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Evaluation Tolerant of Four Melon Genotypes in Early Growth Stage under Normal and Drought Stress Conditions

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Abstract: Plant breeding initiative in semi-arid and arid area are primarily focused on developing genotypes at early growth stage under normal conditions and keeping them steady during drought stress conditions. Therefore, four melon genotypes responses to drought stress were evaluated in this study during early growth stage. Two treatments for irrigation rates (Full Irrigation= 100%) and (Deficit Irrigation= 50%) were carried out in randomized complete block design (RCBD) with three biological replications in vermiculite culture in greenhouse in the research farm of faculty of agriculture at Sohag university in Egypt during season 2023. Young plants (45 days old plants) were utilized, and phenotypic traits 1° Leaf Score Tolerance, 2° Leaf Score Tolerance, Flowers Numbers, Vine Length, Green Leaves and Brown Leaves Numbers per vine were calculated by comparing differences in drought stress compared to control to identify tolerant and susceptible genotypes. The findings demonstrated that, in all estimated traits under drought stress conditions, there was significant variation between the studied four melon genotypes. whereas, the best results for all the studied traits were produced under normal conditions. Additionally, the highest significant positive correlation was found between 1° Leaf Score Tolerance and 2° Leaf Score Tolerance (0.966*) under normal conditions, and between Vine Length and Green Leaves Numbers per vine (0.999**) under drought stress conditions. Furthermore, the highest significant negative correlation was observed between 2° Leaf Score Tolerance and Flowers Numbers (-0.974*) and Flowers Numbers and Green Leaves Numbers per vine (-0.960*) under normal conditions, and between Vine Length and Brown Leaves Numbers per vine (-0.974*) and Green Leaves Numbers per vine and Brown Leaves Numbers per vine (-0.981*) under drought stress conditions. Besides, Euclidean heatmap clustering analysis grouped studied genotypes according to their response to normal and drought stress conditions, indicating that, the studied melon genotypes offer high potential for particular breeding purposes. These results have produced helpful framework for breeding strategies in the future under drought stress conditions. Conversely, detailed studies are crucial to predict drought stress tolerance performance in novel breeding strategies.

Keywords: Melon, Early Growth Stage, Phenotypic Seedling Traits, Drought Tolerant.

Research Paper

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INTRODUCTION

Melon (*Cucumis melo* L., 2n=2x= 24) is an important sweet horticulture crop worldwide character (Ibrahim E. A., 2012; Adeyeye *et al.*, 2017; Ansari *et al.*, 2018 and Sergio *et al.*, 2021) because the fruit's pulp with pleasant aroma is sweet, high nutritional and extremely refreshing (Ibrahim, 2011). It is a member of Cucurbitaceae family, which includes numbers of other important crops such as cucumber, watermelon, pumpkin, and squash (Aragão *et al.*, 2013). Additionally, melon was originally classified into ten botanical types Naudin (1859) and reclassified into seven categories of vegetables by Munger and Robinson (1991). Cantalupensis and inodorus are two of them that generate a lot of commercial attention due to their pulp taste (Mc-Creight *et al.*, 1993). Between these two economically significant groups, there is significant differences in fruit morphology, allowing them to be classified into distinct market kinds such as, cantaloupe, galia, charentais (cantalupensis), yellow, piel de sapo, and honeydew (inodorus). So, it considers highly diverse species that exhibit significant variability regarding morphological, physiological and biochemical features (Pitrat, 2017; Haitham *et al.*, 2019 and Emerson *et al.*, 2023).

Melon plant are able to grow and survive in environments that are not ideal for their growth. This is due to several mechanisms and strategies that can be done under abiotic stresses including Escaping, Avoidance, and Tolerance (Chaves *et al.*, 2003 and Pinheiro *et al.*, 2019). The main abiotic stress that constraints melon productivity is drought stress conditions (Sensoy *et al*., 2007; Cetin *et al*., 2018; Bezerra *et al*., 2020; María and Rafael, 2021 and José *et al*., 2023). Numerous harms take by drought stress including growth inhibition, metabolic disturbances and losses in yield and quality of melon production (Rafaella *et al*., 2016; Yusuf *et al.*, 2019; Hussein and Selim, 2020; Silva *et al*., 2021 and Luis *et al*., 2022) like small fruits (Long *et al*., 2006; Dogan *et al*., 2008 and Cabello *et al*., 2009; Chandna *et al*., 2014 and Mani, 2014). Drought stress can affect melon plants at any time of their life, presenting unique special challenges for growth, once of the critical stages of them is early growth stage. An effective and appealing strategy is genetic improvement to discover or create tolerant melon genotypes adaptive to drought stress conditions (Ashraf *et al*., 2009; Turral *et al*., 2011; Mani, 2014; Ripoll *et al*., 2014; Lima *et al*., 2017; Nwokwu *et al*., 2018; Vidya *et al*., 2019; Hussein and Selim, 2020 and Shi *et al*., 2021). In addition, not all stages of melon growth are uniformly tolerant to drought stress conditions, but some stage can cope with water deficit such as early plant growth stage Mansoureh *et al*., 2015; Daryono and Maryanto, 2017). So far, there are no studies evaluating melon response at initial stages of development under drought conditions (Silva *et al*., 2021). Therefore, evaluating response of drought stress at early growth stage is a strategy of pre-discover differential traits toward drought stress conditions (Mohammad *et al*., 2017 and Chevilly *et al*., 2021). Thus, the purpose of this investigation is to determine response of four melon genotypes at early growth stage under normal and drought stress conditions, to learn more about varying reactions between studied genotypes to assist defining novel breeding strategies under drought stress conditions.

