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EFFECT OF DRIP IRRIGATION, ORGANIC FERTILIZATION AND PROGESTERONE RATES ON GROWTH, FLOWERING AND POSTHARVEST CHARACTERS OF TUBEROSE PLANTS GROWN UNDER SANDY SOIL CONDITIONS

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ABSTRACT: This work was carried out during the two consecutive summer seasons of 2003 and 2004 at the Experimental Farm of El-Kassasin Horticultural Research Station, Ismailia Governorate, to study the effect of three drip irrigation rates (1820, 3640 and 5460 m^3/fed.), three organic fertilization rates (0, 15 and 30 m^3/fed.) and three progesterone rates (0.0, 0.5 and 1.0 ppm) on growth, flowering and postharvest characters of tuberose plants grown in sandy soil.

Plant growth characters (plant height, number of leaves/spike and number of spikes/plant), flowering characters (spike length, spike diameter and number of florets/spike) and postharvest characters (longevity and volume of absorbed water) were significantly increased with irrigation at the highest rate; i.e. 5460 m^3/fed or with increasing application of FYM up to 30 m^3/fed.

Spraying tuberose plants by progesterone at 1.0 ppm twice/season at 45 and 60 days after sowing significantly increased plant height, number of leaves/spike and number of spikes/plant, some flowering characters as spike length, spike diameter and number of florets/spike and some postharvest characters as longevity and volume of absorbed water.

Key words: Tuberose, FYM, flowering, postharvest, plant growth, drip irrigation and progesterone.

INTRODUCTION

Water quantity is considered as one of the main factors that greatly affect plant growth, flower quality and postharvest characters of tuberose, particularly under sandy soil conditions. This may be due to that sandy soil is very poor in its ability to preserve water against leaching.

Organic fertilization is very important method of providing the plants with their nutritional requirements without having an undesirable impact on the environment. It is necessary to add organic matter to improve physical and chemical characters of the soil particularly sandy soil.

Generally, increasing irrigation water quantity increased vegetative growth and flowering quality (El – Roumi, 1981; Halepyati *et al.*, 1995and 2002) showed that irrigation tuberose plants by 100 % of E_{Pan} produced higher growth characters and dry matter of plant parts as compared to other treatments. In this concern Koriesh (1989) found that irrigation rose plant with 4 l/plant/day proceed the greatest number of leaves/flower stem as compared to irrigation with 2 or 6 l/plant/ day.

Many investigators studied the effect of organic manure rates on growth and flowering characters. Pawar and Patil (1990) on ginger, Hammam (1996) on *Pimpinella anisum* and Khandkar and Nigam (1996) on *Zingiber officinale* and Abd El – Raouf (2001) on *Ocimum basilicum* found that increasing application of FYM to plants positively affected the stem length and number of leaves and branches / plant. In the same trend Mallanagouda *et al.* (1995) on coriander, Yadav and Singh (1997) on *Tagetes erecta* and Sidky *et al.* (1998) on roselle stated that increasing application of FYM significantly improved flowering and yield but the effect was more prominent at lower rates of FYM.

Stanley and Bondy (1998) reviewed that there is evidence that some plants produce estrogenic compounds (steroids). Janeczko *et al.* (2003) and Schaller (2003) reviewed that sterols found in all eukaryotic organisms are membrane components which regulate the fluidity and the permeability of phospholipids bilayers.

Bhattacharya and Gupta (1981) found that the sterol progesterone in minute amounts (0.25 ug/plant) promoted shoot

growth and inhibited root growth of sunflower. On rose plants, results of Koriesh (1981) indicated that spraying plants with steroids hormone estrogen produced more flowers and longer flower stems. The histological studies proved that estrogen hormone enhanced the transition from vegetative to reproductive stage, then enhanced the development of rose flowers.

These studies aimed to improve the growth, flowering and keeping quality of tuberose spikes by using the water regime, organic fertilization and progesterone treatments.

MATERIALS AND METHODS

This work was carried out during the two successive seasons of 2003 and 2004 at the Experimental Farm of El-Kassasin Horticultural Research Station, Ismailia Governorate, to study the effect of drip irrigation, organic fertilization and progesterone rates on growth, flowering characters and postharvest characters of tuberose (*Polianthes tuberose* L.) cv. Double. The experimental soil was sandy in texture with 8.1 pH, 0.44 % organic matter, 81 ppm N, 23 ppm P and 103 ppm K. The FYM chemical analyses were 15.92 and 16.41 % C/ N ratio, 21.95 and 23.07 % organic matter, 0.34 and 0.36 % N, 0.45 and 0.51 % P and 1.32 and 1.28 % K in the first and second seasons, respectively.

