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Effect of Irrigation Systems and Calcium on Productivity and Quality of Peanut (*Arachis hypogaea* L.) at New Valley

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ABSTRACT

Two field experiments were carried out at Desert Research Center (D.R.C.), Agricultural Experiment Station (27°47.7 42 N, 30°24.7 63 E), EL-Kharga Oasis, New Valley Governorate during the two growing seasons of 2016 and 2017 to study the effect of irrigation systems (surface, advanced surface, drib and sprinkler irrigation) and calcium foliar application levels (0, 2, 4 and 6 cm^3 Ca/ L) on productivity and quality of peanut (*Arachis hypogaea* L.) under New Valley conditions. Results showed that the effect of irrigation systems on all studied parameters were significant. The lowest values of number of pods $plant^{-1}$, pods weight $plant^{-1}$, 100 seed weight, pods yield and seed yield were obtained when surface irrigation system was applied, while maximum values were when sprinkler irrigation system in both seasons. However, the difference between this irrigation system and drip irrigation was not significant in both seasons. The lowest values of harvest index (%), shelling (%), oil seed yield (kg/ fed.), water use efficiency (kg/ m^3) and protein (%) were obtained when surface irrigation was used, while the highest values were obtained when drip irrigation was used in both seasons. On the hand, applying of the drip irrigation system gave the lowest values for phosphorus, calcium, zinc, manganese and iron. Maximum values of the mineral content of seed produced by using advanced surface irrigation system. However, the seed content differences between it and the application of surface irrigation system were insignificant during both seasons. Raising of calcium foliar levels up to 6 cm^3Ca/ to a significant increase in all studied parameters except, oil seed yield (kg/ fed.), water use efficiency (kg/ m^3), phosphorus seed content (%) and Zn seed content (mg/ kg) during both seasons. On the other hand, Mn seed content (mg/ kg) and Fe seed content (mg/ kg) had adverse trend where, maximum values had obtained with control treatment and there was a gradual decrease as concentration of calcium spray application in both seasons. Maximum values of these parameters were produced by 6 cm^3Ca/ L foliar application in both seasons as compared with (control). However, the difference between spraying with this concentration and spraying with the lowest concentration (4 cm^3Ca/ L) was not significant with all the studied traits during both seasons. The interaction between irrigation systems and calcium foliar application levels had a significant effect on all studied characters except, Protein (%), phosphorus seed content (%), Zn seed content (mg/ kg) and Fe seed content (mg/ kg) during both seasons. The highest values of studied traits concerning the number of pods $plant^{-1}$, pods weight $plant^{-1}$ (g), 100 seed weight (g), pods yield (kg/ fed.), seed yield (kg/ fed.) and oil seed yield (kg/ fed.) were obtained when sprinkler system and Ca foliar spraying at rate of 6 cm^3Ca/ L was used both seasons. However, maximum values harvest index (%), shelling (%) and water use efficiency (kg/ m^3) were obtained when drib irrigation system and spraying Ca at rate of 6 cm^3Ca/ L was applied in both seasons. On the other hand, maximum values of Ca seed content (mg/ kg) were obtained at the irrigation by advanced surface system and spraying by the higher rate of calcium (6 cm^3Ca/ L).Nevertheless, the highest values of Mn seed content (mg/ kg) were obtained at the irrigation by advanced surface system and the control treatment of calcium (without foliar) in both seasons. Therefore, the study recommends that using of sprinkler or drip irrigation system and spraying by the rate of 6 cm^3Ca/ L for the cultivation of peanut under New Valley conditions.

Keywords: Peanut, irrigation systems, calcium, foliar application, yield and quality.

INTRODUCTION

Peanut (Arachis hypogaea L.) is considered one of the most important edible oil crops in Egypt, which is due to its seeds' high nutritive value for humans, as well as the produced cakes and the green leafy hay for feeding livestock, in addition to the seed oil's importance for industrial purposes. Peanut is an important legume cash crop for the farmers in arid and semi-arid regions and its seeds contain high amounts of edible oil (43-55 %), protein (25-28 %), carbohydrates (20 %), minerals (2.5 %) and fiber (5 %) (Fageria *et. al.,* 1997). One of the most important factors affecting productivity peanut during the growth stages and filling pods is an irrigation process through providing amount of water suitable for the stage of growth where, the increase of irrigation led to the formation of molds within the pods and lack led sprinkle seed formation such cases showed decreases in the growth rate. Therefore, modern irrigation systems will be effective in providing optimal water requirements to suit the growth stages, and increasing a hence yield.