MATERIALS AND METHODS

During season 2023, the current study was conducted in greenhouse in the research farm of faculty of agriculture, Sohag university, Sohag, Egypt. The studied four melon genotypes (G-1201, G-C-61, G-I-115 and G-I-153) were offered by Genetic Dept., Faculty of Agric., Sohag Univ., Sohag, Egypt. Ten seeds of each genotype were germinated in a Petri plate with moist sterile Whatmann filter paper in incubator at 37°C for three days. Subsequently, at the cotyledon stage, the uniformly seedling size were transferred into plastic pots with commercial substrate (Vermiculate) in triplicate complete randomized block design (RCBD). The plantlets were grown in the full irrigation conditions (100%) until reached three leaves stage. Melon plants were then divided into two groups (normal conditions= 100% irrigation) and (drought conditions= 50% irrigation) until approximately 45 days old plants.

For every genotype and condition, ten samples were assessed from each replication to measure the studied seven phenological traits as indicators of drought tolerance at early growth stage as follow:

1. 1º Leaf Score Tolerance, use scale (0 – 5) for evaluation appearance as follow; 0= first leaf remained in normal horizontal orientation; 1= first leaf pointed upward; 3= first true leaf curled downward; 5= first true leaf curled downward.
2. 2º Leaf Score Tolerance, use scale (0 – 5) for evaluation appearance as follow; 0= second leaf remained in a normal horizontal orientation; 1= second leaf pointed upward; 3= second true leaf curled downward; 5= second true leaf curled downward.
3. Flowers Numbers, count flowers in each plant for each condition.
4. Vine Length, measured from the soil surface to the growing tip of the longest vine branch.
5. Green Leaves Numbers per vine per vine, counted green leaves in each plant for each condition.
6. Brown Leaves Numbers per vine per vine, counted brown leaves in each plant for each condition.

Mean value with standard error of each replication was statistically analyzed for diversity. Furthermore, correlation between studied traits was calculated by Pearson correlation coefficient by heatmap double dendrogram cluster analysis based on unweighted paired group method with arithmetic means (UPGMA). Besides, to find links between the studied four melon genotypes, Euclidean heatmap double dendrogram cluster analysis based on unweighted paired group method with arithmetic means (UPGMA) was carried out.

RESULTS

At early growth stage, several responses of melon plant toward drought stress occurs. Accordingly, the purpose of this study is to determine whether studied four melon genotypes had distinct reactions with high values toward 1º Leaf Score Tolerance, 2º Leaf Score Tolerance, Flowers Numbers, Vine Length, Green Leaves Numbers per vine and Brown Leaves Numbers per vine traits.

Regarding mean performance (Fig. 1), the findings demonstrated that, the genotype G-1201 recorded maximum numbers for 1º and 2º Leaf Score Tolerance under normal conditions. In the meantime, under drought stress conditions, the genotypes G-C-61 and G-1201 recorded greatest values for 1º and 2º Leaf

Score Tolerance. For the flower's numbers trait, the genotype G-I-115 performed best in both normal and drought stress conditions. Additionally, under both normal and drought stress conditions, the genotypes G-1201 and G-C-61 showed highest amount of vine length. Moreover, the genotypes G-1201 and G-C-61, and G-I-153 had the highest number of green leaves per vine under normal and drought stress conditions, respectively. Conversely, under both normal and drought stress conditions, the genotype G-I-115 demonstrated highest results for Brown Leaves Numbers per vine per vine. These results suggests that, genotypes with high values under drought stress conditions are recommended for breeding programs due to their steady growth because of the observed values under normal conditions had less significant variation among studied genotypes. Referring that, normal conditions preserve efficiency maintained than drought stress conditions.

