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Maximizing crop water productivity from the water unit: Effect of spraying antitranspirat compounds at different rates on peanut plant growth and yield characters under different water stress

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Abstract---Egypt is currently suffering from the vast increase in population that is increasing water consumption whether for domestic use or by other sectors especially, the agricultural one. Therefore, the main objective is study the effect of the spraying antitranspirat compounds (Na_2CO_3 MgCO_3 and K_2SO_3) at different rates (0, 2, 4; 6%) under water stress conditions (60; 80% from ETo) on peanut yield crop and yield quality. The experiment was conducted under drip irrigation system in the sandy soils of the experimental Farm of the National Research Centre, El-Nubaria, El-Behera governorate. Resulted data indicated that the highest values were observed after spraying K_2SiO_3 at 6 % and values increased with increasing rates from 0 to 6%. While the lowest values were recorded at control (Na_2CO_3). MgCO_3 and K_2SiO_3 have a positive effect on oil %, Na_2CO_3 for protein and K_2SiO_3 for NPK content. Water crop productivity(CWP) increased in the current experiments in the following order of 60>80 % ETo despite the reduction in crop yield.

CWP values under 80 % water stress were lower than 60 %. Treatment 60 % water stress was superior and scored 17 % more than 80 % water stress. Spraying examined antitranspiration at rate 6% concentration gained the highest CWP of peanut with values 0.54, 0.54 and 0.56 kg/m³. Values of NPK content under 80% higher than 60% irrigation treatments and K₂SiO₃ were more effective than MgCO₃ in increasing should content from NPK. Also, results indicated that irrigation treatments 60% caused 13.9, 25, 13.5% and 7.7, 6.8, 10.8 % after K₂SiO₃ and MgCO₃ for NPK content, respectively.

Keywords---water stress, antitranspirant, water crop productivity, peanut, yield.

Introduction

Agriculture in arid regions largely depends on irrigation due to rain scarcity and shortage of other water resources and the crop is often subjected to drought stress during the growth period and the crop is often subjected to drought stress during the growth period. In this context, growing plants would transpire water equal to their weight each hour if water is supplied adequately (Moftah, 1997). Also, Farid Hellal et al., (2019) plants rarely full fill their maximum yield potential due to diverse climate change, such as water shortage, increase temperature and nutrient deficiency added that drought stress is considered to be one of the largest, single causes of crops yield loss in Egypt. Peanut (*Arachis hypogaea* L.) is a major legume crop in arid and semi-arid regions of the world (Kheira, 2009). Its seed is rich in oil (48–50%), protein (25–28%), carbohydrates (20–26%), and contains several minerals, vitamins, dietary fibers, phytosterols, and flavonoids Bishi et al., 2015. Whereas, peanut yields are low and variable under arid and semi-arid conditions. Water deficits negatively affect peanut growth, depending on the stage of crop growth and the degree of drought stress (FAO, 2018).

It is well known that plants tolerate abiotic stress by both morphological adaptation and responses at biochemical and physiological levels (Batlang, 2006). In addition the water deficit is one of the main abiotic stresses, restricting plant growth and productivity as well as soil water deficit and excessively high temperature are two of the most common yield-limiting factors in crops in semiarid and arid areas (Bakry et al. 2016) and it affects plant growth and development, decreases water potential, cell division, net photosynthesis, and protein synthesis (Fathi and Tari 2016); and loss in yield is expected. The most absorbed water loss by evaporation (99%) and the rest direct contribution to plant growth (Anderson and Kreith, 2005). Stomatal control is the most important step in response to drought, which reduces the rate of water loss and slows the rate of water stress development (Hanson and Hitz, 1982). Photosynthesis is strongly affected by water shortage as a decrease in stomatal conductance reduces the CO₂ assimilation (Cornic, 2000).

Certain chemicals for several biological activities can be used to decrease the transpiration rate and alleviate plant water stress. According to the mechanism

of action, antitranspirant is divided into different groups, which are film-forming types, and stomatal closing kinds (Conde et al. 2016) that play a vital role in reflecting antitranspirants were found to be non-toxic and have a longer period of effectiveness than metabolic types. Antitranspirants are substances applied to the plants to reduce transpiration (water loss) without causing a significant effect on other plant processes, such as photosynthesis and growth development. Also, it includes phenylmercuric acetate (Gubbels, 1979), salicylic acid (Farooq et al., 2009 and Hayat et al., 2008), abscisic acid (Zhang et al., 2016), Vapor Gard (Abdullah et al., 2015) and some others, whereas, spraying abscisic acid at the flowering stage significantly increased wheat grain yield but there was no significant effect on grain yield when sprayed at the grain filling stage (Zhang et al., 2016).