This experiment included 27 treatments which were the combinations between three drip irrigation rates; i.e.1820, 3640 and 5460 m^3/fed, three FYM rates (0, 15 and 30 m^3/fed) and three progesterone rates; i.e. 0.0, 0.5 and 1.0 ppm.

The experimental unit area was 10.8 m^2 (3.6 x 3 m) and each unit contained six dripper lines with 3 m length for each and 60 cm width. Moreover, the distance between emitters was 30 cm. Thus, each experimental unit contained 60 emitters.

Uniform bulbs were handy-sown in hills on April 22nd every season on dripper line at spacing of 60 cm between dripper lines and 30 cm between the bulbs in each dripper line. Prior the irrigation treatments in all experimental units received equal amounts of water (50 m^3 /fed.). The amounts of calculated water were added to different treatments, express through drippers (2 l/hr) to give such amounts of water presented in Schedule 1.

Schedule 1. The amount of water, the time needed to give such amounts and amounts of water supply at every irrigation

Treatments	(m^3/fed)	Irrigation time (min)	Water supplied every time (m^3/fed)
I_1	1820	30	23.333
I_2	3640	60	46.666
I_3	5460	90	70.000

The drip irrigation treatments began when the bulb sprouted (1th May) and were performed in the morning thrice/week up to the end of August. Meanwhile, it was twice/week from the beginning of September up to end of November. Every treatment received 78 irrigation times. The amounts of water were added using water counter and pressure counter at 1 bar.

Organic fertilizers were mixed with 200 Kg super phosphate/fed. It was applied one week before cultivation during soil preparation in mid-row and covered with 10 cm sand. Progesterone was sprayed (at 10 o'clock morning).The first spray was conducted after 45 days from planting, whereas the second one was preformed 15 days later.

These treatments were arranged in a split-split plot design with three replicates in both seasons. Irrigation rates treatments were assigned at random in the main plots, while sub-plots were devoted to organic fertilization rates treatments and progesterone were allotted in the sub-sub plots.

Data Recorded

Plant Growth

Six guarded plants from each plot at age 75 days were labeled at random to evaluate the following characters: plant height (cm), number of leaves/spike and number of spikes/plant.

Flowering Characters

Six guarded plants from each plot at flowering stages were labeled at random to evaluate the following characters: spike length, spike diameter and number of florets/spike.

Postharvest Characters

Spikes of tuberose were harvested in the morning at tight bud stage (when the bottom florets began to swell) and then dipped in coold water for prevailing field temperature (pre-cooling). Spike bases were re-cut (5cm) before dipping in opening solution (10 % sucrose + 200 mg/l 8-hydroxy quinoline potassium sulphate + 150 mg/l citric acid). After 24 hours, spikes were held in distilled

water. The following data were recorded:

1- The longevity of spikes was determined when the wilted florets reach 75 % from the number of the total florets on the spikes.

2 -The volume of water absorbed (ml^3) was recorded every two days.

Statistical Analysis.

Data were subjected to statistical analysis of variance according to Steel and Torrie (1980) and the means were compared by the least significant difference (LSD).

RESULTS AND DISCUSSION

Plant Growth Characters

Main effect of irrigation, organic fertilization and progesterone rates:

Data in Table 1 reveal the effect of drip irrigation, organic fertilization and pregesterone rates on plant height, number of leaves/ spike and number of spikes/plant of tuberose. It can conclude that such characters were significantly increased with increasing water quantity from 1820 up to 5460 m^3 water/fed.

Such reduction in plant growth under low soil moisture level condition may be due to that water stress caused losses in tissue water which reduced turgor pressure in the cell, there by inhibited enlargement and division of cells. The decrease in enlargement and division of cells decrease leaf area and hence the effective photosynthetic surface (Schuppler *et al.*, 1998).

Water stress caused an increase in ABA/ cytokine ratio, which in turn decreased plant growth (Marchner, 1995). He added that, under sufficient water conditions there were a decrease in ABA and an increase in cytokinin, GA and IAA reflecting good growth and dry matter content.

These results are in harmony with those reported by El – Roumi (1981) and Halepyati *et al.* (1995 and 2002) on tuberose, they noticed that plant height, leaf number/plant and leaf area were markedly increased as water levels increased.