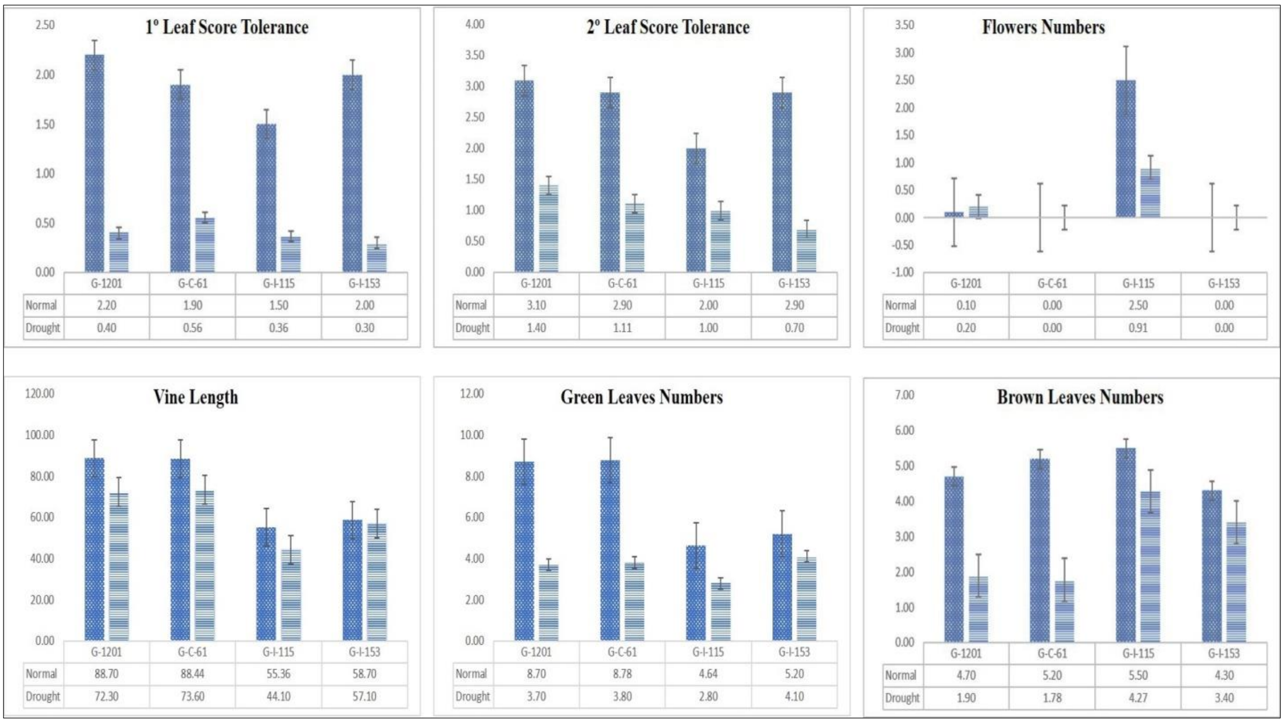

Fig. 1: (Means ± SE) effects of normal and drought stress conditions of 1º Leaf Score Tolerance, 2º Leaf Score Tolerance, Flowers Numbers, Vine Length, Green Leaves Numbers per vine and Brown Leaves Numbers per vine traits for the studied four melon genotypes.

Knowledge correlation between traits help to choose direction of related traits. Table 1 and Fig. 2 show results of Pearson correlation analysis between the examined traits under normal and drought stress conditions. Under normal conditions, the results showed significant positive correlation (0.966*) between 1º Leaf Score Tolerance and 2º Leaf Score Tolerance. This demonstrates definitely that increased 1º Leaf Score Tolerance enhanced 2º Leaf Score Tolerance, encouraging selection for this trait. Additionally, under drought stress conditions, there is highly significant positive correlation between Vine Length and Green Leaves Numbers per vine (0.999**), illustrating that genotypes with long Vine Length have influenced in maintain Green Leaves Numbers per vine. Conversely, under normal conditions, there were significant negative correlations between traits 2º Leaf Score Tolerance and Flowers Numbers (-0.974*) and Flowers Numbers and Green Leaves Numbers per vine (-0.960*). Suggesting that, increased Flowers Numbers causes decreased in 2º Leaf Score Tolerance and Green Leaves Numbers per vine. Significant negative correlation between Vine Length and Brown Leaves Numbers per vine (-0.974*) and Green Leaves Numbers per vine and Brown Leaves Numbers per vine (-0.981*) were also found under drought stress conditions, referring that, increased in Brown Leaves Numbers per vine leading to decreased Vine Length and Green Leaves Numbers per vine.

Table 1: Pearson correlation coefficient between studied traits under normal and drought stress conditions.

Normal Conditions						
	1º Leaf Score Tolerance	**2º Leaf Score Tolerance**	**Flowers Numbers**	**Vine Length**	**Green Leaves Numbers per vine**	**Brown Leaves Numbers per vine**
1º Leaf Score Tolerance	1					
2º Leaf Score Tolerance	0.966*	1				
Flowers Numbers	-0.889	-0.974*	1			
Vine Length	0.792	0.873	-0.834	1		
Green Leaves Numbers per vine	0.809	0.895	-0.960*	0.649	1	
Brown Leaves Numbers per vine	-0.767	-0.716	0.719	-0.286	-0.829	1
Drought Stress Conditions						
1º Leaf Score Tolerance	1					
2º Leaf Score Tolerance	0.491	1				
Flowers Numbers	-0.273	0.057	1			
Vine Length	0.752	0.778	-0.536	1		
Green Leaves Numbers per vine	0.755	0.755	-0.564	0.999**	1	
Brown Leaves Numbers per vine	-0.694	-0.631	0.714	-0.974*	-0.981*	1

