Egypt. J. Hort. **Vol. 48**, No. 1. pp. 37-48 (2021)

Egyptian Journal of Horticulture
https://ejoh.journals.ekb.eg/

Alleviating of Water Deficit in Eggplant by Two Different Mulches

Majid Amiri Rodan[1], Mohammad Reza Hassandokht[2], Davoud Sadeghzadeh-Ahari[3] and Amir Mousavi[4]

[1]*Department of Horticulture Science and Agronomy, Science and Research Branch, Islamic Azad University, Tehran, Iran*

[2]*Department of Horticulture, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran*

[3]*Dry Land Agricultural Research Institute (DARI), Maragheh, Iran*

[4]*Department of Agricultural Biotechnology, National Institute of Genetic Engineering and Biotechnology, Tehran, Iran*

EGGPLANT (*Solanum melongena* L.) is one of the drought-tolerant vegetable crops, however, recently climate change has had a devastating impact on crop cultivation in many parts of Iran. The present research aimed to investigate the application of date straw mulches (DSM) and plastic mulches (PM) on yield and morphological and physiological characters of the plant under different crop water requirements. A split-split plot experiment using an RCB design with three replications in Rodan, Hormozgan, Iran at 2017. The three levels of crop water requirement (CWR), i.e. 40, 70, and 100%, the two levels of DSM (i.e. control and DSM), and the three levels of PM (i.e. 0, 100, and 120 cm in soil depths), were allocated in the main, sub and sub-sub plots, respectively. The results of the analysis of variance revealed that the triple- interaction effects of the DSM, PM, and CWR were statically significant for all traits ($P < 0.05$ or $P < 0.01$). However, none of the simple and interactions effects were not statically significant for leaf length and width. The results revealed that 40% of CWR reduced the yield by 49% compared with 100% CWR. Also, the application of the DSM and PM alleviated the deleterious effects of water deficit. Finally, the application of the mulches is recommended for eggplant in areas affected by water shortages.

Keywords: Date straw mulch, Plastic mulch, Fruit yield, Drought stress.

Introduction

Eggplant (Solanum melongena L.) belongs to the Solanaceae family. The family contains about 3000 species that are adapted to different geographic conditions (Rodan et al., 2020). The plant is one of the most important vegetables after potatoes and tomatoes (Chapman, 2019). The production of eggplant in the world is 54 MT, which about 90% of produced in Asian countries such as China, India, and Iran (Wei et al., 2020). The Eggplant fruits are rich in different phytochemical components such as aspartic acid, tropane, flavonoids, lanosterol, glycoalkaloids, histidine, oxalic acid, solasodine, ascorbic acid, and tryptophan (Naeem and Ugur, 2019). These components make it useful for various pharmaceutical uses including anti-inflammatory, anti-asthmatic, and anti-platelet hypo-lipidemic (Naeem and Ugur, 2019). It provides a valuable amount of mineral compositions to the human body such as K, Na, C, P, Mg, Fe, Zn, Mn, and Cu (Quamruzzaman et al., 2020). Eggplant shows highly different diversity in growth habits and resistance to abiotic stresses. Although the plant is drought-tolerant, many characters such as yield and yield components, suffer from severe

Corresponding author: Mohammad R. Hassandokht, E-mail: mohammadrezahassandokhtmohamma@gmail.com, Tel. +982632248721
(Received 10/12/2020, accepted 07/02/2021)
DOI: 10.21608/ejoh.2020.53012.1155

drought stress (Zayova et al., 2017 and Rodan et al., 2020). Drought stress is one of the most important environmental stresses, which affected the yield and yield components of eggplant and other plants worldwide (Sheikh-Mohamadi et al., 2018, Akbari et al., 2020, Rodan et al., 2020 and Sanjari et al., 2021). Currently, climate change had different influences on amounts of rainfall and temperature in various locations of Iran and many regions and created severe soil drought conditions (Abbaspour et al., 2009 and Kang et al., 2009). There are many management practices to mitigate the adverse effect of drought stress in plant cultivation such as soil mulching with plastic films or organic material (Behzadnejad et al., 2020). Mulching is an effective method to enhance the soil water capacity and plant growth, and weed and pest control, which all cause improved yield (Mendonça et al., 2021). It also is a useful method for arid locations for enhancing the roots of plants under water deficiency (Zhang et al., 2020). There are two types of mulching, organic and inorganic materials such as straw and plastic mulches, respectively. Beneficial effects of different mulching under water stress have been reported for various crops, including eggplant (Sabatino et al., 2018), sesame (Behzadnejad et al., 2020), maize (Shen et al., 2020), wheat (Yang et al., 2020), and tomato (Mendonça et al., 2021). Recently, plastic and straw mulch has become the chief material that was applied for soil mulching in arid regions (Kumari, 2018). Many factors are important to choose suitable mulching such as climate, mulch price, and kind of crop (Wang et al., 2016). However, the response of plants to the mulching is depending on many factors, i.e. genotype, mulch materials, and environmental conditions (Abdrabbo et al., 2017). Since many areas of Iran are under drought conditions, therefore appropriate management practices are necessary to mitigate the adverse effect of water-deficient in plant cultivation. Thus, the present study aimed to investigate the effects of two different mulching including date straw mulch (DSM) and plastic mulch (PM) on yield and other characters of eggplant under drought stress.

Materials and Methods

Experimental conditions

In the present study, a local eggplant cultivar (Bademjan in Persian) was used. The seeds of the cultivar were obtained from a local store. The seeds were sown in a greenhouse with a temperature of 25 °C and relative humidity of 35%. The seedling was transferred to the field at the 5 to 6 leaf- stage in September 2017. The experiment site was located in Rodan city at 190 m asl, 27º 27´ N and 57º 11´ E, in Hormozgan Province, Iran. The average annual rainfall of the studied site is 250 mm and the average annual temperature is 27.5 °C. The experiment was a split-split plot experiment based on RCBD, which divided into three plots including main, sub, and sub-sub plots. The three levels of crop water requirement (CWR), i.e. 40, 70, and 100% the 2 levels of date straw mulches (i.e. control and DSM), and the three levels of plastic mulches (eg polyethylene 15 µ thick) at 0, 100, and 120 cm soil depths (these mulches were placed underground), which were allocated in the main, sub and sub-sub plots, respectively. For the date straw mulch, a 10-12 cm thick straw cover was spread over a 50 cm width area. The plants were established in three rows spaced 80 cm apart with an in-row distance between plants of 15 cm. Each plot was 3×3 m and 30 plants per plot and 1 m distance was established between plots. The texture of the field soil was a sandy loam and cattle manure was applied at bed preparation. Weeds were controlled by hand. No materials were applied to control insects and other pests. The CWR was measured by CROPWAT 8.0 software.