Data in Table 1 show that the most effective treatment in increasing plant height, number of leaves/spike and number of spike/plant was the application of 30 m^3 FYM/fed as compared to other ones. This may reflect the improvement of sandy soil characters (physiological, biological and chemical properties) as well as the increase of available

Table 1. Main effect of drip irrigation, organic fertilization and progesterone rates on plant height, number of leaves/ spike and number of spikes/ tuberose plant

Treatments	2003			2004		
	Plant height (cm)	No of leaves/ spike	No of spikes/ plant	Plant height (cm)	No of leaves/ spike	No of spikes/ plant
Drip irrigation rates						
1820 m^3 / fed	36.47	11.76	1.00	34.83	11.58	1.00
3640 m^3 / fed	47.50	13.19	1.74	45.98	13.41	2.24
5460 m^3 / fed	51.59	14.03	2.04	50.63	14.09	2.52
LSD $_{0.05}$	0.82	0.61	0.31	1.34	0.39	0.47
Organic fertilization rates						
0 m^3 FYM/ fed	41.19	11.46	1.13	39.37	11.69	1.50
15 m^3 FYM/ fed	45.60	13.54	1.74	44.58	13.77	2.04
30 m^3 FYM/ fed	48.77	13.98	1.91	47.50	13.62	2.22
L S D $_{0.05}$	0.62	0.29	0.05	0.75	0.40	0.21
Progesterone rates						
0.0 ppm	39.23	11.80	1.48	37.85	11.88	1.82
0.5 ppm	46.14	13.66	1.59	44.86	13.74	1.92
1.0 ppm	50.19	13.56	1.70	48.74	13.46	2.04
LSD $_{0.05}$	0.48	0.22	0.16	0.52	0.34	N.S

Table 2. Effect of interaction between irrigation and organic fertilization rates on plant height, number of leaves/spike and number of spikes/tuberose plant

Treatments		2003			2004		
Water quantity (m^3 / fed)	FYM (m^3 / fed)	Plant height (cm)	No of leaves / spike	No of spikes/ plant	Plant height (cm)	No of leaves/ spike	No of spikes/ plant
1820	**0**	30.53	9.50	1.00	27.90	9.50	1.00
	15	38.10	12.53	1.00	37.60	12.64	1.00
	30	40.78	13.25	1.00	38.99	12.61	1.00
3640	**0**	44.71	12.03	1.17	42.57	12.39	1.44
	15	46.41	13.69	1.38	44.98	13.69	2.50
	30	51.39	13.86	2.22	50.40	14.14	2.78
5460	**0**	48.35	12.86	1.22	47.63	13.19	2.06
	15	52.28	14.39	2.38	51.16	14.53	2.61
	30	54.14	14.83	2.50	53.09	14.56	2.89
L S D $_{0.05}$		1.08	0.51	0.08	1.23	0.66	0.37

water and nutrients by application rates of farmyard manure (Tsai *et al.*, 1993).

The obtained results are in accordance with those reported by Pawar and Patil (1990) on ginger, Hammam (1996) on *Pimpinella anisum,* Khandkar and Nigam (1996) on *Zingiber officinale* and Abd El – Raouf (2001) on *Ocimum basilicum*. All studied the effect of different FYM rates on yield and quality. They found that yield and quality were affected positively with increasing FYM rates.

Presented data in Table 1 show that spraying plants by progesterone at 1 ppm produced the tallest plants and increased number of spikes/plant. Moreover sprayed plants with progesterone at 0.5 ppm recorded the highest values of number of leaves/plant as compared with those sprayed by water (control).

These results are in harmony with those reported by Koriesh (1981) on roses and Bhattacharya and Gupta (1981) on sunflower and the review of Schaller (2003). They concluded that spraying plants with some steroids hormones increased vegetative characters.

Effect of interaction between irrigation and organic fertilization rates:

It is evident from data in Table 2 that all interaction treatments between drip irrigation rates and farmyard manure rates significantly affected the plant height, number of leaves/spike and number of spikes/ plant. The most effective interaction treatment was the combination between 5460 m^3 water/ fed. and 30 m^3 FYM/fed. which produced the highest values of plant height, number of leaves/spike and number of spikes/plant .Whereas, application of 1820 m^3 water without FYM gave the lowest levels of such characters .

Effect of interaction between irrigation and progesterone rates:

Data presented in Table 3 show the effect of interaction between application of water at 1820 , 3640 and 5460 m^3 water/fed and sprayed plants by progesterone at 0, 0.5 and 1 ppm. It is obvious that all interaction treatments had non significant effect on number of leaves/ plant and number of spikes/plant, but they had significant effect on plant height.