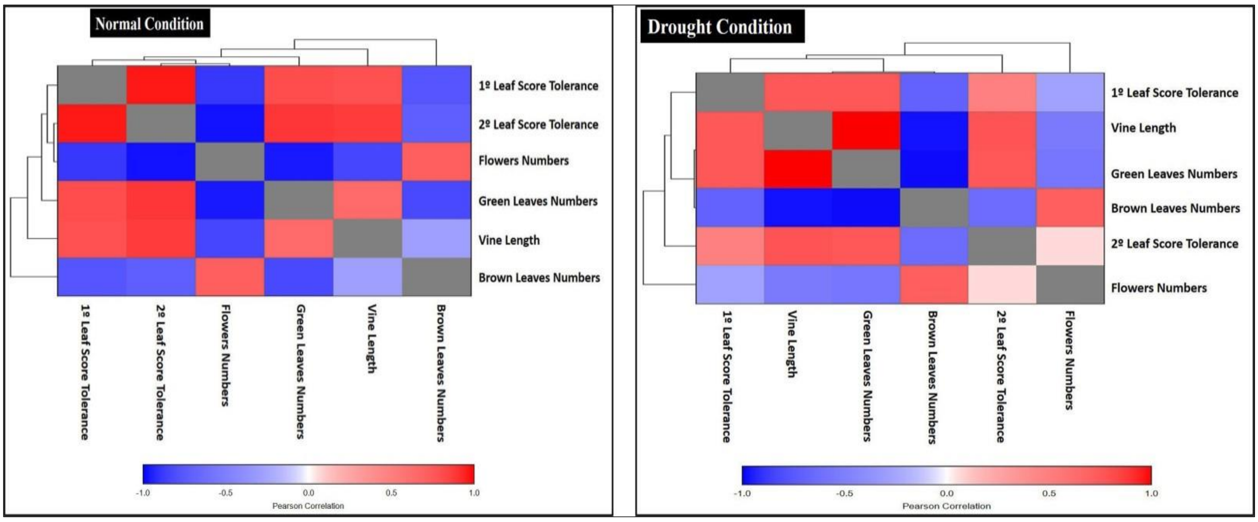

Fig. 2: Pearson correlation of double dendrogram heatmap cluster analysis based on UPGMA of the studied traits under normal and drought conditions

Euclidian heatmap double dendrogram cluster analysis (Table 2 and Fig. 3) was used to calculate similarity index between the studied melon genotypes to evaluate the contribution of the studied traits. The study found that, under normal conditions, genotypes had groups with 1º Leaf Score Tolerance, 2º Leaf Score Tolerance, Green Leaves Numbers per vine and Brown Leaves Numbers per vine, except Flowers Numbers and Vine Length. Whereas, under drought stress conditions, studied genotypes performed well in with 1º Leaf Score Tolerance, 2º Leaf Score Tolerance, Flowers Numbers and Brown Leaves Numbers per vine, except Vine Length and Green Leaves Numbers per vine. Indicating that studied genotypes performed well on studied traits under normal and drought stress conditions.

Table 2: Group of response studied melon genotypes under normal and drought stress

Group	**Normal Conditions**
1	1º Leaf Score Tolerance, 2º Leaf Score Tolerance, Green Leaves Numbers per vine and Brown Leaves Numbers per vine
None	Flowers Numbers and Vine Length
Group	**Drought Conditions**
1	1º Leaf Score Tolerance, 2º Leaf Score Tolerance, Flowers Numbers and Brown Leaves Numbers per vine
None	Vine Length and Green Leaves Numbers per vine

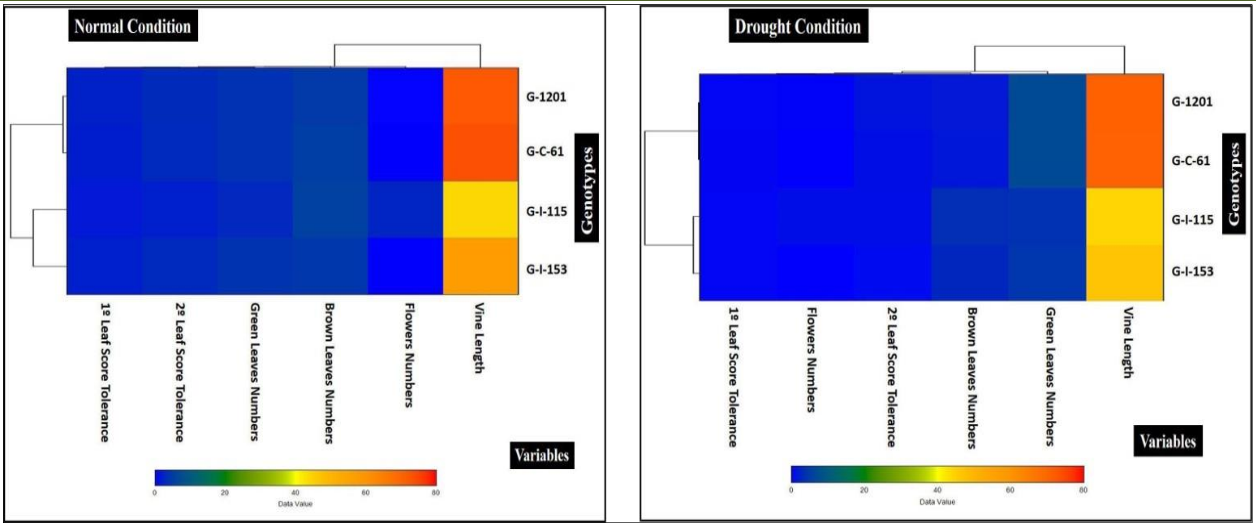

Fig. 3: Euclidean heatmap double dendrogram cluster analysis based on UPGMA between studied genotypes and traits under normal and drought conditions