Egypt suffers from water sufficiency at present and in the future and it is a major challenge in agriculture development. Deficit irrigation is a good tool to increase irrigation water crop productivity (CWP) and reduce water supply costs (English et al., 1996). The severity of water deficit stress on plant function can range from mild to severe depending on the degree and extent of the stress (Jaleel and Llorente, 2009). Also, Jaleel and Llorente (2009) reported that water deficits can limit growth and influence a host of physiological functions in plants to a greater extent than any other environmental factor. Moursi, et al., (2014) indicated the highest and lowest mean values of water productively and productivity of irrigation were recorded under 55 and 85 % depletion of available soil moisture. Drip irrigation represents a high water use efficiency, which has been confirmed experimentally. Sandy soils are generally regarded as very fragile for agricultural production due to their very low fertility (Ebtisam and Abd El-Hady, 2015). Therefore, the main objective is to study the effect of the spraying antitranspiration compounds (Na_2CO_3 , MgCO_3 and K_2SO_3) on peanut yield crop and yield quality) at different rates (0, 2; 4%) under water stress conditions (60; 80% from ETo).

Materials and Methods

Field experiment was carried out, at National Research Centre Farm for Research and Production, Nubaria district, El-Behiera Governorate, Egypt, during the summer of 2020 season. Peanut (*Arachis hypogaea* L.) Giza 45, were grown in 25 cm hills with 2 to 3 seeds/hill using dry seeding on one side of the hills on the 15th of April, 2020 in which 45 Kg/ fed with homogeneity in size and weight were cultivated in density were planted in both lateral 15 cm among in two directions. The study was extended till the 10th of October, 2020. Irrigation treatments (water stress, at 80 and 60 % from ETo) was assigned in main plot and antitranspiration compounds (Na_2CO_3 , MgCO_3 and K_2SO_3) were assigned under submain plots. Irrigation treatments was applied after 21 days from planting date and antitranspiration compounds were sprayed three times after 45, 60 and 75 days from planting.

The distance between lines was 70 cm with inner drippers (30 cm among and 4 liter liter/h) and 15 cm between plants. Additional Agricultural practices have been maintained, as is usual in peanut fields in harmony with the

recommendations of the Ministry of Agriculture. Soil was treated by well-decomposed farmyard manure at 10 tons/fed before planting and well mixed in addition to superphosphate (15 % P_2O_5) and ammonium nitrate (33.3 % N) and elemental sulfur at rates 200, 50, and 150 kg per feddan. The irrigation process was carried out three times per week according to the obtained evapotranspiration (ET_o) of the farm meteorological station by 80 and 60 % and the total water consumed during the growing season was 2540 and 1910 m³/season (Allen et al., 1998). Soil is sand in texture (84.3, 12.5; 3.2 % for sand, silt and clay respectively) after Gee and Bauder (1986). Soil pH (8.13), electrical conductivity (0.82 dS⁻¹) were measured in soil paste extract after Cottenie et al., (1982), CaCO₃ (3.24 %) (Soil Survey Staff, 2003) and organic matter (0.65 %) was determined after (Nelson and Sommers, 1982). Soil water retention determined after Klute (1986) at 0.1 (FC) and 15.0 (WP) bars were estimated. According to soil available water was calculated by subtracting FC–WP and the values were 17.3, 5.6 and 11.7 %_{wb}, respectively.

At the end of cultivation season, 2 middle-line was chosen from each plot taking as examined samples. Determinations related to the peanut crop are as follows: After 130 days of cultivation random samples of 5 guarded plants were taken from each piece to establish the next characters: height of plant (cm). Marketable pods per plant were picked and left to dry up normally, then, the following characters were determined: Number of pods/plant and Pods weight/plant (g). Samples of twenty dry pods were taken to determine the following plant characters: pod weight (g), number of seeds/plant, seeds weight/plant (g), 100 – seed weight (g), seed yield (kg/fed). Whole plants in each plot were harvested and left to dry on air, then they were threshed and the seeds (which were at 13 % moisture) were weighted (kg), Protein in seeds and Oil (%). Oil and protein content of groundnut meal were determined by standard methods i.e. Soxhlet and Kjeldahl method, respectively. Collected data under each treatment were subjected to normal statistical analysis according to Dospekhov (1984). Treatment mean comparisons were done using the least significant difference (LSD) at a 5% level of probability.