Measured characters

At the maturity stage, the following characters were recorded; fruit yield (m^2), K (%), total chlorophyll, chlorophyll a, chlorophyll b, fruit dry matter (%), number of leaves flowers, sub-branches, and fruits, root length (cm), root fresh and dry weights (g), leaf length and width (cm), and plant height (cm). To determine the K content, the fruits dried in an oven at 70 °C. One gram of each sample treatment was kept in the furnace at 550 °C for 6 h and then the powder of each sample dissolved in 100 ml 10% HCl. Finely, K content was measured by flame photometry. The total chlorophyll, Chl a, and b were measured using Lichtenthaler (1987) method. The fresh leaves (0.2 g) of the plants were crushed by 15 ml of acetone (80%). After filtered, absorbance was read at 663 and 646 nm. Finally, the Chlorophyll concentration was calculated using the following equations:

$$\text{Chl a } (\mu g/ml) = 12.25\ A_{663} - 2.79\ A_{646}$$

$$\text{Chl b } (\mu g/ml) = 21.50\ A_{646} - 5.1\ A_{663}$$

$$\text{Chl total } (\mu g/ml) = \text{Chl a} + \text{Chl b}$$

Statistical analysis

In the present study, all data were analyzed using Statistical Analysis Software (V. 9.1; SAS Institute, Cary, NC). The difference between the means of treatments was compared by the LSD test ($P < 0.05$).

Results and Discussion

Analysis of variance

The results of ANOVA revealed that the triple interaction among the studied factors, i.e. drought stress, DSM, and PM was significant on all measured traits except for length, width, and the number of leaves ($P < 0.01$ or $P < 0.05$, Table 1).

Wickens and Keppel (2004) stated that if the highest interaction effect among the factors was significant, the focus should be on this effect compared with other simple and interactions effects. Therefore, in the present study, we focused on the triple interaction among the factors for all traits except for leaf characters.

Measured characters

The results of the present study showed that the fruit yield reduced under drought stress but the applications of both mulches increased the eggplant yield (Fig. 1). This increase in fruit yield was especially observed in the application of DSM and PM of 120 cm soil depth. It could

TABLE 1. ANOVA of the measured characters in the present study.

S.O.V	df	Mean square							
		Y	NF	NoF	DM	NL	LL	LW	PH
Rep	2	0.16^{ns}	5.4^{ns}	13.4^{ns}	2.9^{ns}	2051.3^{ns}	12.9^{ns}	14.1^{ns}	161.8^{ns}
(CWR (a	2	0.21**	50.9*	3.1^{ns}	5.06*	425.0^{ns}	40.8^{ns}	1.2^{ns}	951**
Ea	4	0.044	5.21	6.18	0.62	1216.8	12.9	2.4	73.8
(DSM (b	1	0.2**	12.5^{ns}	0.01^{ns}	0.56^{ns}	2.6 ^{ns}	8.5^{ns}	4.7^{ns}	244.6 ^{ns}
a*b	2	0.14*	1.8^{ns}	1.1^{ns}	0.26^{ns}	1542*	10.5^{ns}	1.3^{ns}	19.2 ^{ns}
Eb	6	0.09	5	4.2	0.5	1101.3	12.7	1.8	57.3
(PM (c	2	0.18**	66.3*	3.3*	2.7*	936*	4.1^{ns}	2.0^{ns}	382**
a*c	4	0.06*	8 ^{ns}	2.2*	3.3*	549.8^{ns}	3.6^{ns}	0.8^{ns}	51.6*
b*c	2	0.018*	0.3 ^{ns}	1.9*	1.01^{ns}	3.77^{ns}	1.3^{ns}	1.1^{ns}	1.4 ^{ns}
a*b*c	4	0.02**	12.8*	0.32**	2.9*	**168.8	2.2^{ns}	0.5^{ns}	47.8*
Error	24	0.001	3.4	1.65	0.48	10.6	3.25	1.3	17.55
CV (%)	-	6.31	6.65	20	24.2	7.22	14	9.1	9.7

S.O.V	df	NSB	RL	RFW	RDW	TCL	CLa	CLb	K
Rep	2	40.1^{ns}	654.01^{ns}	445.018^{ns}	455.12^{ns}	0.023^{ns}	0.001^{ns}	0.074^{ns}	6.9^{ns}
(CWR (a	2	401.1**	61.4**	1115**	47.5**	0.23**	0.08**	0.036**	3^{ns}
Ea	4	12.9	0.19	0.18	0.29	0.00014	0.00003	0.009	2.4
(DSM (b	1	294*	411.1**	1061**	39.8**	0.003*	0.001**	0.0001^{ns}	24*
a*b	2	15.7^{ns}	651.2**	3253**	57.5**	1.1**	0.62**	0.07**	3^{ns}
Eb	6	5.1	0.012	0.018	0.092	0.00012	0.00002	0.007	1.7
(PM (c	2	112.3*	423.4**	2230**	56.7**	0.32**	0.15**	0.03**	2 ^{ns}
a*c	4	40.4*	200.1**	1196**	94.2**	0.02**	0.009**	0.0037^{ns}	13*
b*c	2	1.1^{ns}	175.4**	572**	23.7**	0.017**	0.059**	0.03*	35*
a*b*c	4	36.3*	428**	558**	68.43**	0.15**	0.07**	0.02*	28*
Error	24	3.1	0.0055	0.011	0.006	0.0001	0.000002	0.0055	1.15
CV (%)	-	16.5	6.6	4.8	5.6	6.8	6.3	21.6	11.2

CWR: Crop water requirement, DSM: Date straw mulch, PM: Plastic mulch, Y: yield; NF: Number of flower; NoF: Number of fruit; DM: Dry matter; NL: Number of leaf; LL: leaf length; LW: leaf width; PH: Plant height; NSB: Number of sub-branches; RL: Root length; RFW: Root fresh weight; RDW: Root dry weight; TCL: Total chlorophyll; CLa: Chlorophyll a; CLb: Chlorophyll b. * and **: Significance at 0.05 and 0.01 probability levels, respectively. NS: Non significant be due to the various effects of mulch on plant growth periods such as protection of surface soil structure and rainwater, improving soil physical and chemical properties, and increasing water storage capacity (Kashif et al., 2018).