DISCUSSION

Each genotype of melon has a unique genotypic and phenotypic trait. Phenotypic traits are observed external traits calculate by measuring parameters to determine the interactions of contained proteins encode that are encoded by genes (Rachmawati *et al.*, 2009 and Hossein *et al*., 2022). Drought stress in and external factor referring to limited water supply to plant roots, leading to lack of moisture in active plant root zone and poor nutrient utilization, which reduces transpiration rates in plants (Ibrahim, 2012 and Zhang *et al.*, 2021). Plants of early growth stage are severely affected by drought stress conditions (Ahmadi-Mirabad *et al*., 2013). Additionally, performance of genotypes at early growth stage has been considered highly predictive in response of adult plant under normal and drought stress conditions, which are useful in contribute great effective in screen large germplasm. Therefore, comparison between genotypes under normal and drought stress conditions is useful scenario of breeding techniques to produce steady genotypes agreement climate change (Turral *et al*., 2011 and Ansari *et al*., 2019). Thus, in order to obtain further comprehension profile in response of melon genotypes toward normal and drought stress conditions, our main goal is to evaluate tolerant of four melon genotypes at early growth stage under normal and drought stress conditions, since the studied traits thought to be distinctive traits toward normal and drought stress conditions.

The study found that there is significant decrease of the studied traits under drought stress conditions as compared to control conditions, which are in agreement of Naroui Rad *et al*., (2017); Ansari *et al*., (2018) and Haitham *et al*., (2019); Zhang *et al*., (2021) and Hossein *et al*., 2022. According to several findings, tolerant melon genotypes under drought stress conditions showed significant increase in water use efficiency Ibrahim, (2012); Arzani and Ashraf, (2016); Tedeschi *et al*., (2017); Akhoundnejad and Dasgan, (2019); Zhang *et al*., (2021) and Hossein *et al*., 2022. Besides, in research conducted by Kusvuran *et al*., (2012), thirty melon genotypes were evaluated for their response of drought stress conditions at seedling stage, their findings revealed three groups for tolerant, intermediate and susceptible genotypes. Furthermore, acceleration of flowers numbers is an indicator of drought tolerant in plants. Since drought stress causes production of giberelin, that reduces plant growth. Plus, hydrolysis occurrence of starch into simple sugars make plants also more rapid flowering (Poerwanto, 2014). Furthermore, a study by Stephen & Davenport (1986) revealed that, plants that under drought stress conditions provides inductions flower acceleration than control conditions. So, escaping strategy regarding flower acceleration is an effective to reduce lost productivity by speeding up flowering to shorten drought stress time (Farooq *et al*., 2009). Our findings demonstrated that flowers numbers were found under normal and drought conditions at genotypes G-1201 and G-I-115, indicating that these genotypes are stressed to protect plant genes from drought stress and transfer them to next generations as mentioned by Yuanita *et al*., (2018). On the other hand, vine length used as a measurement for describing plant growth and development in a particular condition in early growth stage. Since, existence of strong apical dominance, that result increase in cell divisions and differentiation, help in multiplication and cellular elongation for better plantlets growth by improve uptake nutrients, leading increase rate of plantlets metabolisms such as photosynthesis and respiration and improve assimilation of carbohydrates. So, vine length trait recommended to be good trait for response of melon plantlets under normal and drought stress conditions. Our results are in consistent with those of Kusvuran *et al*., (2011) who found significant differences in vine length between their studied melon genotypes. Numerous studies of vine length have been documented by Wang *et al*., (2016); Haitham *et al*., (2019); Vidya *et al*., (2019). Besides, green leaves numbers per vine are an essential part of melon plantlets, since serves as an indicator growth due to photosynthetic activities which increases chlorophyll content and improve carbohydrate synthesis to form new cells for protections. According to our results, green leaves numbers per vine considered direct substantial on plant development, since with increase vine length, green leaves lumbers increase, as mentioned in studies by Mansoureh *et al*., (2015); Daryono and Maryanto, (2017); Haitham *et al*., (2019) and Emerson *et al*., (2023). In contrast, it has been observed that, brown leaves number per vine was impacted by drought stress conditions, because of unbalance hormones that can decrease nutrient movement from root to leaves. Similar results have been documented on melon by Ashraful *et al*., (2020) and Seleiman *et al*., (2021) who found several numbers of brown leaves among studied genotypes under drought stress conditions and they approved that this due to hereditary reasons. Furthermore, based on correlation and heatmap analysis, significant results essential for melon breeding strategies at cellular level and *in vitro* selection criteria for drought tolerant in melon, as found by Szamosi *et al*., (2010).

Conclusion

According to findings of this study, examined phenotypic traits significantly decreased under drought stress conditions as compared to normal conditions. These traits considered indicator at cellular level and *in vitro* selection criteria. Therefore, the studied genotypes are considered moderate to tolerant under drought stress conditions, which may be play substantial role on the incorporation of drought tolerant genes in future breeding strategies. In addition, detailed studies are crucial to predict drought stress tolerance performance such as studies at DNA level.

