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Impact of Higher Carbon Dioxide Concentrations and Elevated Temperatures on the Growth of Field Bindweed (*Convolvulus arvensis* L.) in Turkey

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ABSTRACT

Field bindweed (*Convolvulus arvensis* L.) is one of the worst weeds in Turkey as well as worldwide. Climate change, with increasing temperature and concentrations of greenhouse gases and unpredictable extreme weather events, has been among the foremost problems of the world. The effect of climate change on crop husbandry and weeds is to be investigated. The effect of rising temperature and CO_2 on different populations of *C. arvensis* was studied under greenhouse conditions in the Malatya Province of Turkey, in 2019. For this study, the weed seeds were collected from 14 provinces throughout Turkey during 2018. Two temperature regimes (day/night 26/16°C and 29/19°C) and two CO_2 levels (400±50 and 800±50 ppm) were used. Plant aboveground length, root length, and dry weights of root, aboveground parts, and total plant were not affected by temperature, CO_2, and seed source. However, seed source affected root length differently depending on temperature and root length, and root dry weight as affected by CO_2 level. In addition, seed source and temperature showed significant effect on measured parameters, while no significant effect was determined for CO_2.

Keywords: Climate change, C_3 plant, Plant biomass, Weed.

INTRODUCTION

Field bindweed (*Convolvulus arvensis* L.) is a perennial Eurasian plant from Convolvulaceae family, particularly originating from Mediterranean Basin (Sosnoskie *et al*., 2020). It has been one of the most harmful weeds, as was reported in 32 different crops in 54 countries (Holm *et al*., 1991) and mentioned as a major problem in wheat (*Triticum aestivum* L.), cotton (*Gossypium hirsitum* L.), sugarcane (*Saccharum officinarum* L.), potato (*Solanum tuberosum* L.), maize (*Zea mays* L.), vineyards (*Vitis* spp.), orchards as well as non-agricultural areas (Sanaullah, 2020; Memon Asma, 2004; Abad *et al*., 2020; Steinmaus *et al*., 2008; Izadi-Darbandi *et al*., 2018; Andelkovic *et al*., 2021). In Turkey, it causes significant damage in agricultural areas, especially in cereals and vegetables (Guncan, 1979; Ozkan and Tepe, 2020; Jabran, 2020).

Field bindweed is commonly well known due to its competitiveness with other species, not only in crop fields but also in other disturbed habitats and industrial areas. In addition to crop yield losses, its climbing habit on the cultivated plants causes difficulties at harvest and the other agronomic applications such as irrigation or pruning (Sosnoskie *et al*., 2020; Vogelgsang, 1998). Only one individual field bindweed plant is able to reduce the water content in a soil profile up to 60 cm, which can cause complete crop failure in dry years (Vogelgsang, 1998; Swan, 1980). Losses of crop yield due to bindweed have been reported to be about 30% in wheat and 75% in maize (Swan, 1980; Safdar *et al*.,

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2019). Residues or extracts of bindweed, especially from whole plant or root, affected morphology and yield of wheat, with yield loss reaching 88% depending on the amount of residue (Yarnia, 2010). Bindweed densities changed due to crops in rotation, but yield loss was not proportional with bindweed density. It was reported that crop loss was 56, 92 and 74% in wheat, barley (*Hordeum vulgare* L.), and field peas (*Pisum sativum* L.) under measured bindweed densities of 140, 65 and 100 m^{-2}, respectively (Black *et al*., 1994). Furthermore, it acts as an alternative host to viruses (*Beet necrotic yellow vein virus*) that cause plant diseases and creates a breeding ground for harmful insects (*Euxoa ochrogaster*) in cultivated plants (Tamaki *et al*., 1975; Legreve *et al*., 2005). The other problem with bindweed is difficulty of control, i.e., methods such as tillage or herbicides cannot control bindweed patches to an expected level or duration (Sosnoskie *et al*., 2020; Bayat and Zargar, 2020). This perennial weed is able to reproduce by its seeds and underground parts and can survive under a wide range of temperature and other environmental conditions (Sosnoskie *et al*., 2020; Ozkil and Uremis, 2019; Karkanis *et al*., 2018; Bajwa *et al*., 2020).

Human activities have an essential role in regulating energy flow and ecosystem carbon cycle due to weather, climate, atmosphere composition and shaping of climate changes (Norby and Luo, 2004). It was reported that the atmospheric CO_2 concentration increased by 47% from 1750 to date, and the global temperature is 1.09°C higher in 2011–2020 compared to pre-industrial time (1850–1900), and it is much higher on land, i.e. 1.59°C (IPCC, 2021). The global average surface temperature in July 2022 was 1.15°C above the average for the comparison period of 1880-1920. The atmospheric CO_2 concentration has reached 417.51 ppm, which was 408.76 in 2019 and 280 ppm before the industrial revolution (CO2earth, 2022).