The highest fruit weight (4.74 kg) belonged to the DSM and PM in 120 cm soil depth under 100%CWR and the lowest (1.15 kg) was obtained without mulch 40% CWR. Eggplant growth was improved by mulch, and the use of synthetic mulches such as PM increased the eggplant yield compared to not using mulch (Adamczewska-Sowinska and Turczuk, 2016). Abdrabbo et al. (2017) reported that growth parameters and eggplant yield increased with increasing CWR level from 50 to 100%. Also, the authors demonstrated that the highest growth and yield of the plant were obtained in the application of black polyethylene mulch in 100% CWR compared to no mulch application. Water availability affects flower formation and fruit growth, therefore a decrease in water supply resulted in decreasing the number of flowers and yield (Beyá-Marshall et al., 2018). Drought stress reduced the number of flowers in chrysanthemums and tea plants (Qu et al., 2019 and Sahithi et al., 2020). In this study, the number of flowers and fruits decreased by reducing the water requirement from 100 to 40% (Fig. 2). The application of PM resulted in increasing the number of flowers and fruits at the three levels of CWR. Also, the results revealed

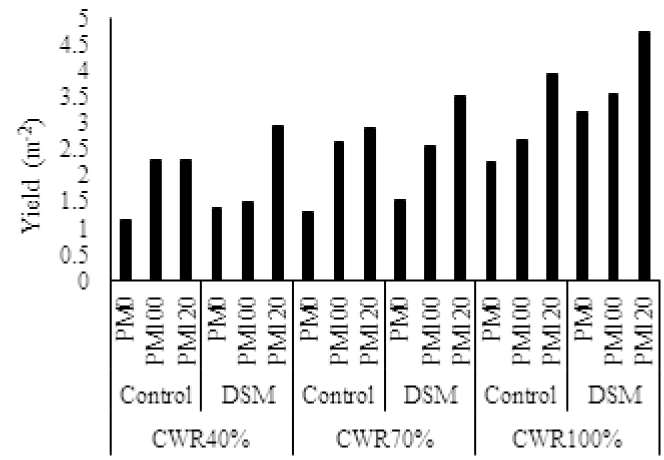

Fig. 1. Triple interaction of DSM, PM, and CWR on eggplant yield.

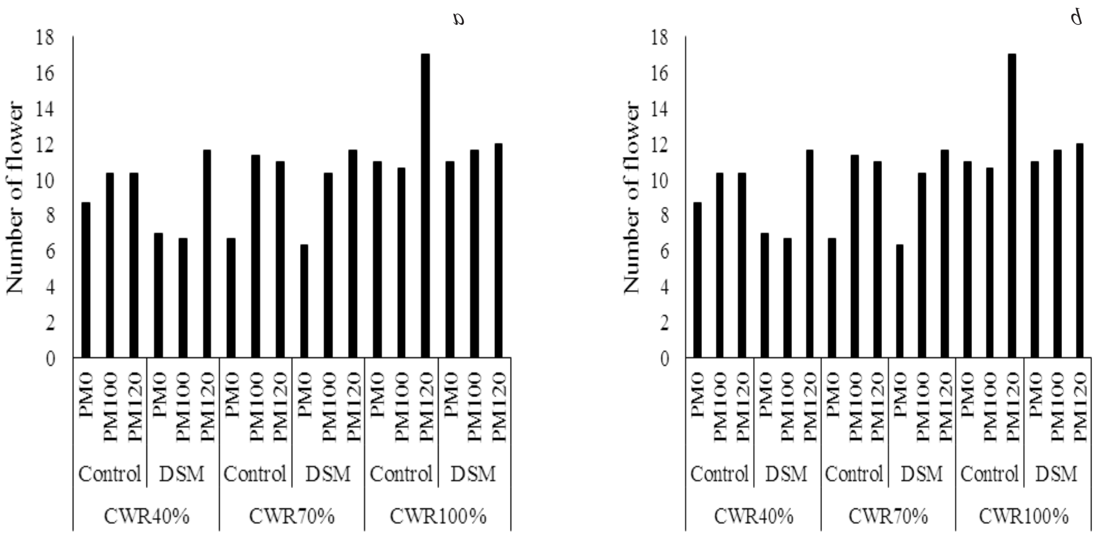

Fig. 2. Triple interaction of DSM, PM, and CWR on the number of flower (a) and fruit (b).

that there was no significant difference between the application of DSM along with PM and with PM alone in the number of flowers and fruits. The highest number of flowers and fruits were recorded with without DWM and PM in 120 cm soil depth under 100% CWR. The number of fruits increased with the application of black polyethylene mulch in eggplant cultivation (AL-Bayati and Hamdoon, 2019). Mulching maintains the moisture in the soil, which caused to increase in the number of fruits and flowers.

The results showed that dry matter increased with decreasing water requirement (Fig. 3).

The highest amount of dry matter (12.5%) obtained in DMS and PM in 120 cm soil depth under 100% CWR and the lowest (9.1%) was observed in DSM without PM under 70% CWR. A significant increase in eggplant dry matter has been observed with decreasing irrigation levels (Serhat, 2017). Wheat straw mulch increased the dry matter of rice (Yan et al., 2018) and peanuts (Ghosh et al., 2006). According to the results of ANOVA, the interaction of the three studied factors was significant on the number of leaves ($P < 0.01$, Fig. 4).