Table 3. Effect of interaction between drip irrigation rates and progesterone(Prog. ppm) rates on plant height, number of leaves/ spike and number of spikes/ tuberose plant

Treatments. Water quantity (m^3 / fed)	Prog.	2003 Plant height (cm)	2003 No of leaves/ spike	2003 No of spikes/ plant	2004 Plant height (cm)	2004 No of leaves/ spike	2004 No of spikes/ plant
1820	**0.0**	28.03	10.44	1.00	26.07	10.47	1.00
	0.5	38.77	12.50	1.00	27.03	12.36	1.00
	1.0	42.61	12.33	1.00	41.40	11.92	1.00
3640	**0.0**	42.69	11.89	1.56	41.43	12.08	2.00
	0.5	47.69	13.75	1.72	46.66	14.14	2.28
	1.0	52.13	13.94	1.94	49.85	14.00	2.44
5460	**0.0**	46.96	13.06	1.89	46.04	13.08	2.44
	0.5	51.98	14.61	2.06	50.87	14.72	2.44
	1.0	55.84	14.42	2.17	54.98	14.47	2.67
L S D $_{0.05}$		0.83	N.S	N.S	0.90	N.S	N.S

Table 4 . Effect of interaction between organic fertilization rates and progesterone (Prog. ppm) rates on plant height, number of leaves/ spike and number of spikes / tuberose plant

Treatments. FY M (m^3 / fed)	Prog.	2003 Plant height (cm)	2003 No of leaves/ spike	2003 No of spikes/ plant	2004 Plant height (cm)	2004 No of leaves/ spike	2004 No of spikes/ plant
0	**0.0**	35.92	10.19	1.06	34.08	10.36	1.33
	0.5	41.64	11.64	1.11	40.19	11.92	1.50
	1.0	46.02	12.5	1.22	43.82	12.81	1.67
15	**0.0**	38.95	12.44	1.67	37.92	12.81	1.94
	0.5	47.00	14.31	1.72	45.74	14.56	2.00
	1.0	50.84	13.86	1.83	50.09	13.94	2.17
30	**0.0**	42.81	12.75	1.72	41.54	12.47	2.17
	0.5	49.79	14.92	1.94	48.64	14.75	2.22
	1.0	53.72	14.28	2.06	52.32	13.64	2.28
L S D $_{0.05}$		0.83	0.38	N.S	0.90	0.59	N.S

The data indicate that application of 5460 m^3 water and twice spray of progesterone at 1 ppm increased plant height as compared to other treatments under study.

Effect of interaction between organic fertilization and progesterone rates:

It is evident from the data in Table 4 that the interaction between farmyard manure rates and progesterone rates significantly increased plant height and number of leaves/plant in two seasons under study, meanwhile, it had insignificant effect on number of spikes/plant.

The beneficial interaction treatment for increasing plant height of tuberose was application of 30 m^3 FYM/fed and spraying plants twice by 1 ppm progesterone, whereas the highest number of leaves/plant was recorded when 30 m^3 FYM/fed was applied to the soil and plants were sprayed with 0.5 ppm progesterone.

Effect of interaction between irrigation, organic fertilization and progesterone rates:

Data of three interaction treatments show that the interaction between drip irrigation, organic fertilization and progesterone rates had no significant effect on plant height, number of leaves/spike and number of spikes/plant, except plant height in second season only.

Flowering Characters

Main effect of irrigation, organic fertilization and progesterone rates:

Table 5 shows the effect of irrigation, organic fertilization and progesterone on some flowering characters as spike length, spike diameter, number of florets/spike and longevity. It is obvious from the data that spike length, spike diameter, number of florets/spike and longevity were increased with increasing water quantity from 1820 to 5460 m^3/fed.

These results are in good line with those obtained from the data of vegetative growth in Table 1 in this study. Exposing plants to water stress inhibited physiological processes and reduce leaf area, which caused a significant reduction in vegetative growth, spike length, spike diameter, number of florets/spike and longevity. These results indicate the importance of water supply along plant life for increasing growth and flowering characters.

The obtained results are in harmony with those reported by

Table 5.Effect of irrigation, organic fertilization and progesterone rates on spike length ,spike diameter, number of florets/spike and longevity of tuberose spikes

Treatments	2003				2004			
	Spike length (cm)	Spike diam. (cm)	No of florets/ spike	Long-evity (days)	Spike length (cm)	Spike diam. (cm)	No of florets/ spike	Long-evity (days)
drip irrigation rates								
1820 m^3 / fed	70.41	0.73	16.04	13.93	70.12	0.71	16.02	14.07
3640 m^3 / fed	79.43	0.92	17.94	16.00	79.06	1.01	18.09	17.07
5460 m^3 / fed	83.83	0.96	19.09	16.48	82.94	1.05	19.19	18.00
L S D $_{0.05}$	0.57	0.03	0.21	0.27	0.88	0.04	0.91	0.30
Organic fertilization rates								
0 m^3 FYM/ fed	70.37	0.79	14.57	14.70	70.02	0.85	14.41	15.22
15 m^3 FYM/ fed	79.87	0.90	18.12	15.59	79.52	0.95	18.25	16.67
30 m^3 FYM/ fed	83.43	0.92	20.37	16.11	82.68	0.96	20.64	17.26
L S D $_{0.05}$	0.53	N.S	0.38	0.32	1.09	0.02	0.44	0.33
progesterone rates								
0.0 ppm	69.89	0.87	15.69	15.07	69.42	0.89	15.98	15.89
0.5 ppm	81.49	0.87	17.87	15.52	80.74	0.93	17.92	16.44
1.0 ppm	82.29	0.87	19.51	15.83	82.05	0.94	19.40	16.82
LSD $_{0.05}$	0.75	N.S	0.20	0.31	0.74	0.02	0.39	0.25