Results and Discussion

Data manifested in table 1 indicated that growth characteristics of the peanut plant (plant height, plant weight, pod weight per plant, seed weight per plant, no of pods per plant, 100 seed weight and seed yield) as affected by spraying antitranspirant compounds (Na₂CO₃, MgCO₃ and K₂SiO₃) at different rates under water stress conditions (80 and 60 from ET_o). Data on hand revealed that increasing the concentration of antitranspirant in spraying solutions is associated with increasing most of the examined growth characters of peanut, especially under 80% water stress. The lowest values of the peanut characters were observed under control of 0% antitranspirant under 60 % water stress while the opposite was true for the highest values that attained at 80% water stress and 6% antitranspirant solution. Regardless of antitranspiration, data in table 2 showed the effect of water stress and sprayed antitranspirant (Na₂CO₃, MgCO₃ and K₂SiO₃) on the peanut plant growth characters, one can notice that the values under 80% water stress are higher than 60%. The highest values of the plant growth characters were observed after spraying Na₂CO₃ under 80% water

treatment while the highest values were recorded after K_2SiO_3 , especially under 60% water stress.

Data in table 3 represented the interaction effect of antitranspirant compound and their rates. Data one hand revealed that the highest values of the plant growth characters were being recorded at 6 % of then started antitransparent material, especially potassium silicate. In addition, it is easy to arrange the effect of antitransparent compounds in descending order relative to their effect on the peanut gross characters as follows $K_2SiO_3 > MgCO_3 > Na_2CO_3$. The outlined data in table 1 pointed out that the values of some plant growth characteristics (plant height, pod weight/plant, seed weight/plant, no of pods/plant, no. of seed/plant) and CWP of peanut plant as affected by antitransparent compounds in addition to the Na_2CO_3 under different water stress (80 and 60% from ETo). Treatment values over their studied blank characters were obtained under control of 80 and 60% irrigation treatments and anti transparent compounds. Also, data noticed that the opposite trend was attained at CWP where the highest values were recorded under 60% water stress.

Regarding irrigation treatments (Table 1), one can notice that a reduction was observed after the reduction of irrigation treatment from 80 to 60% within percentage values 1.8, 4.4, 128, 8.8, 8.7, 0.9. % for plant growth characters (plant height, pod weight/plant, seed weight/plant, no of pods/plant, no. of seed/plant), While 60 % water stress treatments cause an increase of 18.4 % for WUE. Regardless of irrigation treatments, data manifested in table 2 showed the effect of the sprayed antitransparent compounds on the plant growth characters (plant height, pod weight/plant, seed weight/plant, no of pods/plant, no. of seed/plant) and water use efficiency. Data on hand revealed that anti transparent compounds have a positive effect on most of the studied peanut plant growth characters where potassium silicate was the superior one who increased all characters values compared with magnesium sulfate carbonate comparing with Na_2CO_3 and treated plot. The percentage of increase were 10.2 13 1.7 2.5; 0.6% and 5.3 6.6, 3.5, 6.3, 2, 1.4 $MgCO_3$ and potassium silicate for studies character, respectively. Whereas, $MgCO_3$ and K_2SiO_3 improved crop water productivity by 0.8 and 5.7%, respectively compared with Na_2CO_3 .