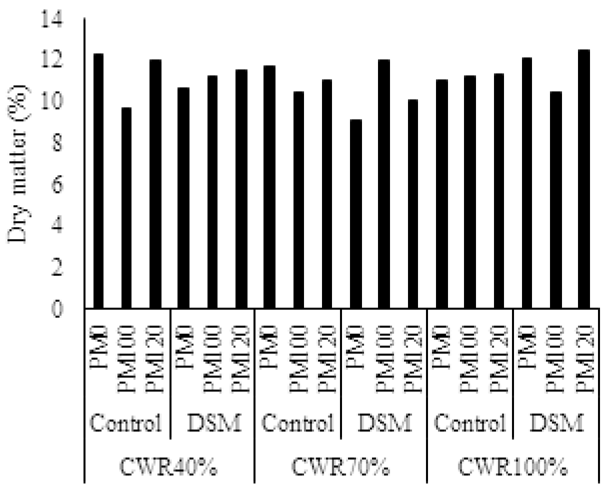

Fig. 3. Triple interaction of DSM, PM, and CWR on dry matter.

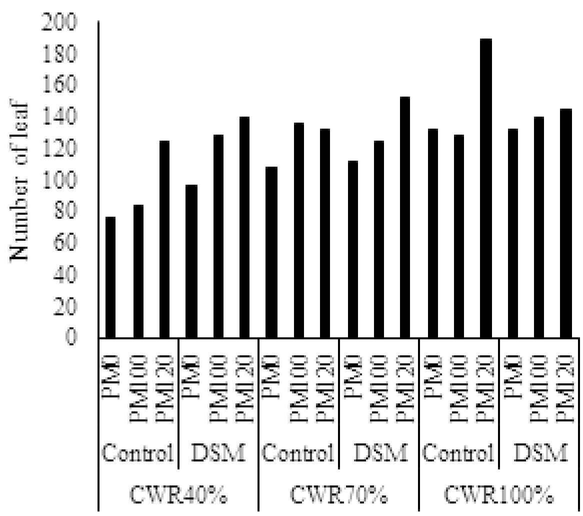

Fig. 4. Triple interaction of DSM, PM, and CWR on the number of leaves.

However, none of the simple and interactions effects were not significant on leaf width and length. Drought affects the formation and differentiation of primary leaf cells and resulted in reducing the number of leaves (da Silva Lobato et al., 2008). Reduction in leaf number under drought stress is a morphological compromise and a factor for redistribution of nutrients in the plant (Sheikh-Mohamadi et al., 2017, 2018). Decreased leaf growth under osmotic stress reduces the rate of cell division and cell development due to loss of torque stress, and leaf fall due to the production of ethylene and ABA hormones under drought stress (Tezara et al., 2002). In this study, by reducing the percentage of water requirement from 100 to 40%, the number of leaves decreased and the application of both mulches resulted in increasing the number of leaves in the plant, which agreed with the report by (AL-Bayati and Hamdoon, 2019). The area and number of leaves increased by the application of mulch in cucumber compared to no mulch treatment (Ibeawuchi et al., 2008). The results of the present study showed that with decreasing CWR, the plant height decreased (Fig. 5).

Drought stress significantly reduced the plant height of eggplant (Kirnak et al., 2001). The decrease in plant height in response to drought stress was observed in other plants such as canola (Khodabin et al., 2020), wheat (Kamal et al., 2019), and tomato (C. Zhang et al., 2020). The results showed that the application of both mulches reduced the adverse effects of water shortage on plant height and this reduction has been more with increasing depth of the PM. The height of potato plants increased with the application of plastic and straw mulches (Wang et al., 2011). The results showed that the number of sub-branches under 40% CWR decreased compared to the control (100% CWR, Fig. 6).

The highest number of sub-branches (32.3) was obtained by the interaction of DSM and PM in 100 cm soil depth under 70% CWR and also DSM and PM in 120 cm depth soil under 100% CWR. Also, the lowest value (10.6) was observed in without DSM and PM in 100 cm soil depth under 40% CWR. Drought stress in rapeseed reduced the number of sub-branches, while the mulch treatment mitigated the drought effect and resulted in increasing the character (Rad et al., 2010). Moisture stored in the soil by mulch can help plant growth and increase the number of sub-branches. According to the results, by reducing the percentage of CWR, the root length decreased and severe drought stress (40% CWR) caused a decrease in fresh and dry weights of the plant roots (Fig. 7). The application of the PM at depth of 120 cm in the soil resulted in increasing the root length under CWR of 100 and 70%, however, the application of both mulches has reduced the root length. Drought stress has reduced the length, fresh and dry weights of different plants such as olives (Gholami and Zahedi, 2020), strawberries

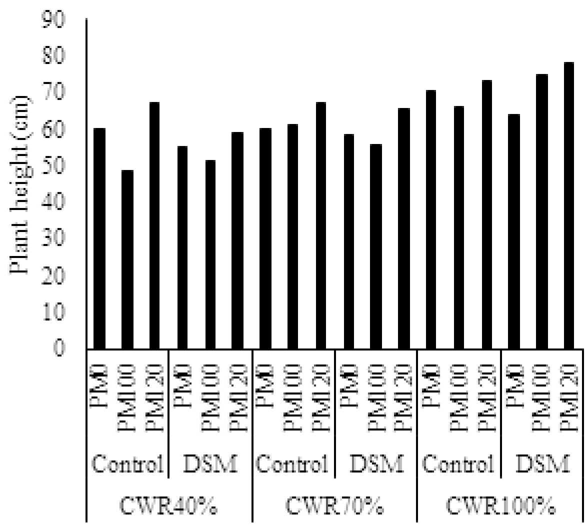

Fig. 5. Triple interaction of DSM, PM, and CWR on plant height.