Table 6 . Effect of interaction between irrigation and organic fertilization rates on spike length ,spike diameter, number of floret/spike and longevity of tuberose spikes

Treatments		2003				2004			
Water quantity (m^3/ fed)	FYM (m^3/ fed)	Spike length (cm)	Spike diam. (cm)	No of florets/ spike	Long-evity (days	Spike length (cm)	Spike diam. (cm)	No of florets/ spike	Long-evity (days
1820	0	66.34	0.71	12.83	13.33	66.17	0.69	12.56	13.33
	15	71.15	0.73	16.50	13.89	70.51	0.69	16.53	14.11
	30	73.73	0.75	18.78	14.56	73.68	0.73	18.97	14.78
3640	0	70.03	0.80	14.83	15.00	70.05	0.86	14.67	15.56
	15	81.88	0.94	18.28	16.22	81.79	1.08	18.64	17.11
	30	86.40	1.01	20.69	16.78	85.63	1.08	20.97	18.56
5460	0	74.73	0.86	16.06	15.78	73.83	0.98	16.00	16.78
	15	84.01	0.99	19.58	16.67	83.09	1.08	19.58	18.78
	30	92.73	1.03	21.64	17.00	91.90	1.08	21.97	18.84
L S D $_{0.05}$		0.91	N.S	N.S	N.S	1.89	0.03	N.S	0.58

EL– Roumi (1981) on tuberose, Koriesh (1989) on rose plants and Halepyati *et al.* (1995 and 2002) on tuberose. They found that increasing irrigation rates to plants significantly increased spike length and yield of spikes, and water stress affected on quality of flowering (reduction in number of flowers and length).

Results in the same Table 5 show that flowering characters were significantly increased with increasing organic manure up to 30 m^3 FYM/ fed. This was due that organic manure enhanced vegetative growth, which reflected on spike length, spike diameter, number of florets/spike and longevity in both seasons.

The obtained results are in accordance with those reported by Mallanagouda *et al.* (1995) on coriander, Yadav and Singh (1997) on *Tagetes erecta* and Sidky *et al.* (1998) on roselle. They found that increasing the rate of organic fertilization significantly increased flowering characters and yield.

It is obvious from the data that spike length, spike diameter, number of florets/spike and longevity were significantly increased by spraying plant by progesterone.

Spraying plants twice with the highest concentration of progesterone (1.0 ppm) gave the highest values of flowering characters.

The presented results coincided with those reported by Janeczko *et al.* (2003) who demonstrated that the application of some steroids increased the percentage of generative plants versus vegetative plants of *Arabidopsis thalianawas.* They added that androsterone was more effective in stimulating flowering than the progesterone .

Effect of interaction between irrigation and organic fertilization rates:

Data presented in Table 6 show that all interaction treatments had insignificant effect on number of florets/spike in two seasons and had insignificant effect on spike diameter and longevity in first season only, but the interaction treatments had significant increased on spike length in two seasons.

Effect of interaction between irrigation and progesterone rates:

It is obvious from the data in Table 7 that the interaction treatments showed no significant effect on spike diameter, number

Table 7 . Effect of interaction between irrigation rates and progesterone (Prog. ppm) rates on spike length, spike diameter,and number of florets / spike and longevity of tuberose spikes

Treatments Water quantity (m^3/fed)	Prog.	2003 Spike length (cm)	2003 Spike diam. (cm)	2003 No of florets/ spike	2003 Longevity (days)	2004 Spike length (cm)	2004 Spike diam. (cm)	2004 No of florets/ spike	2004 Longevity (days)
1820	0.0	63.33	0.73	14.22	13.78	63.09	0.69	14.50	13.56
	0.5	73.97	0.73	16.11	13.89	73.22	0.71	15.78	14.22
	1.0	73.93	0.73	17.78	14.11	74.06	0.72	17.78	14.44
3640	0.0	70.85	0.92	16.00	15.44	70.62	0.98	16.61	16.67
	0.5	82.56	0.92	18.03	16.11	81.99	1.02	18.19	17.11
	1.0	84.90	0.92	19.78	16.44	84.86	1.03	19.47	17.44
5460	0.0	75.48	0.96	16.86	16.00	74.55	0.98	16.83	17.44
	0.5	87.94	0.96	19.44	16.56	87.02	1.08	19.78	18.00
	1.0	88.05	0.96	20.97	16.89	87.24	1.08	20.94	18.56
L S D $_{0.05}$		1.30	N.S	N.S	N.S	1.29	0.03	N.S	N.S