Under the conditions of arid and semi-arid regions such as New Valley Governorate, where rainfall is scarce, limited water resources which confined to ground water that represent all life pattern. However, the dominant irrigation system in these areas is surface irrigation. Therefore, conservation of strategic water reserves is the determining factor not only for the success of agriculture, but also for the possibility of horizontal expansion. Consequently, the use of modern irrigation systems in irrigation operation and scheduling is essential for the reduction of irrigation water demands (Cetin and Bilgel 2012). Efficient irrigation systems require the selection of an appropriate method for the crop growth, adequate monitoring of the irrigation system and of water delivery and appropriate application rates depending on the growth stage of the crop to maximize the return of water unit used for irrigation. Economic use of water is a vital problem that confronts farmers and agricultural scientists in irrigated areas of arid and semi-arid regions. Knowledge of the right amounts of irrigation water is essential to obtain an economically maximum yield of different crops. Improper irrigation water operating accounts for significant water losses in some large irrigation schemes.

Calcium is one of the most important factors that contribute to maximizing the productivity of peanut. Calcium is the most critical element in the growth and development of peanut seeds and is the main limiting of the peanut production in many parts of the world and perhaps it can said that calcium is the most important and vital element in the peanut production (Harter and Barros 2011). In fact, calcium is one of the most important nutritional elements to gain high yield and high quality of peanut. Low content of calcium leads to several serious problems for peanut including the production of immature pods, black embryo in the seed, weak germination of seeds and increase production potential of aflatoxin, especially in soils where are suitable for growth and activity of the fungus (Aspergillus flavus) and thus, decays peanut pod (Ismail 2016 and Jan 2017).

Under high pH conditions, calcium can become insoluble (Malavolta 2006). So, application of Ca to the leaves (foliar application) is a practice that is now commonly used by farmers to supplement fertilizer in the soil. Thus, continued studies on the subject are justified, particularly because foliar applications are easy to implement and are relatively inexpensive, especially if foliar fertilizer sprays combined with pesticide applications (Evangelista *et al*., 2016). Some studies have demonstrated that foliar applications of calcium on peanut can be beneficial and increasing yield and quality (Farinelli *et al*., 2016). Also, other investigators have also reported high peanut yields and qualities under calcium foliar application.

The objective of this research is to study the effect of different irrigation systems and calcium foliar application on yield and quality of peanut under New Valley conditions.

MATERIALS AND METHODS

Location of Experiment

Two field experiments were carried out in the Desert Research Center (D.R.C.), Agricultural Experiment Station at EL-Kharga Oasis, New Valley Governorate (27°47.7 42 N, 30°24.7 63 E) during the two growing seasons of 2016 and 2017, to study the effect of different irrigation systems and calcium foliar application on yield and quality of peanut under New Valley conditions. The soil was sandy clay loam texture whereas pH 8.88 to 8.81, organic matter 0.50 and 0.55 %, EC 622 and 594 ppm, available nitrogen 59 and 62 ppm, available phosphorus 0.57 and 0.60 ppm and available potassium 31 and 34 ppm in the first and second seasons respectively.

Treatments and experimental design.

Giza 6 cultivar of peanut (Arachis hypogaea L.) was cultivation at 1st May. Treatments were comprises as three modern irrigation systems as compared of the dominant system (surface irrigation) which were (drip, sprinkler and developed surface irrigation) and three levels of chelate calcium (2, 4 and 6 cm^3 $L^{-1}$of water) as a foliar application. A flow meter installed in each irrigation system to calculate the water consumption rate of each irrigation system. The design of the experiment was strip split plot design. Where, irrigation systems were arranged in the vertical strip and calcium foliar application in the horizontal strip with three replications. The area of the experimental unit was 10.5 m^2 (3 m long in 3.5 m width) consisting of five lines with a width of 70 cm and a length of 3 meters and the distance between plants were 25 cm for all irrigation systems.

Inoculants preparation and inoculation

Rhizobium (Okadeen) mixed well with 10 % sugar solution and added to seeds of peanut which spreading on a clean plastic sheet under shading. Seeds of peanut were sprayed whit inoculate suspend after diluted 1:1 with well water and left for dryness for 30 minutes before sowing.