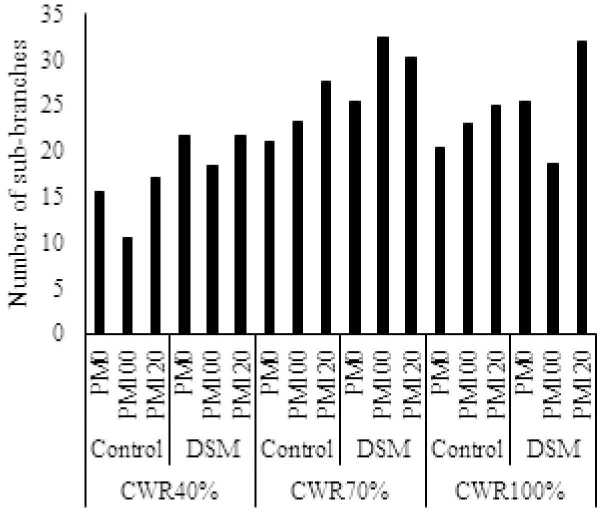

Fig. 6. Triple interaction of DSM, PM, and CWR on the number of sub-branches.

(Mozafari et al., 2018), and sorghum (Ali et al., 2011). Mulching is one of the appropriate strategies to increase moisture in the root zone of plants and root growth (Scopel et al., 2004). Moisture storage by mulch causes minimal stress on the plant, and with enough moisture in the soil, the roots can easily move to greater depths (Lamont, 2005).

The chlorophyll content is one of the important factors in maintaining photosynthetic capacity (Jiang and Huang, 2001), it is also one of the most important indicators of environmental stresses on plants such as heat, drought, nutrient deficiency, and aging (Pask et al., 2012). According to the results, drought stress reduced the amount of total chlorophyll, chlorophyll a, and chlorophyll b in the plant (Fig. 7). Kirnak et al. (2001) showed that chlorophyll a (37%), b (40%), and total (33%) decreased under severe drought stress in eggplant. Reduction of chlorophyll under drought stress conditions can be due to destruction of chloroplast thylakoid membranes and optical oxidation of chlorophyll by reactive oxygen species (Reddy et al., 2004), increase chlorophyllase activity (Ranjan et al., 2001), and decrease chlorophyll synthesis (Gajanayake et al., 2014). Chlorophyll a, b, and total decreased under drought stress in sesame plants while the application of mulch improved these pigments (Behzadnejad et al., 2020). In this study, the application of both mulch under 70 and 40% CWR resulted in increasing the chlorophyll content. It seems the application of the mulches in times of water shortage has reduced the adverse effects of dehydration and prevented chlorophyll degradation in eggplant.

Potassium content decreased with a decreasing percentage of water requirement from 100 to 40% (Fig. 8). The application of DSM more effective in increasing the potassium content compared with others. The application of mulches may have caused water saturation, resulting in reduced potassium content compared with DSM alone. Water deficiency reduces nutrients such as potassium in eggplant and potassium content decreased with decreasing the percentage of water requirement (Mohawesh, 2018).

The application of polyethylene foil mulch caused potassium accumulation compared to its non-use in garlic bulbs (Adamczewska-Sowinska and Turczuk, 2016). The element content in apples by application of straw mulch was higher than the inorganic mulch application(der Merwe and Prins, 2012).

Conclusion

According to the result of the present study, many characters were affected by drought stress. Also, the results revealed that the application of date straw and plastic mulches were useful to alleviate the adverse effects of drought stress. Therefore it is recommended that farmers rely on the application of these mulches during eggplant cultivation.

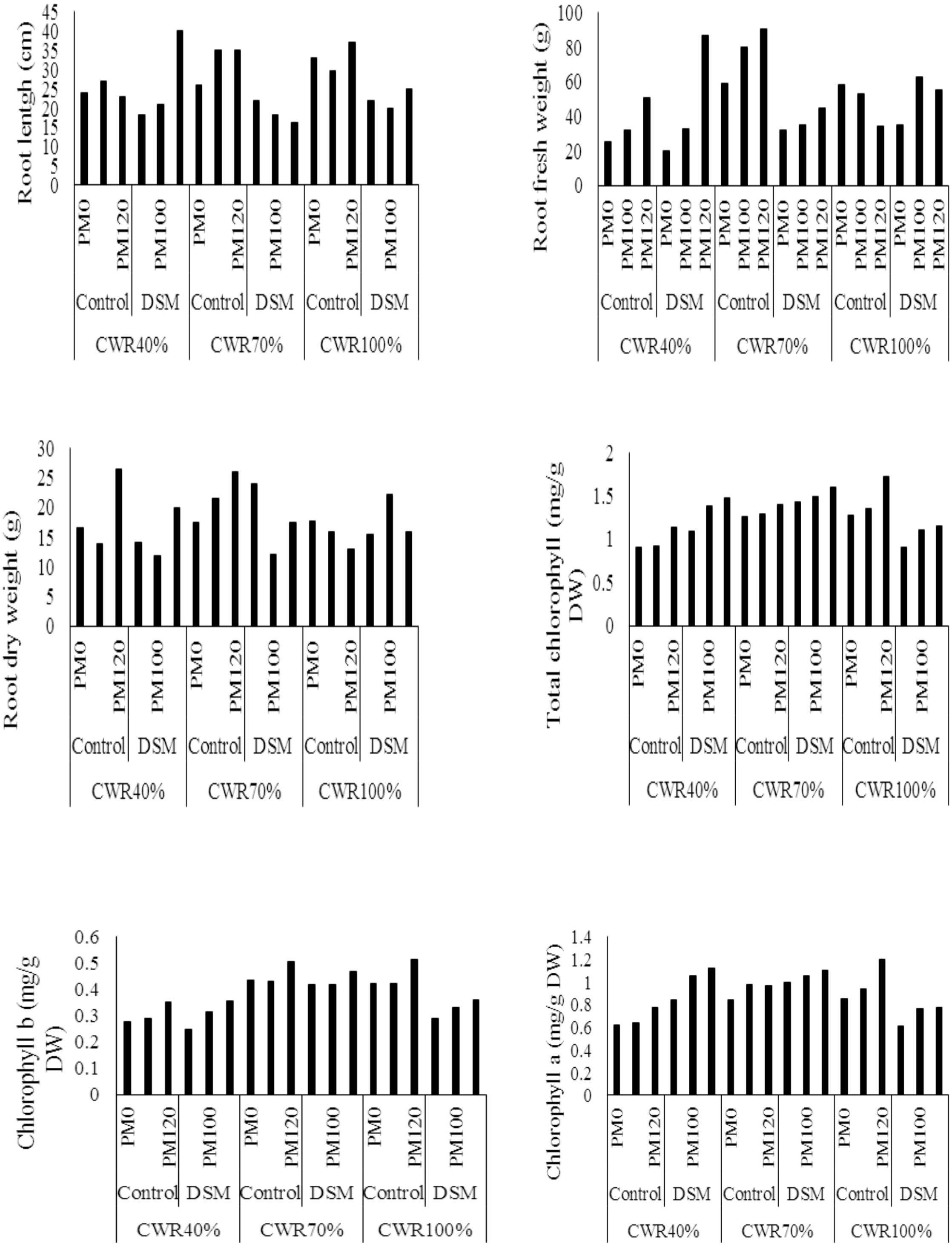

Fig. 7. Triple interaction of DSM, PM, and CWR on root length (a) and root fresh (b) and chlorophyll b (c) weights, total chlorophyll (d), chlorophyll a (e), and chlorophyll b (f).