Changes in the global climate have a significant impact on the biology, spread and control of weeds, invasive alien plant species, parasitic plants and crops (Grenz *et al*., 2007; Ziska *et al*., 2011; Diez *et al*., 2012; Uludag, 2012). Weeds show generally faster growth and earlier maturation than crops. Weeds, especially C3 types, respond directly to increasing CO_2 levels, which mostly stimulate photosynthesis and growth (Patterson, 1995). Not only the invasion of perennial weeds will be greater than that of annual weeds, and plant community composition will change significantly with climate change, but also control of perennial weeds will be difficult due to increasing accumulation of resources in storage organs by increased photosynthesis (Patterson, 1995; Ziska, 2014). On the other hand, C3 plants can be affected negatively by elevating temperatures, although they have advantages to increasing CO_2 levels. For example, yield of rice, a C3 crop, decreases due to increasing night temperatures and floret sterility due to high temperatures (Korres *et al*., 2016).

Different factors such as light, CO_2, temperature, herbicides and soil can contribute to morphological or physiological diversity of bindweeds (Gianoli, 2001). Root and shoot weight and their ratios were different among the five biotypes of bindweed (Degennaro and Weller, 1984). Decreasing light caused declining flower production, leaf area, and dry matter of shoots, roots, and rhizomes in *Convolvulus arvensis* and *Centaurea repens* species (Dall'armellina and Zimdahl, 1988). Supporting help (poles) for bindweed increased length of plant and root/shoot ratio, but not total dry weight (Den Dubbelden and Oosterbeek, 1995). All these studies did not consider climate change, i.e. they were conducted under the climatic conditions during the experiments. Although C3 and C4 plants have a general pattern in change under climate change, it should be noted that bindweed has very large morphological or physiological flexibility that might cause different responses by varying populations/individuals. The aim of this study was to determine the response of

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different populations of bindweed under different temperatures and elevated CO_2 in controlled conditions.

MATERIALS AND METHODS

Site, Plant Materials and Experimental Studies

Seeds of bindweed were collected from several agricultural areas (orchards, vegetables and field areas) in different provinces of Turkey in 2018 (Table 1). The seeds were manually inspected to find out and remove damaged ones, then, they were cleaned and stored at +4°C until used in experiments. The studies were carried out in a fully automated greenhouse at Faculty of Agriculture of Malatya Turgut Ozal University, Malatya, Turkey in 2019. The experiment was arranged according to a completely randomized plot design with four replications. The light intensity in the rooms varied 70-140 µmol m^{-2}.

In the experiment, two temperature regimes (day/night 26/16°C and 29/19°C) and two carbon dioxide concentrations (400±50 and 800±50 ppm) were used where lower values for ambient and the higher ones represent future scenarios. The dormancy of the seeds was removed via soaking seeds in 90°C water for 5 seconds (Karaman and Tursun, 2021). Then, five seeds were sown in each pot at the depth of 2-3 cm with a 2:1 peat-perlite mixture. The plants were thinned to one per pot in the 4-6 leaf stage. Due to the creeping feature of the field bindweed, the plants in the pots were allowed to creep individual support poles. Plants were irrigated when required (almost twice a week).

After two months, plant length was determined by measuring the longest stem

Table 1. Provinces in Turkey where field bindweed (*Convolvulus arvensis* L.) seeds were collected and their altitudes above sea level.

Provinces	Altitude (m)	Region	Climate Class (Köppen)[a]
Malatya	966 m	Eastern Anatolia	BSk
Erzurum	1900 m		Dsb
Sanliurfa	510 m	Southeastern Anatolia	Csa
Ankara	858 m	Central Anatolia	Csa
Karaman	1058 m		BSk
Kayseri	1060 m		Csa
Konya	1023 m		BSk
Samsun	10 m	Black Sea	Cfa
Adana	26 m	Mediterranean	Csa
Hatay	89 m		Csa
Denizli	390 m	Aegean	Csa
Usak	911 m		Csa
Tekirdag	25 m	Marmara	Csa
Canakkale	12 m		Csa

[a] BSk: Semi-Dry Steppe Climate (Cold); Cfa: The climate is warm in winter, very hot in summer and rainy in all seasons.; Csa: Warm winter, very hot summer and dry climate (Mediterranean climate); Dsb; Heavy winter, dry and hot summer (Kottek *et al*., 2006; Mecitalbayrak, 2019).

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and root length was calculated via measuring all underground parts. Aboveground parts and underground parts were dried separately at 105°C for 24 hours before weighing (Hitchcock, 1931).

Data Analysis

The data underwent one-way Analysis Of Variance (ANOVA) with GLM model using IBM SPSS 25 statistical package program. The difference between treatments was determined using the Duncan multiple comparison test ($P \leq 0.05$).