Agricultural practices

The previous crop was wheat during both seasons. During soil preparation, 5 m^3/fed of chicken manure mixed with 37.5 kg P^2O^5/fed were applied. Potassium sulfate (K^2SO^4 48 %) was applied when plants aged 45 days from sowing date at the rate of 50 kg /fed were applied. Nitrogen fertilizer in the form ammonium sulfate (20.5 %) in four equal doses, the first after four weeks from planting date and the other doses every two weeks as a solution with irrigation. During the growing period, other standard cultural practices (fertilization, irrigation, weed control, pest and disease control) applied at proper time intervals. The plants harvested by hand when the 60 % of the pods were matured in both growing seasons (1th of October).

Character studied:

Data were recorded by means of five individual plants with respect to yield and quality parameters which taken at random from each plot representing the three replications. The procedure of recording the various data was carried out in the following manner: number of pods /plant, pods weight /plant, 100 seed weight (g), harvest index (%), shelling (%), pods yield (kg/ fed.), seed yield (kg/ fed.), oil seed yield (kg/ fed.), water use efficiency (WUE) kg/ m^3, protein (%), seed phosphor content (%), seed Ca content (mg/ kg), seed Zn content (mg/ kg), seed Mn content (mg/ kg) and seed Fe content (mg/ kg). Whereas, harvest index was calculated by the following formula: HI: (Seed yield)/ (biological yield) X 100. Shelling percentage worked out by using the formula as suggested by Beadle (1987), by dividing weight of seeds/ weight of pods x 100. Oil seed yield kg/ fed. calculated by multiplying seed oil % by seed yield kg/ fed. Water use efficiency (WUE) which calculated using the equation of Vites (1965) for seed yield, as follows: WUE = Seed yield kg fed-1/actual consumptive use m3 /fed. Protein of seed (%) were determined by using the Kjeldahl method (N %) as described by Peach and Tracey (1956) with a conversion factor of 6.25. Ca and P seed content % was calculated according to Official Methods of Analysis of AOAC (2000). Fe, Mn and Zn seed content mg/ kg were determined as described by Page *et. al*., (1982) by using Atomic Absorption model GBC 932.

Statistical analysis

All data were subjected to statistical analysis according to procedure outlined by Snedecor and Cochran (1990). Means of the different treatments were compared using the least significant difference (LSD) test at P<0.05.

RESULTS AND DISCUSSION

1. Effect of irrigation systems:

Data illustrated in Table (1, 2 and 3) showed that watering peanut plants different irrigation systems had a significant effect on all studied traits such as number of pods plant-1, pods weight $plant^{-1}$ (g), 100 seed weight (g), harvest index (%), shelling (%), pods yield (kg/ fed.), seed yield (kg/ fed.), oil seed yield (kg/ fed.), water use efficiency (WUE) kg/ m^3, Protein (%), phosphorus seed content (%), Ca seed content (mg/ kg), Zn seed content (mg/ kg), Mn seed content (mg/ kg) and Fe seed content (mg/ kg) during both seasons. In terms of number of pods $plant^{-1}$, pods weight $plant^{-1}$, 100 seed weight (g),pods yield (kg/ fed.) and seed yield(kg/ fed.), the lowest values obtained when using the surface irrigation system, while the highest values obtained when using sprinkler irrigation system in both seasons. However, the difference between this irrigation system and drip irrigation was not significant during both seasons. The highest yield was mainly due to high frequency of irrigation, which in turn maintained the soil moisture content in the active root zone at an adequate level throughout the crop period (Krishnamurthi *et al*., 2003).

Table 1. Effect of irrigation systems, calcium foliar application and their interactions on peanut yield and quality during 2016 and 2017 growing seasons under New Valley conditions.