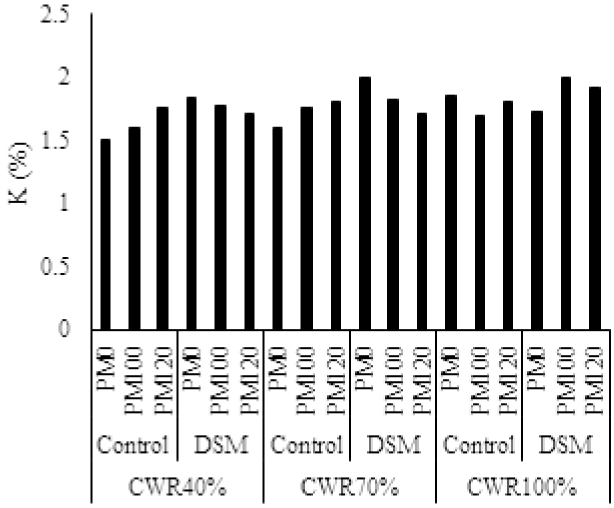

Fig. 8. Triple interaction of DSM, PM, and CWR on K content.

Acknowledgment

The study was supported by Islamic Azad University, Science and Research Branch, Tehran, Iran.

Funding statements

The author received no external funding for this study.

Conflicts of interest

The author declares that there are no conflicts of interest related to the publication of this study.

References

Abbaspour, K.C., Faramarzi, M., Ghasemi, S.S. and Yang, H. (2009) Assessing the impact of climate change on water resources in Iran. *Water Resour.,* **45**, 23-28.

Abdrabbo, M.A.A., Saleh, S.M. and Hashem, F.A. (2017) Eggplant Production Under Deficit Irrigation and Polyethylene Mulch. *Egypt. J. Appl. Sci.,* **32**, 34-45.

Adamczewska-Sowinska, K. and Turczuk, J. (2016) Yielding and biological value of garlic chives (Allium tuberosum Rottl. ex Spreng.) depending to the type of mulch. *J. Elem.,* 21, 67-75.

Akbari, Katam, R., Husain, R., Farajpour, M., Mazzuca, S. and Mahna, N. (2020) Sodium chloride induced stress responses of antioxidative activities in leaves and roots of pistachio rootstock. *Biomolecules*., 10, 1-18.

Al-Bayati, H.J.M. and Hamdoon, D.N. (2019) Response of eggplant Solanum melongena L. To soil mulching, organic and inorganic fertilizers on vegetative growth traits and yield grown under unheated plastic house, in: IOP Conference Series: Earth and Environmental Science. IOP Publishing, p. 12075.

Ali, M.A., Jabran, K., Awan, S.I., Abbas, A., Zulkiffal, M., Acet, T., Farooq, J. and Rehman, A. (2011) Morpho-physiological diversity and its implications for improving drought tolerance in grain sorghum at different growth stages. *Aust. J. Crop. Sci.,* **5**, 311-319.

Behzadnejad, J., Tahmasebi-Sarvestani, Z., Aein, A. and Mokhtassi-Bidgoli, A. (2020) Wheat straw mulching helps improve yield in sesame (Sesamum indicum L.) under drought stress. *Int. J. Plant Prod.,* **7**, 1–12.

Beyá-Marshall, V., Herrera, J., Fichet, T., Trentacoste, E.R. and Kremer, C. (2018) The effect of water status on productive and flowering variables in young 'Arbequina'olive trees under limited irrigation water availability in a semiarid region of Chile. *Hortic. Environ. Biotechnol*., **59**, 815–826.

Chapman, M.A. (2019) Introduction: *The Importance of Eggplant,* in: The Eggplant Genome. Springer, pp. 1–10.

da Silva Lobato, A.K., de Oliveira Neto, C.F., dos Santos Filho, B.G., Da Costa, R.C., Cruz, F.J.R., Neves, H.K.B. and dos Santos Lopes, M.J. (2008) Physiological and biochemical behavior in soybean (Glycine max cv. Sambaiba) plants under water deficit. *Aust. J. Crop. Sci*., **2,** 25–32.

der Merwe, V. and Prins, J.D. (2012) The effects of organic and inorganic mulches on the yield and fruit quality of 'Cripps' Pink'apple trees.

Gajanayake, B., Reddy, K.R., Shankle, M.W. and Arancibia, R.A. (2014) Growth, developmental, and physiological responses of two sweetpotato (Ipomoea batatas L.[Lam]) cultivars to early season soil moisture deficit. *Sci. Hortic.,* **168**, 218–228.

Gholami, R. and Zahedi, S.M. (2020) Effects of Deficit Irrigation and Mulching on Morpho-physiological and Biochemical Characteristics of Konservolia Olives. *Gesunde Pflanz.,* **72**, 49–55.

Ghosh, P.K., Dayal, D., Bandyopadhyay, K.K. and Mohanty, M. (2006) Evaluation of straw and polythene mulch for enhancing productivity of irrigated summer groundnut. *F. Crop. Res.,* **99**, 76–86.

Ibeawuchi, I.I., Iheoma, O.R., Obilo, O.P. and Obiefuna, J.C. (2008) Effect of time of mulch application on the growth and yield of cucumber (Cucumis sativus) in Owerri, Southeastern Nigeria. **Life Sci. J., 5**, 68–71.