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References

- Adeyeye A. S., Akanbi, W. B., Olalekan, K. K., Lamidi, W. A., Othman, H. J., & Ishaku, M. A. (2017). The Growth and Yield Performance of Sweet Melon as Affected by Planting Spacing in North East Nigeria. *International Journal of Research in Agriculture and Forestry, 4*(8), 17 – 21.
- Ahmadi-Mirabad, A., Lotfi, M., Roozban, M. R. (2013). Impact of water-deficit stress on growth, yield and sugar content of cantaloupe (*Cucumis melo* L.) – *Int. J. Agric. Crop Sci, 5*, 2778-2782.
- Akhoundnejad, Y., & Dasgan, H. Y. (2019). Effect of different irrigation levels on physiological performance of some drought tolerant melon (*Cucumis melo* L.) genotypes. Appl. *Ecol. Environ. Res, 17*, 9997–10012.
- Ansari, W. A., Atri, N., Ahmad, J., Qureshi, M. I., Singh, B., Kumar, R., ... & Pandey, S. (2019). Drought mediated physiological and molecular changes in muskmelon (Cucumis melo L.). *PloS one*, *14*(9), e0222647.
- Ansari, W. A., Atri, N., Singh, B., Kumar, P., & Pandey, S. (2018). Morpho-physiological and biochemical responses of muskmelon genotypes to different degree of water deficit. *Photosynthetica*, *56*(4), 1019-1030.
- Aragão, F. A. S., Torres Filho, J., Nunes, G. H. S., Queiróz, M. A., Bordallo, P. N., Buso, G. S. C., Ferreira, M. A., Costa, Z. P., & Bezerra, N. F. (2013). Genetic divergence among accessions of melon from traditional agriculture of the Brazilian Northeast. *Genetics and Molecular Research*, *12*(4), 6356-6371.
- Arzani, A., & Ashraf, M. (2016). Smart engineering of genetic resources for enhanced salinity tolerance in crop plants. *Critical Reviews in Plant Sciences*, *35*(3), 146-189.
- Ashraf, M., Öztürk, M. A., & Athar, H. R. (2009). *Salinity and Water Stress*: Improving Crop Efficiency. Dordrecht: Springer.
- Ashraful, A., Bambang, H., Hayat, U., Krishna, R. S., & Datta, A. 2020. Effects of Silicon on Growth, Yield and *Fruit Quality of Cantaloupe under Drought Stress*, *2*(4), 1955-1969.
- Astaraki, H., Ramshini, H., Lotfi, M., & Izadi Darbandi, A. (2022). Yield stability of melon genotypes under drought stress conditions. *International Journal of Horticultural Science and Technology*, *9*(2), 185-199.
- Bezerra, R. U., Viana, T. V. A., Azevedo, B. M., Pereira-Filho, J. V., & Lima, A. D. (2020). Produção e qualidade da abóbora maranhão sob influência de lâminas de irrigação e doses de nitrogênio. *Irriga*, *25*(1), 87-101.
- Cabello, M. J., Castellanos, M. T., Romojaro, F., Martinez-Madrid, C., & Ribas, F. (2009). Yield and quality of melon grown under different irrigation and nitrogen rates. *Agricultural water management*, *96*(5), 866-874.
- Cetin, M., Sevik, H., Yigit, N., Ozel, H. B., Aricak, B., & Varol, T. (2018). The variable of leaf micromorphogical characters on grown in distinct climate conditions in some landscape plants. *Fresenius Environmental Bulletin*, *27*(5), 3206-3211.
- Chandna, R., Azooz, M. M., & Ahmad, P. (2014). "Recent advances of metabolomics to reveal plant

response during salt stress," in Salt Stress in Plants: Signalling, Omics and Adaptations (New York, NY: Springer). 1–14.