Char. Treatments		Number of pods plant^{-1}		Pods weight plant^{-1} (g)		100 seed weight (g)		Harvest index (%)		Shelling (%)	
Seasons		**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Surface irrigation (SI)		33.16	33.65	37.76	37.98	43.84	44.00	16.62	16.96	62.19	63.27
Ad. surface irrigation (ASI)		37.69	38.12	41.02	41.57	48.60	48.95	20.49	21.06	65.35	65.73
Drib irrigation (DI)		41.17	42.54	47.61	48.85	52.58	53.17	25.61	26.12	70.03	71.54
Sprinkler irrigation (SPI)		43.52	44.47	50.14	51.47	54.10	55.15	23.41	23.80	67.91	68.23
LSD at 5%		2.38	2.11	2.61	2.73	1.65	2.05	2.18	2.16	1.81	1.95
0 (control)		31.63	31.89	39.28	39.65	40.64	40.80	15.55	16.14	60.13	60.66
2 cm^{3}Ca/ L		35.23	36.24	46.22	46.80	45.61	46.18	19.48	19.71	64.69	65.14
4 cm^{3}Ca/ L		38.46	38.93	50.47	51.04	50.63	51.19	22.63	23.11	69.37	71.64
6 cm^{3}Ca/ L		39.64	40.02	53.12	53.86	51.62	52.00	23.84	24.93	71.36	73.04
LSD at 5%		1.26	1.15	3.00	2.91	1.63	1.74	1.32	1.85	2.48	2.29
Surface irrigation (SI)	0 (control)	32.65	33.52	38.65	39.07	42.49	42.78	16.34	16.80	61.41	62.72
	2 cm^{3}Ca/ L	34.45	35.20	42.24	42.64	44.98	45.34	18.30	18.59	63.69	64.46
	4 cm^{3}Ca/ L	36.06	36.54	44.37	44.76	46.75	47.11	19.88	20.29	66.03	67.21
	6 cm^{3}Ca/ L	36.65	37.09	45.84	46.17	48.08	48.40	20.48	20.95	67.03	67.91
Ad. surface irrigation (ASI)	0 (control)	34.91	35.76	40.28	40.86	44.87	45.26	18.27	18.85	62.99	63.95
	2 cm^{3}Ca/ L	36.71	37.43	43.87	44.44	47.36	47.82	20.24	20.64	65.27	65.69
	4 cm^{3}Ca/ L	38.33	38.78	46.00	46.56	49.13	49.59	21.81	22.34	67.61	68.44
	6 cm^{3}Ca/ L	38.92	39.32	47.47	47.97	50.46	50.88	22.42	23.00	68.61	69.14
Drib irrigation (DI)	0 (control)	36.65	37.97	43.57	44.50	46.86	47.37	20.83	21.38	65.33	66.50
	2 cm^{3}Ca/ L	38.45	39.64	47.17	48.08	49.35	49.93	22.80	23.17	67.61	68.24
	4 cm^{3}Ca/ L	40.07	40.99	49.29	50.20	51.12	51.70	24.37	24.87	69.95	70.99
	6 cm^{3}Ca/ L	40.66	41.53	50.77	51.61	52.45	52.99	24.98	25.53	70.95	71.69
Sprinkler irrigation (SPI)	0 (control)	37.83	38.93	44.84	45.81	47.62	48.36	19.73	20.22	64.27	65.20
	2 cm^{3}Ca/ L	39.63	40.61	48.43	49.39	50.11	50.92	21.70	22.01	66.55	66.94
	4 cm^{3}Ca/ L	41.24	41.95	50.56	51.51	51.88	52.69	23.27	23.71	68.89	69.69
	6 cm^{3}Ca/ L	41.83	42.50	52.03	52.92	53.21	53.98	23.88	24.37	69.89	70.39
LSD at 5%		0.28	0.21	0.36	0.39	0.54	0.61	0.15	0.19	0.14	0.22

Ad.: Advanced

The increment percentage in number of pods plant^{-1} as a result of the use of sprinkler irrigation system compared to surface irrigation were 31.40 and 32.15 %, pods weight /plant for 32.79 and 35.52 % for 100 seed weight were 23.40 and 25.34 %, pods yield for 35.67 and 36.23 % and seed yield was 34.03 and 34.67 % in the first and second seasons, respectively.

Regarding of harvest index (%), shelling (%), oil seed yield (kg/ fed.), water use efficiency (kg/ m^3) and protein (%), the lowest values for these traits were obtained when surface irrigation was used, while the highest values were obtained when drip irrigation was used in both seasons. The increment of these characteristics due to the use of drip irrigation system compared to surface irrigation were 54.09, 54.98, 12.61, 13.07, 10.15, 10.68, 60.13, 63.77, 30.84 and 31.12% in the first and second seasons, respectively.