Jiang, Y. and Huang, B. (2001) Drought and heat stress injury to two cool□season turfgrasses in relation to antioxidant metabolism and lipid peroxidation. *Crop Sci.,* **41**, 436–442.

Kamal, M.-H., Dadkhodaie, A., Dorostkar, S. and Heidari, B. (2019) Differential activity of antioxidant enzymes and physiological changes in wheat (Triticum aestivum L.) under drought stress. *Not. Sci. Biol.,* **11**, 266–276.

Kang, Y., Khan, S. and Ma, X. (2009) Climate change impacts on crop yield, crop water productivity and food security–A review. *Prog. Nat. Sci.,* **19**, 1665–1674.

Kashif, A., Weiyu, W., Ahmad, K., Guangxin, R., Zahir, A.M., Yongzhong, F. and Gaihe, Y. (2018) Wheat straw mulching with fertilizer nitrogen: An approach for improving soil water storage and maize crop productivity. *Plant, Soil Environ.,* **64**, 330–337.

Khodabin, G., Tahmasebi-Sarvestani, Z., Rad, A.H.S. and Modarres-Sanavy, S.A.M. (2020) Effect of Drought Stress on Certain Morphological and Physiological Characteristics of a Resistant and a Sensitive Canola Cultivar. *Chem. Biodivers*. **17**, 48-54.

Kirnak, H., Tas, I. and Kaya, C. (2001) Effects of different irrigation levels on growth, yield and quality of eggplant under semiarid conditions. *J. Agric. Fac. HR. U.,* **5**, 77–85.

Kumari, M. (2018) Off season cultivation of cucurbits under polytunnel with plastic and straw mulch. *J. Postharvest Technol*., **6**, 83–86.

Lamont, W.J. (2005) Plastics: Modifying the microclimate for the production of vegetable crops. *Horttechnology*., **15**, 477–481.

Lichtenthaler, H.K. (1987) Chlorophylls and carotenoids: pigments of photosynthetic biomembranes, in: *Methods in Enzymology*. Elsevier, pp. 350–382.

Mendonça, S.R., Ávila, M.C.R., Vital, R.G., Evangelista, Z.R., de Carvalho Pontes, N. and dos Reis Nascimento, A. (2021) The effect of different mulching on tomato development and yield. *Sci. Hortic*., **275**, 109-117.

Mohawesh, O., (2018) Utilizing deficit irrigation to enhance growth performance and water-use efficiency of eggplant in arid environments. *J. Agri. Sci. Technol*., **18**, 265-276.

Mozafari, A., Havas, F. and Ghaderi, N. (2018) Application of iron nanoparticles and salicylic acid in in vitro culture of strawberries (Fragaria× ananassa Duch.) to cope with drought stress. *Plant Cell, Tissue Organ Cult*., **132**, 511–523.

Naeem, M.Y. and Ugur, S. (2019) Nutritional Content and Health Benefits of Eggplant. *Turkish J. Agric. Sci. Technol*., **7**, 31–36.

Pask, A.J.D., Pietragalla, J., Mullan, D.M. and Reynolds, M.P. (2012) Physiological breeding II: a field guide to wheat phenotyping. Cimmyt.

Qu, X., Wang, H., Chen, M., Liao, J., Yuan, J. and Niu, G. (2019) Drought stress–induced physiological and metabolic changes in leaves of two oil tea cultivars. *J. Am. Soc. Hortic. Sci.,* **144**, 439–447.

Quamruzzaman, A.K.M., Khatun, A. and Islam, F. (2020) Nutritional Content and Health Benefits of Bangladeshi Eggplant Ccultivars. *Eur. J. Agric. Food Sci.,* **2**, 19-27.

Rad, A.H.S., Naeemi, M. and Esfahani, S.N. (2010) Evaluation of terminal drought stress tolerance in spring and winter rapeseed genotypes. *Iran. J. Crop Sci.,* **12**, 112–126.

Ranjan, R., Bohra, S.P., Asija, M.J. and Bohra, S. (2001) Plant senescence: physiological, biochemical and molecular aspects. Agrobios India.

Reddy, A.R., Chaitanya, K.V. and Vivekanandan, M. (2004) Drought-induced responses of photosynthesis and antioxidant metabolism in higher plants. *J. Plant Physiol.*, **161**, 1189–1202.

Rodan, M.A., Hassandokht, M.R., Sadeghzadeh-Ahari, D. and Mousavi, A. (2020) Mitigation of drought stress in eggplant by date straw and plastic mulches. *J. Saudi Soc. Agric. Sci*., **19**, 492–498.

Sahithi, B.M., Razi, K., Al Murad, M., Vinothkumar, A., Saravanan, J., Benjamin, L.K., Jeong, B.R. and Muneer, S. (2020) Comparative physiological and proteomic analysis deciphering tolerance and homeostatic signaling pathways in Chrysanthemum under drought stress. *Physiol. Plant*., **8**, 14-19.

Sanjari, S., Shobbar, Z.-S., Ghanati, F., Afshari-Behbahanizadeh, S., Farajpour, M., Jokar, M., Khazaei, A. and Shahbazi, M. (2021) Molecular, chemical, and physiological analyses of sorghum leaf wax under post-flowering drought stress. *Plant Physiol. Biochem*., **159**, 383–391.

Scopel, E., Da Silva, F.A.M., Corbeels, M., Affholder, F. and Maraux, F. (2004) Modelling crop residue mulching effects on water use and production of maize under semi-arid and humid tropical conditions.

Serhat, A. (2017) The Effects of Irrigation Regimes on the Yield and Water Use of Eggplant (Solanum melongena L.). *Toprak Su Derg*., **6**, 49-58.

Sheikh-Mohamadi, M.-H., Etemadi, N., Nikbakht, A., Farajpour, M., Arab, M. and Majidi, M.M. (2017) Screening and selection of twenty iranian wheatgrass genotypes for tolerance to salinity stress during seed germination and seedling growth stage. *HortScience*., **52**(8), 1125-1134.