- Chaves, M. M., Maroco, J. P., & Pereira, J. S. (2003). Understanding Plant Responses to Drought from Genes to The Whole Plant Function. *Journal of Plant Biology*, *30*, 239-264.
- Chevilly, S., Dolz-Edo, L., López-Nicolás, J. M., Morcillo, L., Vilagrosa, A., Yenush, L. (2021). Physiological and Molecular Characterization of the Differential Response of Broccoli (*Brassica oleracea* var. *Italica*) cultivars reveals limiting factors for broccoli tolerance to drought stress. *J. Agric. Food Chem*, *69*, 10394–10404.
- Chevilly, S., Dolz-Edo, L., Martínez-Sánchez, G., Morcillo, L., Vilagrosa, A., López-Nicolás, J. M., ... & Mulet, J. M. (2021). Distinctive traits for drought and salt stress tolerance in melon (Cucumis melo L.). *Frontiers in Plant Science*, *12*, 777060.
- Daryono, B. S., & Maryanto, S. D. (2017). Keanekaragaman dan Potensi Sumber Daya Genetik Melon [Diversity and Potential of Melon Genetic Resources. Gadjah Mada University Press, Yogyakarta. 1-81.
- Dogan, E., Kirnak, H. A. L. İ. L., Berekatoglu, K., Bilgel, L., & Surucu, A. (2008). Water stress imposed on muskmelon (Cucumis melo L.) with subsurface and surface drip irrigation systems under semi-arid climatic conditions. *Irrigation science*, *26*, 131-138.
- Elsayed, H. M., Peiró Barber, R. M., Picó Sirvent, M. B., & Esteras Gómez, C. (2019). Drought tolerance assessment of melon germplasm searching for adaptation to climate change. *African Journal of Agricultural Research*, *14*(27), 1180-1196.
- Emerson Wilberto, S. L., Marlon da Silva, G., Welson Lima, S., Alessandra, M. S., & Alessandro, C. M. (2023). Yield, physiology and quality of yellow melon grown with biofertilizer. Pesq. Agropec. Trop., *Goiânia*. *53*, e75846.
- Farooq, M., Wahid, A., Kobayashi, N. S. M. A., Fujita, D. B. S. M. A., & Basra, S. M. (2009). Plant drought stress: effects, mechanisms and management. *Sustainable agriculture*, 153-188.
- Gómez-Guillamón, M, L., & Fernández-Muñoz, R. (2021). Setting up a Selection Method for Drought Tolerance in Melon Seedlings. *Cucurbit Genetics Cooperative Report*, 44.
- Hussein A. H., & Selim, A. M. (2020). Selection for Drought Tolerance in Different Botanical Varieties from Cucumis *melo* L. Egypt. *J. Plant Breed*, *24*(3), 503– 516.
- Ibrahim, E. A. (2011). Response of Some Egyptians Sweet Melon (*Cucumis Melo* Var. *Aegyptiacus* L.) Cultivars to Water Stress Conditions. J. Plant Production, *Mansoura Univ*, *2*(12), 1805 – 1814.
- Ibrahim, E. A. (2012). Response of some Egyptian sweet melon (*Cucumis melo* var. *Aegyptiacus* L.) cultivars to water stress conditions. *Journal of Applied Horticulture*, *14*(1), 67-70.
- José Eduardo Santos Barboza da Silva, Salvador Barros Torres, Caio César Pereira Leal, Moadir de Sousa Leite, Keylan Silva Guirra, Francisco Assis Nogueira Neto and and Bárbara França Dantas. 2023. Pre-germination treatments with plant growth regulators and bioactivators attenuate salt stress in melon: effects on germination and seedling development. Acta Scientiarum. Agronomy. 45, e60516.
- Kusvuran, S., Dasgan, H. Y., & Abak, K. (2011). Responses of different melon genotypes to drought stress. Y¨uz¨unc¨u Yıl Universityi. *Journal Agricultural Science*, *21*(3), 209-219.
- Lima, E. M. C., Carvalho, J. A., Viol, M. A., Almeida, R. C., & Rezende, F. C. (2017). Gália melons production in protected environment under different irrigation depths. *Journal of the Brazilian Association of Agricultural Engineering*, *37*(1), 75-83.
- Long, R. L., Walsh, K. B., & Midmore, D. J. (2006). Irrigation scheduling to increase muskmelon fruit biomass and soluble solids concentration. *Hortscience*, *41*(2), 367-369.
- Luis Clenio Jário, M., Lucivânio Domingos Da, S., Beatriz Maia Do, N., André Jeffeson Barros Da, S., Adunias Dos Santos Teixeira and Marcio Regys Rabelo De Oliveira. 2022. Agronomic Performance and Fruit Quality of Yellow Melon Fertilized with Doses of Nitrogen and Potassium. Rev. *Caatinga. Mossoró*, *35*(2), 320 – 330.
- Mani, F. (2014). Evaluation of Drought Stress on Yield and Physiological Attributes in Cantaloupe Crop (*Cucumis melo* L.). *Indian Journal of Applied Research*, *4*(12), 6 – 10.
- Mansoureh, D., Mahmoud, L., & Shiva, A. (2015). Genetic diversity of Iranian melon cultigens revealed by AFLP markers. *International Journal of Horticultural Science and Technology*, *2*(1), 43-53.
- McCreight, J. D., Nerson, H., & Grumet, R. (1993). Melon, *Cucumis melo* L. In: Genetic Improvement of Vegetable Crops (Kallos G and Bergh BO, eds.). *Pergamon Press*, *New York*. 267-294.
- Munger, H. M., & Robinson, R. W. (1991). Nomenclature of *Cucumis melo* L. Cucurbit Genet. Cooper. *Rep. 14*, 43-44.
- Naudin, C. V. (1859). Essais d'une monographie des espèces et des variétés du genre Cucumis. *Ann. Sci. Nat. Bot. 11*, 5-87.
- Nwokwu, G. N., Ekwu, L. G., & Utobo, E. B. (2018). Effect of water stress at different phenological stages of muskmelon (*Cucumis melo* L). *Indian J. Agric. Res*,*52*(4), 452-455.
- Pinheiro, T. D., Fabio, D., Carlos, N., & Edson, M. M. (2019). Denise Cunha Fernandes dos Santos Dias. Emergence and vegetative development of

melon in function of the soil salinity. *AJCS*, *13*(3), 458-464.