RESULTS AND DISCUSSION

Five parameters, namely, shoot length, root length, shoot dry weight, root dry weight and whole plant dry weight were analyzed statistically under varying temperature, CO_2, and seed source. There was no common effect of temperature, CO_2, and seed source on any parameters analyzed. However, root length was affected by seed source in connection with temperature or CO_2 levels ($P < 0.05$). In addition, effect of seed source on root dry weight depended on CO_2 levels ($P < 0.01$). Temperature affected all five parameters significantly at probability level of 0.001, while seed source affected length parameters at 0.05 probability level and dry weight parameters at 0.001. On the contrary, CO_2 did not affect any parameter significantly.

The highest shoot length was 99.66 cm (Karaman) and the shortest was 75.88 cm (Adana), all remaining plants were from the same statistical group between these two sources (Table 2). In addition, effect on length was partly reflected in their dry weights, although there were more statistical groups between those two extremes. The maximum root length was 116.82 cm (Konya) and the shortest one was 76.72 cm (Sanliurfa) but these are not reflected to root dry weight unlike shoot length and dry weight. The same seed source did not give a consistence length or dry weight for shoot or root. It is similar to an earlier study where five biotypes of bindweed did not follow the same pattern for shoot and root fresh weights (Degennaro and Weller, 1984). Whole plant dry weight was similar to shoot dry weight for the heaviest and lightest ones, because shoot dry weight was bigger than root dry weight. There was not any pattern for seed source in spite of statistical differences. Similar results were reported for three populations from Jordan that had differences among morphological characters including aboveground and belowground dry weights; but no relation was found regarding features of sites of plant sources, except crop type (Ghosheh and Hurle, 2011). It is mentioned that shoot dry weight and total biomass were two variables for differentiating biotypes, which affect adaptation to different environments and human intervenes (Mehrafarin *et al*., 2008; Mehrafarin *et al*., 2009; Mehrafarin *et al*., 2011).

All parameters were significantly affected by increase in temperature (Table 3). Only 3°C increase from 26 to 29°C caused an increase in biomass and length of both aboveground and belowground parts. Similarly, in another study, the temperature rise from 25.7 to 29.1°C caused increase in plant height, shoot dry weight, and leaf area of C3 crop rice (*Oryza sativa* L.) and annual and perennial C3 weeds, *Monocharia vaginalis*, *Scirpus planiculmis*, *Eleocharis kuroguwai* as well as C4 and CAM (Crassulaceae acid metabolism) weeds (Bir *et al*., 2018). These are not expected results because C3 plants such as bindweed do not get much positive effect from the temperature rise: rapid growth of bindweed including belowground parts happens at 14°C with over 2°C night temperatures in Canada (Weaver and Riley, 1982). The difference between Turkish populations and Canadian population might be due to the fact that populations from Turkey were selected naturally under high temperatures in native area compared to Canadian populations that were exposed to lower temperatures in

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Table 2. Effect of seed source on length and dry weight of bindweed (*Convolvulus arvensis*).

Seed Source	Shoot length (cm)	Shoot dry weight (g)	Root length (cm)	Root dry weight (g)	Whole plant dry weight (g)
MALATYA	90.22±4.35AB	2.11±0.15AB	103.35±7.12AB	0.89±0.09AB	2.99±0.22AB
ADANA	75.88±4.35B	1.36±0.15C	104.44±7.12AB	0.70±0.09ABC	2.06±0.22C
DENIZLI	81.69±4.35AB	1.61±0.15BC	105.38±7.12AB	0.49±0.09C	2.10±0.22C
USAK	83.50±4.35AB	1.62±0.15BC	108.10±7.12AB	0.72±0.09ABC	2.33±0.22BC
TEKIRDAG	85.75±4.35AB	1.66±0.15BC	108.66±7.12AB	0.53±0.09C	2.18±0.22C
CANAKKALE	91.35±4.35AB	1.64±0.15BC	99.32±7.12AB	0.52±0.09C	2.16±0.22C
ERZURUM	92.07±4.35AB	2.29±0.15A	101.07±7.12AB	0.77±0.09ABC	3.06±0.22A
SANLIURFA	80.38±4.35AB	1.83±0.15ABC	76.72±7.12B	0.65±0.09BC	2.47±0.22ABC
ANKARA	84.47±4.35AB	1.86±0.15ABC	91.97±7.12AB	0.73±0.09ABC	2.58±0.22ABC
KARAMAN	99.66±4.35A	2.29±0.15A	104.44±7.12AB	0.81±0.09ABC	3.10±0.22A
KAYSERI	87.54±4.35AB	2.09±0.15AB	90.88±7.12AB	1.05±0.09A	3.13±0.22A
KONYA	79.04±4.35AB	1.59±0.15BC	105.97±7.12AB	0.66±0.09BC	2.25±0.22BC
SAMSUN	85.97±4.35AB	1.92±0.15AB	116.82±7.12A	0.69±0.09BC	2.60±0.22ABC
HATAY	90.66±4.35AB	1.84±0.15ABC	94.88±7.12AB	0.97±0.09AB	2.8±0.22ABC

[a] (A-C) Mean values with similar letters in the same column is not statistically significant (Duncan P> 0.05). The value of ± is the standard error.