Sheikh-Mohamadi, M.H., Etemadi, N., Nikbakht, A., Farajpour, M., Arab, M. and Majidi, M.M. (2018) Wheatgrass germination and seedling growth under osmotic stress. *Agron. J*., **110**, 572–585

Shen, D., Zhang, G., Xie, R., Ming, B., Hou, P., Xue, J., Li, S. Wang, K. (2020) Improvement in photosynthetic rate and grain yield in super-high-yield maize (Zea mays L.) by optimizing irrigation interval under mulch drip irrigation. *Agronomy*., *10*, 1778.

Tezara, W., Mitchell, V., Driscoll, S.P. and Lawlor, D.W. (2002) Effects of water deficit and its interaction with CO2 supply on the biochemistry and physiology of photosynthesis in sunflower. *J. Exp. Bot*., **53**, 1781–1791.

Wang, F.-X., Wu, X.-X., Shock, C.C., Chu, L.-Y., Gu, X.-X. and Xue, X. (2011) Effects of drip irrigation regimes on potato tuber yield and quality under plastic mulch in arid Northwestern China. *F. Crop. Res*., **122**, 78–84.

Wang, X., Jia, Z., Liang, L., Yang, B., Ding, R., Nie, J. and Wang, J. (2016) Impacts of manure application on soil environment, rainfall use efficiency and crop biomass under dryland farming. *Sci. Rep*., **6**, 20994.

Wei, Q., Wang, J., Wang, W., Hu, T., Hu, H. and Bao, C. (2020) A high-quality chromosome-level genome assembly reveals genetics for important traits in eggplant. **Hortic. Res**., **7**, 1–15.

Yan, F., Sun, Yongjian, Xu, H., Yin, Y., Wang, H., Wang, C., Guo, C., Yang, Z. and Sun, Yuanyuan, Ma, J. (2018) Effects of wheat straw mulch application and nitrogen management on rice root growth, dry matter accumulation and rice quality in soils of different fertility. *Paddy Water Environ*., **16**, 507–518.

Yang, H., Wu, G., Mo, P., Chen, S., Wang, S., Xiao, Y., ang Ma, H., Wen, T., Guo, X. and Fan, G. (2020) The combined effects of maize straw mulch and no-tillage on grain yield and water and nitrogen use efficiency of dry-land winter wheat (Triticum aestivum L.). *Soil Tillage Res*., **197**, 104485.

Zayova, E., Philipov, P., Nedev, T. and Stoeva, D. (2017) Response of in vitro cultivated eggplant (Solanum melongena L.) to salt and drought stress. *Agro. Life Sci. J*., **6**, 276–282.

Zhang, C., Li, X., Yan, H., Ullah, I., Zuo, Z., Li, L. and Yu, J. (2020) Effects of irrigation quantity and biochar on soil physical properties, growth characteristics, yield and quality of greenhouse tomato. *Agric. Water Manag*., **241**, 106263.

Zhang, Z., Li, X., Liu, L., Wang, Y. and Li, Y. (2020) Influence of mulched drip irrigation on landscape scale evapotranspiration from farmland in an arid area. *Agric. Water Manag*., **230**, 105953.

انخفاض الإجهاد المائي في الباذنجان عبر غطاءين عضويين مختلفين

مجيد أميري رودان[1] ، محمد رضا حسندخت[2] ، داود صادق زاده أهاري[3] وأمير موسوي[4]
[1]قسم علوم البساتين والزراعة - فرع العلوم والبحوث - جامعة آزاد الإسلامية - طهران - إيران.
[2]قسم البساتين - كلية الزراعة والموارد الطبيعية - جامعة طهران - كرج - إيران.
[3]معهد البحوث الزراعية للأراضي الجافة (داري) - مراغة - إيران.
[4] قسم التكنولوجيا الحيوية الزراعية - المعهد الوطني للهندسة الوراثية والتكنولوجيا الحيوية - طهران - إيران.

يعتبر الباذنجان (*Solanum melongena* L) أحد المحاصيل النباتية التي يتحمل ظروف الجفاف و رغم هذا فإن تغييرات الطقس الأخيرة قد أدت إلى تأثيرات هدامة في زرع المحاصيل في كثير من المناطق الإيرانية. و أما الهدف من هذا البحث فهو دراسة استخدام الغطاءات العضوية من تبن التمر (DSM) و الغطاءات العضوية البلاستيكية (PM) في الأداء و الميزات التشكلية و الفسيولوجية تحت الحاجات المختلفة إلى الماء. تم إجراء الاختبار في إطار مشروع القطع المنشقة مرتين على أساس مشروع الكتل العشوائية تماما (RCS) بثلاثة تكرارات في رودان بمحافظة هرمزگان بدولة إيران عام ٢٠١٧م. كانت ثلاثة مستويات من حاجة النبات إلى الماء (CWR) مشتملة على ٤٠ و ٧٠ و ١٠٠ في المائة و مستويين اثنين من تبن التمر مشتملين على استخدام الغطاء العضوي و التحكم عليه و ثلاثة مستويات من الغطاء العضوي البلاستيكي مشتملة على ٠ و ١٠٠ و ١٢٠ سم في عمق التربة حيث تم توزيعها على التوالي في القِطع الرئيسية و الفرعية و أكثر فرعيا. و قد تبين من نتائج تحليل التباين أن التأثيرات المتقابلة الثلاثية PM و DSM و CWR إحصائيا كانت ذات معنى على كافة الصفات في مستوى واحد في المائة أو خمسة في المائة و رغم ذلك لم يكن معنى لأي من التأثيرات البسيطة و المتقابلة إحصائيا في طول الأوراق و عرضها. و قد تبين من النتائج أن الحاجة إلى الماء بنسبة ٤٠ في المائة قياسا مع ١٠٠ في المائة تخفف الأداء بنسبة قدرها ٤٩ في المائة. هذا و إن استخدام DSM و PM قد سبب التأثيرات السلبية الناتجة عن شح الماء. و أخيرا يوصى باستخدام هذه الغطاءات العضوية للباذنجان في المناطق التي تعاني شح الماء.

الكلمات المفتاحية: الغطاء العضوي لتبن التمر، الغطاء العضوي البلاستيكي، أداء الفاكهة، وطأة الجفاف.