Table 8. Effect of interaction between organic fertilization and progesterone (Prog. ppm) rates on spike length, spike diameter, number of floret/spike and longevity of tuberose spikes

Treatments FYM (m^3/fed)	Prog	2003 Spike length (cm)	2003 Spike diam. (cm)	2003 No of florets/ spike	2003 Long-Evity (days)	2004 Spike length (cm)	2004 Spike diam. (cm)	2004 No of florets/ spike	2004 Long-Evity (days)
0	0.0	64.91	0.80	12.42	14.44	64.85	0.82	12.36	14.89
	0.5	71.41	0.79	14.53	14.67	71.12	0.86	14.69	15.22
	1.0	74.78	0.78	16.78	15.00	74.08	0.86	16.17	15.56
15	0.0	70.32	0.90	16.11	15.22	69.62	0.92	16.81	16.00
	0.5	85.42	0.90	18.39	15.67	84.57	0.97	17.97	16.78
	1.0	83.89	0.90	19.86	15.89	84.37	0.97	19.97	17.22
30	0.0	74.43	0.91	18.56	15.56	73.79	0.92	18.78	16.78
	0.5	87.64	0.92	20.67	16.22	86.54	0.97	21.08	17.33
	1.0	88.22	0.92	21.89	16.56	87.71	0.99	22.06	17.67
LSD $_{0.05}$		1.30	N.S	0.35	N.S	1.29	N.S	N.S	N.S

of florets/spike and longevity, except spike diameter in second season only. But all interaction treatments showed significant increase in spike length.

Irrigation tuberose plants at rate of 5460 m^3/fed and spraying plants with progesterone at 1 ppm resulted in the highest levels of spike length and spike diameter.

Effect of interaction between organic fertilization and progesterone rates:

Data in Table 8 show the effect of interaction treatments between organic fertilization rates (0, 15 and 30 m^3 FYM/fed.) and progesterone rates (0, 0.5 and 1 ppm) on spike length, spike diameter, number of florets/spike and longevity.

The data show that all interaction treatments between organic fertilization rates and progesterone rates had insignificant effect on spike diameter, number of florets/pike and longevity, except number of florets /spike. Meanwhile this interaction treatments recorded significant increase on spike length in both study seasons .

Effect of interaction between irrigation, organic fertilization and progesterone rates

Concerning the effect of interaction between drip irrigation rates, organic fertilization rates and progesterone rates on spike length, spike diameter, number of florets/spike and longevity, it is obvious that all interaction treatments had insignificantly effect on flowering characters studied.

Postharvest Characters

Volume of Absorbed Water

Main effect of irrigation, organic fertilization and progesterone rates:

As for the effect of irrigation, organic fertilization and progesterone rates on volume of absorbed water by spikes of tuberose in vase life at 3, 5, 7, 9, 11 and 13 days, the results in Table 9 show that volume of absorbed water was increased with increasing water quantity applied to tuberose plants from 1820 to 5460 m^3/fed.

It is clear from the data in Table 9 that the superior treatment in increasing volume of absorbed water by spikes in vase life was irrigation with 5460 m^3/fed.

These results are in good line with those obtained from plant growth characters Table 1 and flowering characters Table 5.

Table 9. Effect of irrigation, organic fertilization and progesterone rates on volume of absorbed water (ml^3 / three spikes) by spikes of tuberose