- Pitrat, M. (2008). Melon (*Cucumis melo* L.). In: Handbook of crop breeding. Vol. I: Vegetables (ed. Prohens J, Nuez F, Springer, New York, USA). 283-315.
- Poerwanto, R. (2014). *Materi Perkuliahan*: Pembungaan dan Pembuahan. Departemen Agronomi dan Hortikultura, Institut Pertanian Bogor.
- Rachmawati, D., Nasir, M., Sudjino, D. K. (2009). jino, and K. Dewi, Bahan Ajar Fisiologi Tumbuhan [Plant Physiology Teaching Materials]. Gadjah Mada University Press, *Yogyakarta*, 14-20.
- Rad, M. R. N., Ghasemi, M. M., & Koohpayegani, J. A. (2017). Evaluation of melon (Cucumis melo. L) genotypes aiming effective selection of parents for breeding directed at high yield under drought stress condition. *Journal of Horticultural Research*, *25*(1), 125-134.
- Rafaella Martins de Araújo, F., Edna Maria Mendes, A., Cristiane Alves de, P., José Francismar de, M., & Flavinicíus, P. B. (2016). Influence of the main stem pruning and fruit thinning on quality of melon. Rev. *Ceres*, *Viçosa*, *63*(6), 789-795.
- Ripoll, J., Urban, L., Staudt, M., Lopez-Lauri, F., Bidel, L. P., & Bertin, N. (2014). Water shortage and quality of fleshy fruits—making the most of the unavoidable. *Journal of Experimental Botany*, *65*(15), 4097-4117.
- Seleiman, M. F., Al-Suhaibani, N., Ali, N., Akmal, M., Alotaibi, M., Refay, Y., ... & Battaglia, M. L. (2021). Drought stress impacts on plants and different approaches to alleviate its adverse effects. *Plants*, *10*(2), 259.
- Sensoy, S., Ertek, A., Gedik, I., & Kucukyumuk, C. (2007). Irrigation frequency and amount affect yield and quality of field-grown melon (Cucumis melo L.). *Agricultural Water Management*, *88*(1-3), 269-274.
- Shi, W., Wang, M., & Liu, Y. (2021). Crop yield and production responses to climate disasters in China. *Science of the Total Environment 750*, 141147.
- Silva, J. E. S. B., Torres, S. B., Leal, C. C. P., Leite, M. S., Guirra, K. S., Dantas, B. F., Morais, M. B., & Guirra, B. S. (2021). Pre-germination treatments of melon seeds for the production of seedlings irrigated with biosaline water. *Brazilian Journal of Biology*, *84*, e257314.
- Stephen, S. M., & Davenport, T. L. (1986). Characterization of Water Stress and Low Temperature Effects on Flower Induction in Citrus. *Journal of Plant Physiology*, *81*, 26-29.
- Szamosi, C., Solmaz, I., Sari, N., & Bársony, C. (2010). Morphological evaluation and comparison of Hungarian and Turkish melon (*Cucumis melo* L.) germplasm. *Scientia Horticulturae, 124*(2), 170–182.
- Tedeschi, A., Zong, L., Huang, C. H., Vitale, L., Volpe, M. G., & Xue, X. (2017). Effect of Salinity on Growth Parameters, Soil Water Potential and Ion Composition in Cucumis melo cv. Huanghemi in North-Western China. *J. Agron. Crop Sci*, *203*, 41–55.
- Turral, H., Burke, J., & Faurès, J. M. (2011). Climate change, water and food security. FAO Water Reports No. 36, *Food and Agriculture Organization of the United Nations*.
- Vidya, A., Praveenakumar, R., Vikasa, S., & Mukunda, G. K. (2019). To Study the Growth and Development of Yellow Melon Crop (*Cucumis melo* L.) under Different Growing Conditions at Different Levels of Spacing. *Int. J. Curr. Microbiol. App. Sci*, *8*(6), 3091-3099.
- Wang, L. M., Zhang, L. D., Chen, J. B., Huang, D. F., & Zhang, Y. D. (2016). Physiological analysis and transcriptome comparison of two muskmelon (*Cucumis melo* L.) cultivars in response to salt stress. Genet. *Mol. Res*, *15*, 1–18.
- Yuanita, R., Budi Setiadi, D., & Ganies, R. A. (2018). Phenotypical Characters of Melon (*Cucumis Melo* L.) in Response to Karst Critical Land. *Biotropic the Journal of Tropical Biology*, *2*(1), 1-11.
- Yusuf, F. A., Wiko, A. W., Aprilia, S. S., & Budi, S. D. (2019). Morphological Studies of Stability and Identity of Melon (*Cucumis melo* L.) 'Hikapel' and Comparative Cultivars. The 6th International Conference on Biological Science ICBS 2019. AIP Conf. Proc. 2260, 030006-1–030006-8. Published by AIP Publishing. 978-0-7354-2020-5.
- Zhang, Y., Wang, L. F., Li, T. T., & Liu, W. C. (2021). Mutual promotion of LAP2 and CAT2 synergistically regulates plant salt and osmotic stress tolerance. Front. *Plant Sci*, *12*, 672672.