Regarding CWP , Table 1 shows the interaction effect of the antitranspirant compounds and their rates on the peanut CWP under water stress conditions (80 and 60%), data revealed that the lowest CWP values were recorded after spraying 0% (control) of Na_2CO_3 and $MgCO_3$ (0.44 kg/m³) under 80% water stress condition, while the highest ones were attained at 6% concentration in spraying solution of both $MgCO_3$ followed by K_2SiO_3 under water stress 60 %. Accordingly, the effect of the water stress treatments and antitranspiration compounds, data in Table 2 indicated that Na_2CO_3 scored the lowest CWP value (0.46 kg/m³) under 80 % water stress, while the highest ones were observed at K_2SiO_3 under 60 % water stress (0.57 kg/m³). In addition, values of the CWP under 80 % water stress were lower than 60 % (Table2). Concerning the effect of water stress, data in table 2 resulted that treatment 60 % water stress was superior and scored 17 % more than 80 % water stress. Data in table 3 demonstrated that spraying examined antitranspiration at rat 6% concentration gained the highest CWP of

peanut with values 0.54, 0.54 and 0.56 kg/m³. Our data was in harmony with those obtained by Kirda (2002), who stated that low irrigation, during which water deficit stress is applied either at a certain growth stage or during the whole growing season, is a technique for maximizing CWP and increasing the yield per water unit. Many deficit irrigation strategies could be applied, such as continuous deficit irrigation and regulated deficit irrigation to save water without major effects on yield (Iniesta et al., 2009).

Data in Table 3 illustrated the effect of some anti-transparent compounds in addition to the Na₂CO₃ on their oil routine and healed parameter. Reduction expressed in percentage as follows 1, 2 1 and 0 % NPK respectively. Regarding the irrigation treatment, both investigated anti transparent compounds enhanced peanut yield parameters and shoot content of NPK in seeds (Table 4) compared with Na₂CO₃. Also, it is clear to mention that potassium silicate has a great effect on the study characters and causes enhancement which represented in percentage as follows 0.8, 1 and 16% 4 magnesium carbonate and 08, 58, 36.5% 4 potassium silicate compared with untreated one for oil content, seed yield and do not plant fresh with, respectively where the negative effect will obtain at routine percent by 2.2 and 2.8 for both anti transparent material, respectively. Peanut seed content in NPK was highly improved after potassium syndicate than magnesium carbonate and this increase was expressed in percentage as follows: underwater stress 80 and 60%. The maximum values of the previous yield parameters were obtained under 60% water stress and Na₂CO₃ treatment and antitransparent compounds, except for some cases that will mention later in this discussion (Table 1, 2; 3). Regarding the irrigation treatments, a decrease in irrigation from 80 to 60% led to a reduction by an estimated percent of about 1.5, 4.4 and 11.4, 10.5%.oil, and protein %, respectively.

Tables 4, 5; 6 showed the variation in oil, protein and NPK content in peanut plants as affected by antitransparent compounds at different rates (0, 1, 2, 4, 6 %) under different water stress treatments, data pointed out that the minimum values were recorded under water stress treatment 60%, while the maximum values were attained 60 % water stress, 6% K₂SiO₃. also, data manifested in table 5 showed the effect of the water stress treatments and investigated antitransparent compounds on oil, protein, NPK content of peanut plant, resulting data cleared that values under 80 % water stress were higher than 60 % water stress treatment with rate of change 1.6, 4.6, -1.4, -2.1 and 0 %, respectively. Concerning the effect of the antitransparent compounds at different rates on the previos yield characters, data in table 6 notice that the highest values were observed after spraying K₂SiO₃ at 6 % and values increased with increasing rates from 0 to 6%. While the lowest values were recorded at control (Na₂CO₃). Also, data cleared that MgCO₃ and K₂SiO₃ have a positive effect on oil %, Na₂CO₃ for protein and K₂SiO₃ for NPK content. The previous findings are in agreement with those obtained by Ibrahim and Selim (2010), who found that carbohydrate percentage and protein percentage of the grain yield foliar sprayed of different concentrations of kaolin and K₂SO₄ to wheat plants under the different levels of water holding capacity (WHC) caused increases in carbohydrate percentage and protein content as compared with the corresponding WHC levels.

Table 1
Effect of different antitranspiration compounds and rates on the peanut plant growth characters