On the other hand, applying drip irrigation system gave the lowest values for the seed content of phosphorus, calcium, zinc, manganese and iron. The highest values were produced by using advanced surface irrigation system. However, the differences between it and the application of surface irrigation system were insignificant in both seasons. The increment of these parameters as a result of applying this irrigation system compared to drip irrigation were 35.24, 35.36, 55.55, 58.46, 37.18, 39.71, 35.03, 36.66 and 30.98 and 33.76 % for these characteristics in the first and second seasons, respectively. These results may be due to that applying surface irrigation system, whether advanced or normal may be able to dissolve elements, considering that water is the best solvent of nutrients in the soil and evidence was reported that using drip irrigation system had limited water available in rhizospheres and therefore the adsorbed amounts these elements in seeds were decreased. The good effect of applying sprinkler system, tempering the atmosphere surrounding the plant, which reduces the negative impact of heat stress under New Valley conditions. These findings are in harmony with those obtained by El-Boraie *et al*., (2009); Krishnamurthi *et al*., (2003); Manjunatha *et al*., (2016); Farinelli *et al*., (2016) and Varshney and Raghvaiah (2017).

2. Effect of calcium foliar application:

Concerning effect of calcium foliar levels on some parameters of peanut, data in Table (1, 2 and 3) illustrate that, raising calcium foliar levels up to 6 cm^{3}Ca/ L led to a significant increase in all studied parameters except, oil seed yield (kg/ fed.), water use efficiency (kg/ m^3), phosphorus seed content (%) and

Zn seed content (mg/ kg) in both seasons. On the other hand, Mn seed content (mg/ kg) and Fe seed content (mg/ kg) had adverse trend where, the highest values were obtained with control treatment and there was a gradual decrease whenever concentration of calcium spray was increased during both seasons.

Table 2. Effect of irrigation systems, calcium foliar application and their interactions on peanut yield and quality during 2016 and 2017 growing seasons under New Valley conditions.

Char. Treatments		Pods yield (kg/ fed.)		Seed yield (kg/ fed.)		Oil seed yield (kg/ fed.)		Water use efficiency (WUE) kg/ m^3		Protein (%)	
Seasons		2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Surface irrigation (SI)		1214	1220	867	871	463	468	0.469	0.461	19.65	19.86
Ad. surface irrigation (ASI)		1268	1281	952	974	479	482	0.493	0.488	21.16	21.42
Drib irrigation (DI)		1618	1637	1132	1148	510	518	0.751	0.755	25.71	26.04
Sprinkler irrigation (SPI)		1647	1662	1162	1173	491	496	0.684	0.679	23.13	23.25
LSD at 5%		31	28	33	27	12	13	0.021	0.025	1.36	1.28
0 (control)		1172	1180	796	804	337	348	0.314	0.316	16.55	16.77
2 cm^3Ca/ L		1420	1437	887	894	384	391	0.342	0.351	17.36	17.74
4 cm^3Ca/ L		1563	1578	972	985	425	433	0.363	0.369	18.63	19.01
6 cm^3Ca/ L		1591	1606	1012	1029	459	471	0.365	0.369	19.14	19.89
LSD at 5%		35	32	49	45	NS	NS	NS	NS	0.69	0.92
Surface irrigation (SI)	0 (control)	1193	1207	830	849	400	408	0.643	0.640	18.35	18.57
	2 cm^3Ca/ L	1317	1331	875	888	424	430	0.657	0.657	18.76	19.05
	4 cm^3Ca/ L	1389	1452	918	933	444	451	0.667	0.666	19.39	19.69
	6 cm^3Ca/ L	1403	1416	938	954	461	470	0.668	0.666	19.65	20.13
Ad. surface irrigation (ASI)	0 (control)	1220	1235	874	896	408	415	0.655	0.653	19.11	19.35
	2 cm^3Ca/ L	1344	1359	920	934	432	437	0.669	0.671	19.51	19.83
	4 cm^3Ca/ L	1416	1480	962	980	452	458	0.679	0.680	20.15	20.47
	6 cm^3Ca/ L	1430	1444	982	1000	469	477	0.680	0.680	20.40	20.91
Drib irrigation (DI)	0 (control)	1395	1413	964	981	424	433	0.784	0.787	21.38	21.66
	2 cm^3Ca/ L	1519	1537	1010	1020	447	455	0.798	0.804	21.79	22.14
	4 cm^3Ca/ L	1591	1658	1052	1065	468	476	0.805	0.810	22.42	22.78
	6 cm^3Ca/ L	1605	1622	1072	1086	485	495	0.809	0.813	22.68	23.22
Sprinkler irrigation (SPI)	0 (control)	1410	1426	979	993	414	422	0.750	0.749	20.09	20.26
	2 cm^3Ca/ L	1534	1550	1025	1031	438	444	0.764	0.766	20.50	20.75
	4 cm^3Ca/ L	1605	1670	1067	1077	458	465	0.775	0.775	21.13	21.38
	6 cm^3Ca/ L	1619	1634	1087	1097	475	484	0.776	0.775	21.39	21.82
LSD at 5%		12	10	14	13	8	7	0.011	0.010	NS	NS

