristics

The fruit weight of tomato varieties decreased due to dodder infection at a rate of 36.7 and 47.1%, and the fruits of the Bursa variety were more affected, while the effect of dodder on the fruits of Koy and F1 pembe was similar in terms of statistical (Table 2).

Due to the nature of fruit growth for both the Koy and F1 pembe varieties, which grow transversely, fruit length was not significantly affected (reduction rate of 10.2 and 12.9%, respectively) compared to the Bursa variety, whose fruits grow longitudinally (reduction rate of fruit length is 40.8%) (Table 2).

In contrast to fruit length, the effect of dodder infection on the fruit width of the Koy and F1 pembe varieties was greater than that of the Bursa variety, as shown in the Table (2).

Table 2. Tomato varieties fruit characteristics

| Tomato variety | Weight of fruit (g) | | | Fruit length (mm) | | | Width of fruit (mm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Inf. | Uninf. | RP(%) | Inf. | Uninf. | RP(%) | Inf. | Uninf. | RP(%) |
| Koy | 182.9 | 288.8 | 36.7a | 48.0 | 53.4 | 10.2a | 61.0 | 88.7 | 31.2b |
| F1 pembe | 131.0 | 212.9 | 38.5a | 39.6 | 45.4 | 12.9a | 44.7 | 70.1 | 36.2b |
| Bursa | 42.9 | 81.2 | 47.1b | 46.3 | 78.2 | 40.8b | 29.7 | 39.3 | 24.3a |

| | | | |
|---|---|---|---|
| LSD | 4.8 | 8.7 | 6.3 |

Inf.: Infected tomato plant, Uninf.: Uninfectef tomato plant, and RP: Reduction percentage

2.2.4. The effect of field dodder infestation on tomato production

A significant decrease in the number of tomato fruits due to the infection was observed, reaching 52.8% in the Bursa variety, while the lowest decrease in the number of fruits was in the Koy variety, which was 37.2% (Table 3). Lanini (1992) reported similar results, where it was found that field dodder reduces the number of tomato fruits but it didn't affect the diameter of tomato fruits.

Because the infection reduced the weight and number of fruits, the rate of reduction in the final production of tomato varieties was much greater. The percentage of reduction or loss in tomato yield for the Bursa variety was 76.3%, the F1 pembe variety was 67.4%, and the Koy variety was 61.7% (Table 3). One study showed that tomato plants infected with field dodder lost 50-75% of yield (Goldwasser et al., 2012).

Table 3. Tomato varieties number of fruits and production

| Tomato variety | Number of tomato fruits (No/m$^2$) | | | Production of tomato (g/m$^2$) | | |
|---|---|---|---|---|---|---|
| | Inf. | Uninf. | RP(%) | Inf. | Uninf. | RP(%) |
| Koy | 11.5 | 18.3 | 37.2a | 1996 | 5214 | 61.7a |
| F1 pembe | 16.8 | 30.5 | 44.9b | 2103 | 6446 | 67.4b |
| Bursa | 50.7 | 107.3 | 52.8c | 2085 | 8813 | 76.3c |
| LSD | | | 6.7 | | | 5.3 |

Inf.: Infected tomato plant, Uninf.: Uninfectef tomato plant, and RP: Reduction percentage

2.2.5. The effect of field dodder infestation on the nutritional content of tomato fruits

The infestation of field dodder led to an important decrease in the nutritional content of the fruits of tomato varieties, with the exception of fat. The nutritional content of the tomato fruits decreased from all the studied nutrients. The color characteristics of the fruits were also affected, such that the red color index (a) decreased and the white (L) and yellow (b) color index increased (Table 4), which indicates a delay in the ripening of the fruits. Al-Gburi (2021) reported that field dodder reduced the nutrient content of eggplant fruits at different rates between infected and uninfected eggplant plants. Total carbohydrate reduction rate was determined as 59.25%, nitrogen 60.42%, phosphorus 51.85%, potassium 38.37%, calcium 35.67%, boron 17.17%, and protein 60.20%.