Table 3. Effect of increasing temperature on shoot length (cm), root length (cm), shoot dry weight (g), root dry weight (g), and whole plant dry weight (g) of bindweed.

	Shoot length (cm)	Root length (cm)	Shoot dry weight (g)	Root dry weight (g)	Whole plant dry weight (g)
26°C	68.49±13.57B	77.13±20.98B	1.62±0.58B	0.53±0.27B	2.14±0.75B
29°C	104.11±21.52A	124.59±38.65A	2.05±0.72A	0.93±0.51A	2.97±1.12A
Percentage increase (%)	34	38	21	43	18

introduced areas. However, it needs to be studied experimentally.

Furthermore, the increase in root length with elevated temperature was affected by seed sources (Figure 1). Root length increased in all provinces but not the same amount. Percentage increase of root length changed between 61.91 (Denizli population) and 18.64% (Hatay population) with 39.08% median for all populations. The highest root length under 29°C were measured for six populations, Samsun, Denizli, Tekirdag, Malatya, Adana, and Karaman between 129.88 to 153.00 cm (in statistically the same group) and the lowest Sanliurfa (90.63 cm). Under 26 °C, the longest root established in Usak population and the shortest for (Denizli, Sanliurfa an Ankara Provinces (53.13 to 69.69 cm).

The effect of CO_2 on root and shoot parameters was not significant, but root length and root dry weight of bindweed were affected by CO_2 differently depending on seed sources. The change in root length varied between 89.5 and 110.38 cm in Ankara, Karaman, Konya, Malatya and Tekirdağ with CO_2 increase (400 and 800

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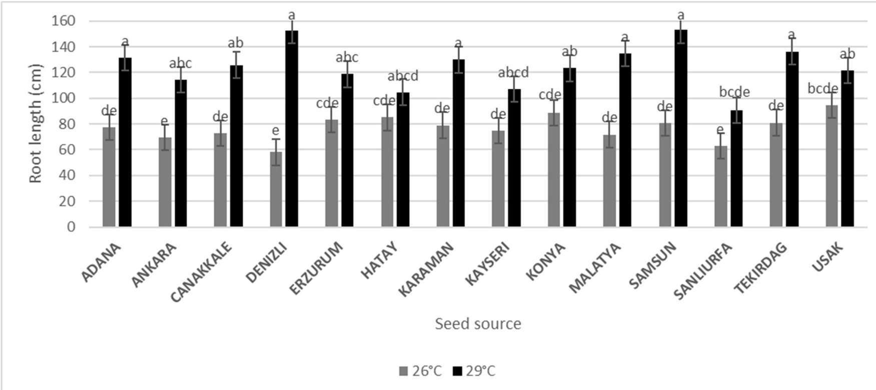

Figure 1. The effect of temperature on root length (cm) according to seed source.

ppm) and was statistically in the same group (Figure 2-A). Root length decreased for six populations between 18.38 cm and 51.25 cm; but increased for three populations between 9.63 cm and 22.06 cm. Root length and root dry weight data were not consistent among seed sources. Dry weight of bindweed root was similar for both CO_2 levels for Denizli, Hatay, and Malatya populations varying between 0.47 and 0.99 g (Figure 2-B). Dry weight increased with increasing CO_2 for only Adana, Canakkale, Kayseri, Sanliurfa, and Tekirdag populations. It was reported that there was 32.9% genetic variation among five Turkish populations although it was higher (53.8%) within populations (Sunar *et al*., 2015). We believe that this variation among populations is not small and may help to explain differences among seeds from different populations.

Overall results of these experiment show that the effect of CO_2 is not significant on bindweed, although root length and root dry weight were significantly affected by CO_2 elevation and the effect differed among seed sources. However, the effects on root length and dry weight were not parallel. A study showed that a C4 species of grain sorghum (*Sorghum bicolor*) showed beneficial effect from elevated CO_2 as well as C3 species such as bean (*Phaseolus vulgaris*) (Korres *et al*., 2016). On the other hand, the effect of increasing temperature caused increasing growth of bindweed, which is not easy to explain the physiological and anatomical reasons. However, some experimental results agree with our results. Broad leaf (C3 plant) species responded positively to elevated CO_2, but bindweed was the less responsive species (Ziska, 2003). Effect of elevated CO_2 on photosynthesis and yield of foxtail millet, a C4 crop species, was similar to C3 plants (Li *et al*., 2019). These two examples show that not all C3 or C4 plants behave the same way. In our study, a C3 plant, bindweed, behaved mostly similar to a C4 plant. The combined effect of CO_2 and rising temperature on C3 gramineae plants were additive (Mueller, 2016). Reich et al. (2018) after a 20-year experiment in grassland, reported that the CO_2 effect may can reverse effects on the development of C3 and C4 plants over time. However, it caused debates (Wolf and Ziska 2018; Nie *et al*., 2018). In addition, the response of fast-growing herbaceous C3 species to elevating CO2 was stronger compared to slower grown C3 and C4 species (Poorter and Navas, 2003). Response of bindweed populations to varying environmental conditions can be due to variability of growth and reproduction capability of bindweed (Degennaro and Weller, 1984). Thus, populations from native rangelands of Turkey and alien rangeland of Canada might respond differently, although they have not been compared in a common garden experiment, but the genetic variation among bindweed populations can be mentioned as a reason. Our findings and earlier literature suggest that ecologic, physiologic, and