The maximum values of these parameters were produced by application of 6 cm^3Ca/L foliar during both seasons as compared with (control). However, the difference between spraying with this concentration and spraying with the lowest concentration (4 cm^3Ca/ L) was not significant with all the studied traits in both seasons. The increases percentages outcome the foliar of 6 cm^3 Ca/ L compared with control treatment in number of pods plant^{-1} were 25.52 and 25.49, pods weight plant-1 (g) were 35.23 and 35.84, 100 seed weight (g) were 27.2 and 27.45, harvest index (%) were 53.31 and 54.46, shelling (%) were 18.68 and 20.41, pods yield (kg/ fed.) were 35.5 and 36.16; seed yield (kg/ fed.) were 27.14 and 27.99, Protein (%) were 15.5 and 18.60 and Ca seed content (mg/ kg) were 60.8 and 65.5 during the first and second seasons, respectively. Concerning Mn seed content (mg/ kg) and Fe seed content (mg/ kg) the increases percentages outcome control treatment compared with the foliar of 6 cm^3Ca/ L treatment were 36.89 and 37.82 and 34.13 and 34.31 % during the first and second seasons, respectively.

Results indicated that foliar application of 6 cm^3Ca/ L was quite enough to achieve maximum values of the studied parameters under the current experiment. The most advanced effect of phosphorus on the plant growth is promoted due to calcium (Ca) application.

Role in plant growth, development and respond to external and internal signals (Reddy 2001 and Kudla *et. al.*, 2010). Many researches on the effect of Ca in crop plants are reported. For instance, Xu *et. al.*, (2013) reported that Ca could improve the photosynthetic rate of plant under drought conditions. Ca deficiency restrains the growth of meristematic tissues and youngest leaves would become deformed and chlorotic (Marschner 1995). Calcium deficiency leads to high percentage of aborted seeds (empty pods) and improperly filled pods (Ntare *et. al.*, 2008).Additionally, Ca supply can promote nitrogen absorption and increase nitrogen use efficiency to make plant active (Mahmood *et. al.*, 2009). Many researchers pointed out that Ca increase the yield of peanut among them Gashti *et. al.*, (2012); Arnold (2014) and Ismail (2016) and Jan (2017).

3. Effect of the interaction between irrigation systems calcium foliar application:

Results in Table (1, 2 and 3) indicated that the interaction between irrigation systems and calcium foliar application levels had a significant effects on all studied characters except, protein (%), phosphorus seed content (%), Zn seed content (mg/ kg) and Fe seed content (mg/ kg) during both seasons. Maximum values of studied traits in concerning number of pods plant-1, pods weight plant^{-1} (g), 100 seed weight (g), pods yield (kg/ fed.), seed yield (kg/ fed.) and oil seed yield (kg/ fed.) were obtained at the irrigation by sprinkler system and spraying plants at rate of 6 cm^{3}Ca/ L during both seasons. However, the maximum values harvest index (%), shelling (%) and water use efficiency(kg/ m^3) were obtained at the irrigation by drib system and spraying of plants at the rate of 6 cm^{3}Ca/ L during both seasons. On the other side, maximum values of Ca seed content (mg/ kg) were obtained when advanced surface system and spraying by the higher rate of calcium (6 cm^{3}Ca/ L). Nevertheless, the highest values of Mn seed content (mg/ kg) were obtained at the irrigation by advanced surface system and control treatment of calcium (without foliar) during both seasons. Therefore, the study recommends that using of sprinkler irrigation system or drip irrigation and spraying rate of 6 cm^{3}Ca/ L enhanced peanut productivity under New Valley conditions.