Treatments	Days in vase life					
	3	5	7	9	11	13
1 st season						
Drip irrigation rates						
1860 m^3 / fed	32.22	82.33	82.33	98.26	164.63	197.70
3640 m^3 / fed	45.96	129.11	129.11	146.00	245.30	280.78
5460 m^3 / fed	49.67	140.74	140.74	162.70	277.44	312.70
LSD$_{0.05}$	3.39	11.31	11.31	10.03	11.47	10.99
Organic fertilization rates						
0 m^3 FYM/fed	37.84	78.78	101.78	121.74	200.19	233.22
15 m^3 FYM/fed	43.70	96.89	118.74	136.85	231.07	268.19
30 m^3 FYM/fed	46.67	108.74	131.67	148.37	256.11	289.78
LSD $_{0.05}$	1.13	3.24	3.46	3.71	2.60	3.67
Progesterone rates						
0.0 ppm	40.26	86.18	107.83	128.07	212.67	246.07
0.5 ppm	43.19	95.78	118.33	135.44	232.63	267.26
1.0 ppm	44.41	102.44	126.00	143.44	242.07	277.85
LSD $_{0.05}$	1.53	2.08	2.22	2.41	3.33	4.10
2 nd season						
Drip irrigation rates						
1820 m^3 / fed	35.48	89.18	111.07	127.59	200.41	222.59
3640 m^3 / fed	48.82	115.37	137.22	153.52	261.78	295.18
5460 m^3 / fed	56.44	135.04	161.48	182.26	282.89	321.74
LSD$_{0.05}$	2.07	3.36	3.54	4.31	6.27	8.64
Organic fertilization rates						
0 m^3 FYM/fed	40.04	95.70	118.96	139.67	206.00	231.07
15 m^3 FYM/fed	48.22	116.67	138.19	155.74	257.30	290.37
30 m^3 FYM/fed	52.48	127.22	152.63	167.96	281.78	318.07
LSD $_{0.05}$	0.98	2.45	3.04	3.07	2.53	4.53
Progesterone rates						
0.0 ppm	43.00	103.48	124.33	142.59	222.26	251.52
0.5 ppm	47.63	114.44	138.48	155.15	252.26	284.63
1.0 ppm	50.11	121.67	146.96	165.63	270.56	303.37
LSD $_{0.05}$	1.23	2.78	3.00	2.84	4.44	4.43

Exposing plants to water stress inhibited physiological processes and reduced leaf area, which caused a significant reduction in spike weight, number of opening flowers in vase life and volume of absorbed water by spikes in vase.

It could be concluded that volume of absorbed water was significantly increased with increasing FYM quantity from 0 to 30 m^3/fed. Application of maximum level of FYM (30 m^3/fed.) resulted in an increase in volume of absorbed water by spikes in vase life as compared to other organic manure rates in this study.

These results are in agreement with those obtained from plant growth parameters Table 1 and flowering characters Table 5. This was due to increasing organic manure enhanced vegetative growth, which reflected on spike length, spike diameter, number of florets/spike, so that reflected on volume of absorbed water by spikes in vase life.

Obtained results revealed that there were a significant and gradual increase in volume of absorbed water by spikes in vase life at different days with increasing concentration of progesterone, which sprayed on tuberose plants from 0.0 to 1.0 ppm.

Effect of interaction between irrigation and organic fertilization rate:

It is clear from the data in Table 10 that the interaction between irrigation and organic fertilization rates significantly increased volume of absorbed water by spikes in vase life at different days, and the highest interaction treatment in increasing volume absorbed water by spikes was the combination between irrigating plants with 5460 m^3/fed and applying 30 m^3 FYM/fed.

Effect of interaction between irrigation and progesterone rates:

It is clear from the data in Table 11 show that the interaction treatment appeared significant increase in volume of absorbed water by spikes in vase life at different days, except volume of absorbed water at 3, 7 and 9 days in first season and 5 days in two seasons.

The highest interaction treatment in increasing volume of absorbed water by spikes in vase life was irrigating plants at 5460 m^3/fed and spraying plants with 1.0 ppm progesterone.

Table 10 . Effect of interaction between irrigation and organic fertilization rates on volume of absorbed water (ml^3 / three spikes) by spikes of tuberose

Water quantity (m^3/fed)	FYM (m^3/fed)	Days in vase life					
		3	5	7	9	11	13
				1 st season			
1820	0	29.44	60.44	73.33	89.44	141.67	171.89
	15	32.56	69.44	80.00	95.33	161.89	198.78
	30	34.67	80.89	93.67	110.00	190.33	222.44
3640	0	39.00	77.56	101.22	123.56	207.11	238.78
	15	41.67	105.33	134.67	149.56	252.00	287.11
	30	43.33	117.89	151.44	164.89	276.78	316.44
5460	0	44.00	98.33	130.78	152.22	251.78	289.00
	15	46.89	115.89	141.56	165.67	279.33	318.67
	30	52.00	127.44	149.89	170.22	301.22	330.44
LSD $_{0.05}$		1.96	5.61	5.99	6.42	4.51	6.35
				2 nd season			
1820	0	34.11	76.78	96.89	110.44	179.00	198.22
	15	35.89	91.11	110.78	125.78	203.44	217.33
	30	36.44	99.67	125.56	146.56	218.68	252.22
3640	0	37.33	91.22	113.67	134.22	213.44	233.44
	15	51.56	121.22	142.78	161.89	268.89	313.11
	30	57.56	133.67	155.22	164.44	303.00	339.00
5460	0	48.67	119.11	146.33	174.33	225.56	261.56
	15	57.22	137.67	161.00	179.56	299.56	340.67
	30	63.44	148.33	177.11	192.89	323.56	363.00
LSD $_{0.05}$		1.69	4.25	5.27	5.31	6.12	7.85