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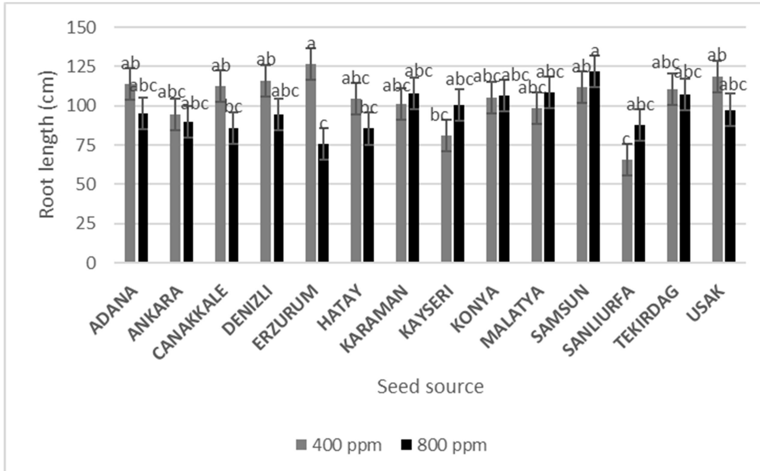
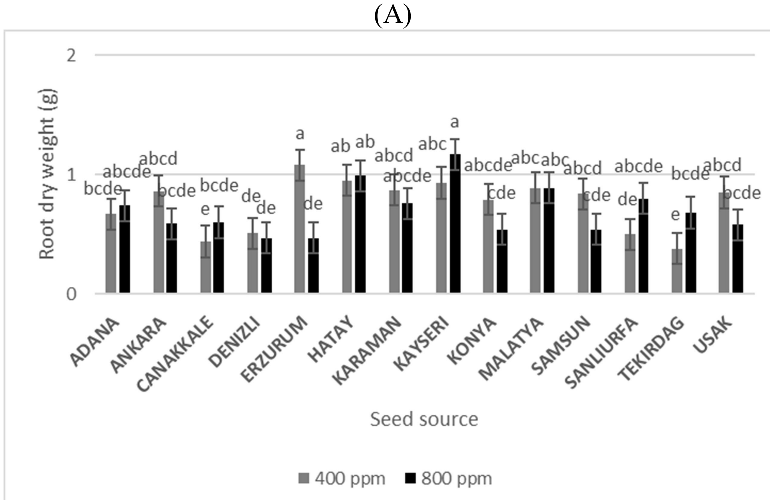


(A)



(B)

Figure 2. The effect of increasing CO_2 depending on seed source A) on root length (cm) and B) on dry weight (g).

genomic, even epigenetic studies should be run in parallel to explain precisely the climate change effect on bindweed or any other plant species. Our analysis and interpretation of the biomass data provides insights different from those of Reich *et al*. (2018), but we agree with their suggestion for conducting long-term experiments.

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REFERENCES

1. Abad, J., Diana, M., Gonzaga, S.L., Felix, C.J. and Ana, S. 2020. Under-Vine Cover Crops: Impact on Weed Development, Yield and Grape Composition. (Eds.): Collins, C. and De Bei, R. *XIIIth International Terroir Congress November* 17-18 2020, Adelaide, Australia. *OENO One*, **54(4):** 975-983.
2. Andelkovic, A., Tmusic, G., Marisavljevic, D., Markovic, M., Cvijanovic, D., Anackov, G. and Pavlovic, D. 2021. Distribution of Economically Important Weed Species in the Riparian and Roadside Vegetation of Serbia. *Acta Herbologica*, **30(1):** 51-64.