Table 4. Nutritional content of tomato varieties fruits

| Tomato variety | Koy | | | F1 pembe | | | Bursa | | |
|---|---|---|---|---|---|---|---|---|---|
| | Inf. | Uninf. | RP(%) | Inf. | Uninf. | RP(%) | Inf. | Uninf. | RP(%) |
| Glucose (%) | 3.77 | 2.24 | 40.58 | 3.28 | 1.72 | 47.56 | 2.17 | 1.25 | 42.40 |
| Fructose (%) | 3.45 | 2.08 | 39.71 | 2.12 | 0.8 | 62.26 | 2.25 | 0.87 | 61.33 |
| Protein (%) | 15.63 | 10.95 | 29.94 | 15.96 | 14.61 | 8.46 | 11.46 | 10.35 | 9.69 |
| Fat (%) | 0.71 | 0.76 | -7.04 | 0.82 | 0.87 | -6.10 | 0.68 | 0.79 | -16.18 |
| K (g/kg) | 3.84 | 17.84 | 47.28 | 29.76 | 24.12 | 18.95 | 28.72 | 20.21 | 29.63 |
| Ca (g/kg) | 2.84 | 0.884 | 68.87 | 1.084 | 0.718 | 33.76 | 1.006 | 0.89 | 11.53 |
| Mg (g/kg) | 2.17 | 1.56 | 28.11 | 2.214 | 1.734 | 21.68 | 1.14 | 1.08 | 5.26 |
| P (g/kg) | 3.95 | 1.74 | 55.95 | 4.887 | 2.378 | 51.34 | 2.74 | 2.12 | 22.63 |
| Fe (g/kg) | 0.087 | 0.064 | 26.44 | 0.084 | 0.047 | 44.05 | 0.069 | 0.053 | 23.19 |
| Moisture (%) | 94.54 | 94.68 | -0.15 | 94.6 | 94.63 | -0.03 | 95.05 | 95.12 | -0.07 |
| Color depth (%) L* | 35.81 | 37.19 | -3.85 | 37.21 | 40.85 | -9.78 | 36.55 | 36.85 | -0.82 |
| Color depth (%) a* | 32.6 | 30.9 | 5.21 | 33.8 | 33.5 | 0.89 | 32.84 | 31.44 | 4.26 |
| Color depth (%) b* | 30.17 | 31.86 | -5.60 | 27.92 | 28.75 | -2.97 | 29.06 | 31.83 | -9.53 |

*=D65 was made with daylight and 10 degrees' perspective. The fruits' color was L (brightness; 100 white, 0 black), a (+ red; – green) and b (+ yellow; – blue) was measured on the cheek area (Kaymak et al., 2010).
Inf.: Infected tomato plant, Uninf.: Uninfectef tomato plant, and RP: Reduction percentage

## 4. Conclusion

The results of this experiment showed that the tomato varieties used showed different sensitivity to field dodder infection. Bursa variety was the most sensitive, followed by the F1pembe variety and then the Koy variety. Despite the difference in the rate of field dodder infection between varieties, the weed caused significant losses in the quantity and quality of production of the three varieties.

According to these results, there must be effective management of lands infested with field dodder planted with these varieties, or the use of varieties resistant to the infestation.

**References**

Al-Gburi, B.K. (2021). Effect of different control applications on *Cuscuta campestris*, and biochemical content of eggplant. *Journal of the Saudi Society of Agricultural Sciences*, *20*(4), 209-216.

Almhemed, K. (2023). *Investigation of alternative control methods against field dodder* (*Cuscuta campestris* Yunc.) *in eggplant* (*Solanum melongena* L.). Doctoral thesis. Kahramanmaras Sutcu Imam Universty, Turkey, 197p.

Aly, R., Westwood, J., Cramer, C. (2003). Crop protection against parasites/pathogens through expression of sarcotoxin-like peptide. Patent No. WO02094008.

Ashton F. M., Santana D. (1976). *Cuscuta* spp. (Dodder): A literature review of its biology and control. Univ. of California Coop, Ext. Bull. 1880,1-20.