Irrigation treatments	Antitranspirates	%	plant height cm	Plant weight g	Pod weight / plant g	Seed weight / plant g	No of pods/plant	100 seed weight	Seed yield kg/fed	CWP kg/m ³
80	Na ₂ CO ₃	0	28.4	254.3	30.26	21.38	18.9	61.21	1117.1	0.44
		2	28.8	284.1	31.25	22.38	20.7	61.57	1120.7	0.44
		4	29.10	296.1	31.58	24.06	21.5	62.01	1173.9	0.46
		6	29.60	312.5	32.60	25.98	23.3	62.08	1266.5	0.50
	MgCO ₃	0	28.7	256.8	30.35	21.45	19.2	61.35	1126.1	0.44
		2	29.2	340.9	31.58	22.98	20.8	61.95	1149.4	0.45
		4	29.7	340.5	32.05	23.87	22.4	62.35	1185.2	0.47
		6	30.1	393.8	32.89	26.85	23.8	63.15	1210.3	0.48
	KSiO ₃	0	29.4	259.4	30.68	21.68	20.1	61.85	1147.0	0.45
		2	30.1	409.1	31.68	23.67	21.4	61.98	1215.7	0.48
		4	30.8	391.6	32.54	25.43	22.6	62.67	1307.4	0.51
		6	32.5	496.1	33.65	27.85	24.2	63.47	1341.2	0.53
60	Na ₂ CO ₃	0	28.1	249.2	29.10	20.15	18.1	60.21	985.7	0.52
		2	29.2	309.7	29.35	20.64	18.6	60.35	1006.6	0.53
		4	29.3	355.3	30.24	20.87	19.4	61.25	1034.7	0.54
		6	29.5	390.6	30.64	20.92	19.8	61.67	1120.1	0.59
	MgCO ₃	0	29.3	251.7	29.68	20.26	18.2	60.25	988.1	0.52
		2	29.8	371.6	30.11	20.86	19.1	60.89	1029.9	0.54
		4	30.2	408.6	30.35	21.32	20.1	61.38	1087.9	0.57
		6	30.3	492.2	31.25	21.74	20.8	61.98	1136.9	0.60
	KSiO ₃	0	29.8	254.2	29.87	20.13	19.2	60.24	996.5	0.52
		2	30.2	445.9	30.68	20.84	19.9	60.74	1067.0	0.56
		4	30.6	469.9	31.24	21.11	21.3	61.68	1114.2	0.58
		6	30.8	620.2	31.88	21.89	21.8	62.48	1148.2	0.60
	LSD 5%		1.2	78.3	1.32	0.58	0.76	1.22	13.22	0.16

Table 2
Effect of different antitranspiration compounds and rates on the peanut plant growth characters

Irrigation treatment	Antitranspirates	plant height	Plant weight g	Pod weight/	Seed weight/	No of pods/pla	100 seed weigh	Seed yield	CWP kg/m ³
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ts		cm		plant g	plant g	nt		kg/fed	
80	Na ₂ CO ₃	28.98	286.75	31.42	23.45	21.10	61.72	1169.56	0.46
	MgCO ₃	29.43	333.00	31.72	23.79	21.55	62.20	1167.77	0.46
	K ₂ SiO ₃	30.70	389.05	32.14	24.66	22.08	62.49	1252.82	0.49
	Mean	29.70	336.27	31.76	23.97	21.58	62.14	1196.72	0.47
60	Na ₂ CO ₃	29.03	326.20	29.83	20.65	18.98	60.87	1036.79	0.54
	MgCO ₃	29.90	381.03	30.35	21.05	19.55	61.13	1060.68	0.56
	K ₂ SiO ₃	30.35	447.55	30.92	20.99	20.55	61.29	1081.44	0.57
LSD5%	Mean	29.76	384.93	30.37	20.89	19.69	61.09	1059.64	0.55
	Irrigation	0.21		0.93	0.98	1.21	0.89	11.21	0.21
	AntiTrans	0.07		0.62	0.61	0.94	0.53	9.08	0.11

Table 3
Effect of different antitranspiration compounds and rates on the peanut plant growth characters