Table 3. Effect of irrigation systems, calcium foliar application and their interactions on peanut yield and quality during 2016 and 2017 growing seasons under New Valley conditions.

Char. Treatments		Phosphor seed content (%)		Ca seed content (mg/ kg)		Zn seed content (mg/ kg)		Mn seed content (mg/ kg)		Fe seed content (mg/ kg)	
Seasons		2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Surface irrigation (SI)		0.741	0.745	0.88	0.93	38.06	39.26	54.44	55.08	212.39	217.05
Ad. surface irrigation (ASI)		0.871	0.879	0.98	1.03	40.62	41.69	56.28	57.00	219.41	225.15
Drib irrigation (DI)		0.644	0.648	0.63	0.65	29.61	29.84	41.68	41.71	167.52	168.32
Sprinkler irrigation (SPI)		0.711	0.718	0.74	0.77	35.61	35.98	48.2	49.1	189.2	191.06
LSD at 5%		0.22	0.19	0.11	0.12	2.61	2.52	2.24	2.17	8.15	9.01
0 (control)		0.563	0.570	0.40	0.41	27.63	28.03	39.48	39.90	215.22	215.84
2 cm^{3}Ca/ L		0.571	0.576	0.76	0.79	30.52	30.84	34.63	35.19	197.30	199.05
4 cm^{3}Ca/ L		0.587	0.591	0.95	0.96	33.66	34.02	31.81	32.05	172.34	175.00
6 cm^{3}Ca/ L		0.634	0.544	1.07	1.09	35.41	36.00	28.84	28.95	160.46	160.70
LSD at 5%		NS	NS	0.11	0.10	NS	NS	1.89	1.94	5.17	7.64
Surface irrigation (SI)	0 (control)	0.903	0.910	0.92	0.95	33.10	33.90	46.71	47.19	214.06	217.20
	2 cm^{3}Ca/ L	0.907	0.913	1.05	1.08	34.54	35.30	44.29	44.89	205.10	208.30
	4 cm^{3}Ca/ L	0.915	0.921	1.14	1.16	36.11	36.89	42.88	43.32	192.62	196.28
	6 cm^{3}Ca/ L	0.939	0.897	1.20	1.23	36.99	37.88	41.29	41.76	186.68	190.01
Ad. surface irrigation (ASI)	0 (control)	0.970	0.971	0.99	1.02	34.38	35.11	48.13	48.65	217.57	221.25
	2 cm^{3}Ca/ L	0.974	0.974	1.12	1.15	35.82	36.52	45.71	46.35	208.61	212.35
	4 cm^{3}Ca/ L	0.982	0.981	1.22	1.24	37.39	38.11	44.30	44.78	196.13	200.33
	6 cm^{3}Ca/ L	1.005	0.958	1.28	1.30	38.27	39.10	42.71	43.22	190.19	194.06
Drib irrigation (DI)	0 (control)	0.875	0.876	0.77	0.79	28.87	29.19	40.83	41.01	191.62	192.83
	2 cm^{3}Ca/ L	0.879	0.879	0.90	0.92	30.32	30.59	38.41	38.70	182.66	183.94
	4 cm^{3}Ca/ L	0.887	0.887	0.99	1.01	31.89	32.18	37.00	37.13	170.18	171.91
	6 cm^{3}Ca/ L	0.911	0.863	1.05	1.07	32.76	33.17	35.41	35.58	164.24	165.65
Sprinkler irrigation (SPI)	0 (control)	0.888	0.895	0.82	0.85	31.87	32.26	44.09	44.70	202.46	204.20
	2 cm^{3}Ca/ L	0.892	0.898	0.95	0.98	33.32	33.66	41.67	42.40	193.50	195.31
	4 cm^{3}Ca/ L	0.900	0.906	1.05	1.07	34.89	35.25	40.26	40.83	181.02	183.28
	6 cm^{3}Ca/ L	0.924	0.882	1.11	1.13	35.76	36.24	38.67	39.27	175.08	177.02
LSD at 5%		NS	NS	0.05	0.04	NS	NS	0.56	0.47	NS	NS

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تأثير نظم الرى والكالسيوم على انتاجية وجودة الفول السودانى بالوادي الجديد