Dal, S. (2020). *The effect of dodder (Cuscuta* spp.*) and weed density in Kahramanmaras province chickpea (Cicer arietinum* L.*) fields on the morphologıcal and agronomıc features of chickpea plant.* M.Sc. Thesis, Kahramanmaras Sutcu Imam University, Graduate School of Natural and Applied Sciences, Plant Protection Department. Kahramanmaras. 80 p.

Davis, R.M., Hamilton, G., Lanini, W.T., Spreen, T.H., Osteen, C. (1998). The importance of pesticides and other pest management practices in U.S. Tomato production, Washington, D.C.: USDA National Agriculture Pesticide Impact Assessment Program. Document No. 1-CA-98. 263

Dawson, J.H. (1984). Control of cuscuta in alfalfa, In: Proc. 3 rd Internat. Sym. Parasitic Weeds, A review. p.188-199, Allepo, Syria.

FAO, (2022). United Nations Food and Agriculture Organization. https://www.fao.org/home/en/.

Goldwasser, Y., Lanini, W.T., Wrobel, R.L. (2001). Tolerance of tomato varieties to lespedeza dodder. Weed Science, 49(4), 520-523.

Goldwasser, Y., Sazo, M.R.M., Lanini, W.T. (2012). Control of field dodder (*Cuscuta campestris*) parasitizing tomato with ALS-inhibiting herbicides. *Weed Technology*, *26*(4),740-746.

Guvenc, I., (2016). Vegetable growing: Basic information, preservation and cultivation. ISBN 978-605-83781-3-1, 438pp.

Hutchinson, J. M., Ashton, F.M. (1979).Germination of field dodder (*Cuscuta campestris*). *Weed Science*, *28*, 330-333.

Kaymak, H.C., Ozturk, I., Kalkan, F., Kara, M., Ercisli, S. (2010). Color and physical properties of two common tomato (*Lycopersicon esculentum* Mill.) cultivars. *Journal of Food, Agriculture and Environment*, *8*(2), 44-46.

Lanini, W.T. (1992). Influence of dodder on tomato production. Progress Report to California Research Institute. Escalon, CA: California Tomato Research Institute.

Lanini, W.T., Kogan. M. (2005). Biology and management of Cuscuta in crops. *Ciencia e Investigación Agraria*,. *32*, 127-141

Lian, J.Y., Ye W.H., Cao, H.L., Lai, Z.M., Wang, Z.M., Cai, C.X. (2006). Influence of obligate parasite *Cuscuta campestris* on the community of its host *Mikania micrantha*. Weed Research, 46, 441-443.

Marambe, B., Wijesundara,S., Tennekoon,K.,Pindeniya,D., Jayasinghe, C. (2002). Growth and development of *Cuscuta chinensis* Lam. and its impact on selected crops. *Weed Biology and Management*, *2*, 79-81.

Nir E., Rubin B., Zharasox S.W. (1996).On the biology and selective control of field dodder (*Cuscuta campestris*). Advances in Parasitic Weed Symposium, Cordoba, Spain. Pages 809-816 in M.T. Moreno, J.I. Cubero, D. Joel, L.J. Musselman, and C. Parker, eds.

Tennakoon, K.U., Rosli, R., Le, Q. (2016). Biology of aerial parasitic vines in Brunei Darussalam: Cuscuta and Cassytha. *Biology Scientia Bruneiana*, Special Issue.

Ustuner, T., Ozturk, E. (2018). Effect of dodder (*Cuscuta campestris* Yunc.) on yield and quality in sugar beet (*Beta vulgaris* L.) cultivation. Plant Protection Bulletin, 58(1), 32-40.

Ustuner, T. (2020). The effect of field dodder (*Cuscuta campestris* Yunck.) on the phenological and pomological characteristics of Dila pepper (*Capsicum annum* L.). Harran Journal of Agricultural and Food Sciences, 24(1), 53-63.

Ustuner, T. (2022). The Effect of Field Dodder (*Cuscuta campestris* Yunck.) on Yield and Quality in Parsley [*Petroselinum crispum* (Mill.) Fuss.] Cultivation. Turkish Journal of Weed Science, 25(2), 122-133.

Yuncker, T.G. (1932). The genus Cuscuta. *Memoirs of the Torrey Botanical Club*, *18*, 109-331.