[DOI: 10.22034/JAST.26.1.139]

3. Bajwa, A.A., Farooq, M., Al-Sadi, A.M., Nawaz, A., Jabran, K. and Siddique, K.H. 2020. Impact of Climate Change on Biology and Management of Wheat Pests. *Crop Prot.*, **137**: 105304.
4. Bayat, M. and Zargar, M. 2020. Field Bindweed (*Convolvulus arvensis*) Control and Winter Wheat Response to Post Herbicides Application. *J. Crop Sci. Bio.*, **23(2):** 149-155.
5. Bir, M. S. H., Won, O. J., Bo, A. B., Ruziev, F., Umurzokov, M., Jia, W. and Park, K. W. 2018. Growth Response of Weed Species in a Paddy Field under Elevated Temperatures. *Weed Turfgrass Sci*., **7(4):** 321-329.
6. Black, I. D., Matic, R. and Dyson, C. B. 1994. Competitive Effects of Field Bindweed (*Convolvulus arvensis* L.) in Wheat, Barley and Field Peas. *Plant Prot. Q*., **9:** 12-12.
7. CO2earth. 2022. *Earth's CO_2 Home Page*. https://www.co2.earth/. (Access Date: 29/12/2022)
8. Dall'Armellina, A. A. and Zimdahl, R. L. 1988. Effect of Light on Growth and Development of Field Bindweed (*Convolvulus arvensis*) and Russian Knapweed (*Centaurea repens*). *Weed Sci.*, **36(6):** 779-783.
9. Degennaro, F. P. and Weller, S. C. 1984. Growth and Reproductive Characteristics of Field Bindweed (*Convolvulus arvensis*) Biotypes. *Weed Sci*., **32(4):** 525-528.
10. Den Dubbelden, K. C. and Oosterbeek, B. 1995. The Availability of External Support Affects Allocation Patterns and Morphology of Herbaceous Climbing Plants. *Funct. Ecol.,* **9(4):** 628-634.
11. Diez, J. M., D'Antonio, C. M., Dukes, J. S., Grosholz, E. D., Olden, J. D. and Sorte, C.J. 2012. Will Extreme Climatic Events Facilitate Biological Invasions? *Front. Ecol. Environ*., **10:** 249–257.
12. Ghosheh, H. Z. and Hurle, K. 2011. Variations in Morphology, Phenology, and Herbicide Sensitivity of Field Bindweed (*Convolvulus arvensis*) Populations from Jordan. *Jordan J. Agr. Sci*., **7:** 634-643.
13. Gianoli, E. 2001. Lack of Differential Plasticity to Shading of Internodes and Petioles with Growth Habit in *Convolvulus arvensis* (Convolvulaceae). *Int. J. Plant Sci.,* **162(6):** 1247-1252.
14. Grenz, J., Uludag, A. and Sauerborn, J. 2007. How will global change affect weeds of cotton in western Turkey? *14th EWRS Symposium*, 17-21 June 2007, Hamar, Norway, 209 PP.
15. Guncan, A. 1979. *Studies on the Biology of Field Bindweed (Convolvulus arvensis L.) and its Control Opportunities in Wheat*. Research Series No. 151, Faculty of Agriculture Publications No. 234, Ataturk University Publications No. 515.
16. Hitchcock, D. I. 1931. The Combination of a Standard Gelatin Preparation with Hydrochloric Acid and With Sodium Hydroxide. *J. General Physiol.,* **15(2):** 125-138.
17. Holm, L. G., Plucknett, D. L., Pancho, J. V. and Herberger, J. P. 1991. *The World`s Worst Weeds: Distribution and Biology*. Krieger Publishing Company, Malabar, Florida, USA, PP. 98-104.
18. IPCC, 2021. Summary for Policymakers. In: "*Climate Change 2021: The Physical Science Basis*". (Eds.): Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Berger, C. P. S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M. I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T. K., Waterfield, T., Yelek. O., Yu, I. R. and Zhou, B. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, PP. 3−32.
19. Izadi-Darbandi, E., Mirzaei, M. and Mehdikhani, H. 2018. Evaluation of Flora and Distribution of Weeds in Pistachio (*Pistacia vera*) Orchards of Kerman City. *J. Plant Prot.*, **32(1):** 59-69.
20. Jabran, K. 2020. Use of Mulches for Managing Field Bindweed and Purple Nutsedge, and Weed Control in Spinach. *Int. J. Agric. Biol.*, **23(6):** 1114-1120.
21. Karaman, Y. and Tursun, N. 2021. Germination biology of Field Bindweed seeds collected from different provinces. *Bulg. J. Agric. Sci*., **27(6):** 1168-1177.
22. Karkanis, A., Ntatsi, G., Alemardan, A., Petropoulos, S. and Bilalis, D. 2018. Interference of Weeds in Vegetable Crop Cultivation, in The Changing Climate of Southern Europe with Emphasis on Drought and Elevated Temperatures: A Review. *J. Agric. Sci.*, **156(10):** 1175-1185.
23. Korres, N. E., Norsworthy, J. K., Tehranchian, P., Gitsopoulos, T. K., Loka, D.