Antitranspirates	Rate %	plant height cm	Plant weight g	Pod weight/ plant g	Seed weight/ plant g	No of pods/plant	100 seed weigh	Seed yield kg/ fed	CWP kg/m ³
Na ₂ CO ₃	0	18.83	251.75	19.79	13.84	12.33	40.47	1051.42	0.48
	2	19.33	296.90	20.20	14.34	13.10	40.64	1063.67	0.48
	4	19.47	325.70	20.61	14.98	13.63	41.09	1104.29	0.50
	6	19.70	351.55	21.08	15.63	14.37	41.25	1193.31	0.54
	mean	19.33	306.48	20.42	14.70	13.36	40.86	1103.17	0.50
MgCO ₃	0	19.33	254.25	20.01	13.90	12.47	40.53	1057.10	0.48
	2	19.67	356.25	20.56	14.61	13.30	40.95	1089.66	0.50
	4	19.97	374.55	20.80	15.06	14.17	41.24	1136.55	0.52
	6	20.13	443.00	21.38	16.20	14.87	41.71	1173.59	0.54
	mean	19.78	357.01	20.69	14.94	13.70	41.11	1114.23	0.51
KSiO ₃	0	19.73	256.80	20.18	13.94	13.10	40.70	1071.74	0.49
	2	20.10	427.50	20.79	14.84	13.77	40.91	1141.33	0.52
	4	20.47	430.75	21.26	15.51	14.63	41.45	1210.78	0.55
	6	21.10	558.15	21.84	16.58	15.33	41.98	1244.68	0.56
	mean	20.35	418.30	21.02	15.22	14.21	41.26	1167.13	0.53
	AntiTrans	33.45	0.31	0.84	0.62	0.44	21.31	0.18	
	rates	11.36	0.12	0.51	0.42	0.27	17.31	0.11	

Also, they suggested that foliar spray with K₂SO₄ reduced the transpiration rate, which in turn maintained higher water content in plant tissues, possibly favoring plant metabolism, physiological processes, photosynthetic rate, and carbohydrate metabolism, and many other important functions that directly affect plant growth. Whereas, Lee et al. (2009) potassium sulfate have a central role in the production of many important proteins which are necessary to report stress resistance in plants. Also, the increase in yield and its components was due to the role of K in enhancing different enzyme activation, photosynthesis, protein synthesis,

osmoregulation, energy transfer, stomatal movement, cation-anion balance, and stress resistance (Wang et al. 2013).

Table 4
Effect of different antitranspiration compounds and rates on the peanut plant content of some consiruent

Irrigation treatments	Antitranspirates	%	Oil	Protein	N	P	K
			%				
80	Na ₂ CO ₃	0	42.01	25.01	2.16	0.37	0.33
		2	42.15	25.64	2.55	0.41	0.35
		4	42.58	25.87	2.68	0.41	0.37
		6	42.38	25.94	2.82	0.46	0.38
		Mean	42.28	25.62	2.55	0.41	0.35
	MgCO ₃	0	42.32	24.09	2.18	0.37	0.33
		2	42.63	25.23	3.06	0.49	0.42
		4	42.65	25.34	3.08	0.47	0.43
		6	42.74	25.45	3.55	0.58	0.48
		Mean	42.585	25.03	2.97	0.48	0.42
	K ₂ SiO ₃	0	42.21	23.88	2.2	0.38	0.34
		2	42.65	24.28	3.67	0.59	0.42
		4	42.74	24.64	3.54	0.54	0.47
		6	42.85	25.96	3.4	0.73	0.48
		Mean	42.6125	24.69	3.20	0.56	0.43
60	Na ₂ CO ₃	0	41.08	23.12	2.12	0.36	0.32
		2	41.46	24.63	2.78	0.45	0.38
		4	41.89	24.64	3.22	0.49	0.41
		6	42.08	24.87	3.53	0.58	0.38
		Mean	41.6275	24.32	2.91	0.47	0.37
	MgCO ₃	0	41.05	23.2	2.14	0.37	0.33
		2	41.32	23.33	3.34	0.54	0.42
		4	42.68	24.15	3.08	0.47	0.47
		6	42.78	24.56	3.06	0.5	0.43
		Mean	41.9575	23.81	2.90	0.47	0.41
	K ₂ SiO ₃	0	40.34	22.98	2.16	0.37	0.3
		2	41.65	23.41	3.34	0.54	0.42
		4	42.58	24.36	3.19	0.49	0.47
		6	43.21	24.74	3.4	0.73	0.44
		Mean	41.945	23.87	3.02	0.53	0.41
			0.12	1.1	0.94	0.12	0.16

Accordingly in NPK content, the same trend previously was observed where values under 80% higher than 60% irrigation treatments and K₂SiO₃ were more effective than MgCO₃ in increasing should content from NPK. Also, results indicated that irrigation treatments 60% caused 13.9, 25, 13.5% and 7.7, 6.8, 10.8 % after K₂SiO₃ and MgCO₃ for NPK content, respectively. Reducing crop transpiration is important to improve CWP and a balance between leaf photosynthesis and transpiration can be achieved by adjusting the stomatal behavior to the optimal

status using antitranspirants (Kang et al., 2017). In addition, antitranspirants can increase leaf superoxide dismutase and peroxidase activities to improve drought resistance in crops (Hafez and Gharib 2016) and alleviate the negative effects of drought on crop production (Farooq et al., 2009). Saifullah et al. (2002) reported also that potassium plays an important role in different enzyme activities, photosynthesis, protein synthesis, osmoregulation, energy transfer, stomata movement, cation-anion balance, and stress tolerance, and thus, it is necessary for plants' growth.