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أقيمت تجربتان حقليتان بالمزرعة البحثية بالخارجة التابعة لمركز بحوث الصحراء بمحافظة الوادي الجديد خلال موسمي 2016 و 2017 لدراسة تأثير نظم الري (سطحى - سطحى مطور - تنقيط - رش) ومعدلات رش بالكالسيوم (0 – 2 – 4 – 6 سم^{3}/ لتر) على إنتاجية وجودة الفول السوداني تحت ظروف الوادي الجديد. أظهرت النتائج أن نظم الري كان لها تاثير معنوى على جميع الصفات تحت الدراسة . استخدام نظام الرى بالرش أعطى أعلى القيم لصفات عدد القرون/ نبات، وزن القرون/ نبات، وزن 100 بذرة (جم)، محصول القرون (كجم/ فدان) ومحصول البذور(كجم/ فدان) بينما باستخدام نظام الري السطحي أعطى أقل القيم لهذه الصفات ، فى حين لم يكن هناك فروق معنوية بين نظامى الرش والتنقيط في كلا الموسمين. باستخدام الرى بالتنقيط تم الحصول على أعلى القيم لدليل الحصاد ، نسبة التفريط (٪) ومحصول الزيت (كجم / فدان) وكفاءة استخدام الماء (كجم / م^{3}) والبروتين (٪) بينما كانت أقل القيم لهذة الصفات تحت نظام الري السطحي في كلا الموسمين. نظام الري السطحي المطور أعطى أعلى القيم لمحتوى البذور من الفوسفور,الكالسيوم ,الزنك, المنجنيز والحديد واقل القيم كانت تحت نظام الرى بالتنقيط في كلا الموسمين. أدى زيادة معدل الرش بالكالسيوم إلى 6 سم ^{3} / لتر إلى زيادة معنوية في جميع الصفات تحت الدراسة باستثناء محصول الزيت (كجم / فدان) , كفاءةاستخدام الماء (كجم / م ^{3}) , محتوى البذور من الفوسفور (٪) ومحتوى البذور من الزنك (ملجم / كجم) في كلا الموسمين. من ناحية أخرى، محتوى البذور من المنجنيز و الحديد (ملجم / كجم) كان له اتجاه معاكس حيث تم الحصول على أعلى القيم من معاملة المقارنة وكان هناك انخفاض تدريجي كلما زاد معدل الرش بالكالسيوم في كلا الموسمين. تم الحصول على أعلى القيم لهذه الصفات عند الرش بمعدل 6 سم 3 / لتر في كلا الموسمين بالمقارنة مع معاملة الكنترول . وكان الفرق بين الرش ب 6، 4 سم ^{3} / لتر غير معنوي لجميع الصفات تحت الدراسة في كلا الموسمين. كان للتفاعل بين نظم الري ومعدلات الرش بالكالسيوم تأثيرمعنوي على جميع الصفات المدروسة عدا نسبة البروتين, الفوسفور (٪) , الزنك ،الحديد (ملجم / كجم) لم تتأثر معنويا بالتفاعل بين عاملى الدراسة في كلا الموسمين. أعلى القيم لكل من عدد القرون / نبات, وزن القرون/ نبات (جم) , وزن 100 بذرة ، محصول القرون, محصول البذور ومحصول الزيت (كجم / فدان) تم الحصول عليها عند الري بنظام الرش ومعدل 6 سم ^{3}/ لتر في كلا الموسمين - أعلى القيم لدليل الحصاد , نسبة التفريط (٪) وكفاءة استخدام الماء (كجم/ م^{3}) باستخدام نظام الرى بالرش ومعدل 6 سم ^{3} كالسيوم/ لتر في كلا الموسمين . على الجانب الآخر ، تم الحصول على أعلى القيم لمحتوى البذور من الكالسيوم (ملجم / كجم) عند الري بالنظام السطحى المطور والرش بمعدل 6سم ^{3}/ لتر من الكالسيوم ، بينما تم الحصول على أعلى القيم لمحتوى البذور من المنجنيز (ملجم / كجم) عند الري بالنظام السطحى المطور ومعاملة الكنترول في كلا الموسمين. لذلك زراعة الفول السودانى باستخدام نظام الري بالرش أو بالتنقيط والرش بمعدل 6 سم ^{3}/ لتر أعطى أعلى انتاجية للمحصول وأعلى جودة للبذور تحت ظروف الوادي الجديد بمصر .