[DOI: 10.22034/JAST.26.1.139]

A., Oosterhuis, D. M. and Palhano, M. 2016. Cultivars to Face Climate Change Effects on Crops and Weeds: A Review. *Agron. Sust. Dev.*, **36(1):** 1-22.
24. Kottek, M., Grieser, J., Beck, C., Rudolf, B. and Rubel, F. 2006. World Map of the Köppen-Geiger Climate Classification Updated. *Meteorologische Zeitschrift*, **15(3):** 259-263.
25. Legreve, A., Schmit, J. F., Bragard, C. and Maraite, H. 2005. The Role of Climate and Alternative Hosts in the Epidemiology of Rhizomanina. *In Symposium of the International Working Group on Plant Viruses with Fungal Vectors*, PP. 129-132.
26. Li, P., Li, B., Seneweera, S., Zong, Y., Li, F. Y., Han, Y. and Hao, X. 2019. Photosynthesis and Yield Response to Elevated CO_2, C4 Plant Foxtail Millet Behaves Similarly to C3 Species. *Plant Sci.*, **285**: 239-247.
27. Mecitalbayrak. 2019. Ranked of Provinces by Altitude. https://www.mecitalbayrak.com. (Access date: 03/02/2020).
28. Mehrafarin, A., Meighani, F., Baghestani, M. A. and Mirhadi, M. J. 2008. Evaluation of Biodiversity of Field Bindweed Population in Varamin. *Rostaniha*, **9(1):** 100-112.
29. Mehrafarin, A., Meighani, F., Baghestani, M. A., Mirhadi, M. J. and Labbafi, M. R. 2009. Investigation of Morphophysiological Variation in Field Bindweed (*Convolvulus arvensis* L.) Populations of Karaj, Varamin, and Damavand in Iran. *Afr. J. Plant Sci.*, **3(4):** 064-073.
30. Mehrafarin, A., Meighani, F., Baghestani, M., Mirhadi, M. J. and Labbafi, M. 2011. Study of Morphophysiological Characteristics of Field Bindweed (*Convolvulus arvensis* L.) Population Biotypes in Karaj Using Multivariate Analysis Methods. *Iran. J. Biol.,* **24(2):** 282-292.
31. Memon Asma, R. 2004. Weed Flora Composition of Wheat and Cotton Crops in District Khairpur, Sindh. PhD. Thesis in Botânica, Shah Abdul Latif University, Pakistan.
32. Mueller, K. E., Blumenthal, D. M., Pendall, E., Carrillo, Y., Dijkstra, F. A., Williams, D. G., Follett, R. G. and Morgan, J. A. 2016. Impacts of Warming and Elevated CO_2 on a Semi-Arid Grassland Are Non-Additive, Shift with Precipitation, and Reverse Over Time. *Ecol. Lett.*, **19:** 956–966.
33. Nie, M., Zou, J., Xu, X., Liang, C., Fang, C. and Li, B. 2018. Comment on "Unexpected Reversal of C3 versus C4 Grass Response to Elevated CO_2 during a 20-Year Field Experiment". *Science*, **361(6405):** 1-4.
34. Norby, R.J. and Luo, Y. 2004. Evaluating Ecosystem Responses to Rising Atmospheric CO_2 and Global Warming in a Multi-Factor World. *New Phytol*., **162(2):** 281–293.
35. Ozkan, R. Y. and Tepe, I. 2020. Changes of Weed Flora in Cereal Fields over the Last 31 Years in Van, turkey. *Pak. J. Bot.*, **52(6):** 2003-2009.
36. Ozkil, M. and Uremis, I. 2019. Research on the Germination Biology of Field Bindweed (*Convolvulus arvensis* L.) and Three-Lobe Morningglory (*Ipomoea triloba* L.). *Plant Prot. Bull.,* **59(4):** 3-10.
37. Patterson, D. T. 1995. Weeds in a Changing Climate. *Weed Sci.*, **43(4):** 685-700.
38. Poorter, H. and Navas, M.L. 2003. Plant Growth and Competition at Elevated CO_2: On Winners, Losers and Functional Groups. *New Phytol*., **157:** 175–198.
39. Reich, P. B., Hobbie, S. E., Lee, T. D. and Pastore, M. A. 2018. Response to Comment on "Unexpected reversal of C3 versus C4 Grass Response to Elevated CO_2 during a 20-Year Field Experiment". *Science*, **361(6402):** 1-2.
40. Safdar, M. E., Hayyat, M. S., Maajid, M. Z., Nadeem, M. and Ali, A. 2019. Estimation of Economic Threshold of *Convolvulus arvensis* L. Weed in Wheat (*Triticum aestivum* L.*). P. J. Weed Sci. Res*., **25(1): 17-26.**
41. Sanaullah, U. 2020. Significance of Agricultural Extension in Addressing the Impact Due to Weed Infestation on Major Crops in District Bajaur Khyber Pakhtunkhwa Pakistan. *Pak. J. Weed Sci. Res*., **26(4):** 481-490.
42. Sosnoskie, L.M., Hanson, B. D. and Steckel, L. E. 2020. Field Bindweed (*Convolvulus arvensis*): "All Tied up". *Weed Technol*., **34(6):** 916-921.
43. Steinmaus, S., Elmore, C. L., Smith, R. J., Donaldson, D., Weber, E. A., Roncoroni, J. A. and Miller, P. R. M. 2008. Mulched Cover Crops as an Alternative to Conventional Weed Management Systems in Vineyards. *Weed Res*., **48(3):** 273–281.
44. Sunar, S., Agar, G. and Nardemir, G. 2015. Analysis of Genetic Diversity in Bindweed (*Convolvulus arvensis* L.) Populations Using Random Amplified Polymorphic DNA