Table 5
Effect of different antitranspiration compounds and rates on the peanut plant content of some consiruent

Irrigation treatments	Antitranspirates	Oil	Protein	N	P	K
		%				
80	Na ₂ CO ₃	42.28	25.62	2.55	0.41	0.36
	MgCO ₃	42.59	25.03	2.97	0.48	0.42
	KS ₂ iO ₃	42.61	24.69	3.20	0.56	0.43
	Mean	42.49	25.11	2.91	0.48	0.40
60	Na ₂ CO ₃	41.63	24.32	2.91	0.47	0.37
	MgCO ₃	41.96	23.81	2.91	0.47	0.41
	KS ₂ iO ₃	41.95	23.87	3.02	0.53	0.41
	Mean	41.84	24.00	2.95	0.49	0.40

Table 6
Effect of different antitranspiration compounds and rates on the peanut plant content of some consiruent

Antitranspirates	%	Oil	Protein	N	P	K
		%				
Na ₂ CO ₃	0	41.55	24.07	2.14	0.37	0.33
	2	41.81	25.14	2.67	0.43	0.37
	4	42.24	25.26	2.95	0.45	0.39
	6	42.23	25.41	3.18	0.52	0.38
	Mean	41.95	24.97	2.73	0.44	0.37
MgCO ₃	0	41.69	23.65	2.16	0.37	0.33
	2	41.98	24.28	3.20	0.52	0.42
	4	42.67	24.75	3.08	0.47	0.45
	6	42.76	25.01	3.31	0.54	0.46
	Mean	42.27	24.42	2.94	0.47	0.41
K ₂ SiO ₃	0	41.28	23.43	2.18	0.38	0.32
	2	42.15	23.85	3.51	0.57	0.42
	4	42.66	24.50	3.37	0.52	0.47
	6	43.03	25.35	3.40	0.73	0.46
	Mean	42.28	24.28	3.11	0.55	0.42
LSD5%	Antitranspirant	0.89	0.12	0.91	0.02	0.03
	Rate %	0.63	0.03	0.51	0.01	0.01

Hanson and Hitz (1982) stated that stomatal control is the most important step in response to drought, which reduces the rate of water loss and slows the rate of water stress development, well as photosynthesis is strongly affected by water shortage as a decrease in stomatal conductance reduces the CO₂ assimilation (Cornic, 2000). Also, antitranspirants have been proposed to reduce water loss and enhance the water status of plants. Such antitranspirants are frequently classified into three categories as follows: i) reflective materials designed to reduce the amount of radiant energy absorbed, thus lowering the transpiration rate, ii) chemical compounds that affect guard cell metabolism causing the stomata to close, and iii) film-forming antitranspirants which create a hydrophobic barrier that restricts the diffusion of water vapor from the leaf (Lipe and Wendt, 2008). Nevertheless, limited information is available on the fertility status of soils especially regarding soil-plant relationship, even though analysis of nutrient balance or soil-plant nutrient budget is important and inevitable to assess the sustainability of the agricultural ecosystem.

Conclusion

The main objective of this study was to sustain water availability and maximize crop production from water use units and increase plant resistance to stress and application of anti-transpiration compounds to reduce plant water loss from transpiration. All experiments were conducted under three water application rates calculated as a percent of ET₀ to evaluate performance under stress at 60 and 80% of ET₀. Moreover, it was concluded that performance improvement under 60 and 80% of ET₀ could represent the best future solution, even though crop relative reduction was related to water availability. It could be observed that crop yield of more than 20% under water stress represented the best result especially if the soil surface was treated with soil conditioners. This will reduce irrigation water loss from evaporation, especially under the expected upcoming climate change scenarios, which are expected to lead to an increase in temperature.

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