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(RAPD) Markers. *J. Bio. Env. Sci*., **7:** 197-204.
45. Swan, D.G. 1980. *Field bindweed, Convolvulus arvensis* L.. *College of Agricultural Research Center,* Bulletin 0888, Washington State University, Pullman, WA, USA. 8 pp.
46. Tamaki, G., Moffitt, H. R. and Turner, J. E. 1975. The Influence of Perennial Weeds on the Abundance of the Redbacked Cutworm on Asparagi. *Environ. Entomol*., **4:** 274-276.
47. Uludag, A. 2012. Questions on Effect of Climate Change on Plant Protection. *International Symposium: Current Trends in Plant Protection,* 25-28 September 2012, Belgrade, Serbia, PP. 464-466.
48. Vogelgsang, S. 1998. Pre-emergence Efficacy of Phomopsis *C. arvensis* Ormeno to Control Field Bindweed (*C. arvensis* L.). Ph.D. Thesis, Department of Plant Science, Macdondd Campus of McGU University Montreal, QC, Canada.
49. Weaver, S. E. and Riley, W. R. 1982. The Biology of Canadian Weeds: 53. *Convolvulus arvensis* L. *Can. J. Plant Sci*., **62(2):** 461-472.
50. Wolf, J. and Ziska, L. 2018. Comment on "Unexpected Reversal of C3 versus C4 Grass Response to Elevated CO_2 during a 20-Year Field Experiment". *Science*, **361(6402):** 1-2.
51. Yarnia, M. 2010. Comparison of Field Bindweed (*Convolvulus arvensis* L.) and Bermuda Grass (*Cynodondactylon* L.) Organs Residues on Yield and Yield Components of Bread Wheat (*Triticum aestivum* L.). *Adv. Environ. Biol*., **4(3):** 414-421.
52. Ziska, L.H. 2003. Evaluation of the Growth Response of Six Invasive Species to Past, Present and Future Atmospheric Carbon Dioxide. *J. Exp. Bot.*, **54(381):** 395–404.
53. Ziska, L.H. 2014. Increasing Minimum Daily Temperatures Are Associated with Enhanced Pesticide Use in Cultivated Soybean along a Latitudinal Gradient in the Mid-Western United States. *PLoS One*, **9(6):** e98516.
54. Ziska, L.H., Blumenthal, D. M., Runion, G. B., Hunt, E. R. Jr. and Diaz-Soltero, H. 2011. Invasive Species and Climate Change: An Agronomic Perspective. *Clim. Change*, **105:** 13–42.

تأثیر مقادیر بیشتر دی اکسید کربن و دماهای بالا بر رشد نیلوفرصحرایی (*Convolvulus arvensis* L.) در ترکیه

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چکیده

نیلوفرصحرایی (*Convolvulus arvensis L.*) یکی از بدترین علف های هرز در ترکیه و همچنین در سراسر جهان است. با افزایش دما و غلظت گازهای گلخانه ای و رویدادهای شدید جوی غیرقابل پیش بینی، تغییرات اقلیمی از مهمترین مشکلات جهان بوده است و تأثیر تغییر اقلیم بر تولید محصولات زراعی و علف های هرز باید بررسی شود.(به این منظور)، در سال ۲۰۱۹ اثر افزایش دما و CO2 بر جمعیت های مختلف *C. arvensis* در شرایط گلخانه ای در استان مالاتیا ترکیه، بررسی شد. برای این مطالعه، در طول سال ۲۰۱۸ ، بذر علف های هرز از ۱۴ استان در سراسر ترکیه جمع آوری شد و دو رژیم دمایی (شب/روز برابر ℃ ۱۶/ ۲۶ و ℃۲۹/۱۹) و دو سطح CO_2 (۵۰ ± ۴۰۰ و ۵۰ ± ۸۰۰ ppm) استفاده شد. طول بوته ، طول ریشه و وزن خشک ریشه، قسمت‌های بالایی گیاه و کل گیاه تحت تأثیر دما، CO_2 و محل جمع آوری بذر قرار نگرفت. با این حال،

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محل جمع آوری بذر به طور متفاوتی بر طول ریشه تأثیر گذاشت که به دما و طول ریشه و وزن خشک ریشه زیر تاثیر سطحCO_2 وابسته بود. علاوه بر این، محل جمع آوری بذر و دما تأثیر معنی‌داری بر پارامترهای اندازه‌گیری شده نشان دادند، در حالی که برای CO_2 اثر معنی‌داری مشاهده نشد.

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