Table 11. Effect of interaction between irrigation and progesterone (Prog. ppm) rates on volume of absorbed water (ml^3 / three spikes) by spikes of tuberose

Water quantity (m^3/fed)	Prog.	Days in vase life					
		3	5	7	9	11	13
		1 st season					
1820	**0.0**	30.89	63.78	75.89	90.67	156.00	186.89
	0.5	32.44	71.22	82.67	99.33	166.00	198.33
	1.0	33.33	75.78	88.44	104.78	171.89	207.89
3640	**0.0**	42.67	90.22	118.22	138.00	221.11	256.89
	0.5	46.56	102.00	130.67	145.22	252.33	286.56
	1.0	48.67	108.56	138.44	154.78	262.44	298.89
5460	**0.0**	47.22	104.56	129.44	155.56	260.89	294.44
	0.5	50.56	114.11	141.67	161.78	279.56	316.89
	1.0	51.22	123.00	151.11	170.78	291.89	326.78
LSD $_{0.05}$		N.S	N.S	N.S	N.S	5.78	7.10
		2 nd season					
1820	**0.0**	34.00	79.00	97.11	114.33	184.44	206.44
	0.5	36.00	88.78	110.89	126.22	199.89	220.78
	1.0	36.44	99.78	125.22	142.22	216.89	240.56
3640	**0.0**	44.00	106.89	128.44	144.00	233.11	263.33
	0.5	49.89	117.22	139.00	155.67	268.44	303.44
	1.0	52.56	122.00	144.22	160.89	283.78	318.78
5460	**0.0**	51.00	124.56	147.44	169.44	249.22	284.78
	0.5 p	57.00	137.33	165.56	183.56	288.44	329.67
	1.0	61.33	143.22	171.44	193.78	311.00	350.78
LSD $_{0.05}$		2.13	N.S	5.19	4.91	7.68	7.66

Table 12 . Effect of interaction between organic fertilization and progesterone rates on volume of absorbed water (ml^3 / three spikes) by spikes of tuberose

FYM (m^3/fed)	Prog.	Days in vase life					
		3	5	7	9	11	13
				1 st season			
0	0 .0	35.78	73.89	96.56	116.89	190.67	221.67
	0.5	37.78	78.00	101.33	121.56	201.89	235.33
	1.0	38.89	84.44	107.44	126.78	208.00	242.67
15	0 .0	41.56	88.11	110.00	129.78	212.00	246.67
	0.5	44.00	89.00	120.11	137.22	236.78	274.22
	1.0	45.56	104.56	126.11	143.56	244.44	283.67
30	0 .0	43.44	96.56	117.00	137.56	235.33	269.89
	0.5	47.78	111.33	133.56	147.56	259.22	292.22
	1.0	48.78	118.33	144.44	160.00	273.78	307.22
LSD 0.05		N.S	3.60	3.84	4.18	5.78	7.10
				2 nd season			
0	0 .0	38.67	90.44	111.22	133.00	189.56	216.11
	0.5	40.56	95.89	119.33	138.44	206.89	231.33
	1.0	40.89	100.78	126.33	147.56	221.56	245.78
15	0 .0	43.00	106.11	123.67	142.11	230.89	255.44
	0.5	49.33	118.22	139.22	156.67	261.67	296.67
	1.0	52.33	125.67	151.67	168.44	279.33	319.00
30	0 .0	47.33	113.89	138.11	152.67	246.33	283.00
	0.5	53.00	129.22	156.89	170.33	288.22	325.89
	1.0	57.11	138.56	162.89	180.89	310.78	345.33
LSD 0.05		2.13	4.82	5.19	4.91	7.68	7.66

Effect of interaction between organic fertilization and progesterone rates:

Results in Table 12 show that the interaction treatments had significant increase on volume of absorbed water by spikes in vase life at 3, 5, 7, 9, 11 and 13 days, except volume of absorbed water by spikes at 3 days in first season only which show insignificant effect.

The most effective interaction treatments which gave the highest value of volume of absorbed water by spikes was fertilization plants with 30 m^3 FYM/fed with spraying plants at 1.0 ppm progesterone.

Effect of interaction between irrigation, organic fertilization and progesterone rates:

The interaction between irrigation, organic fertilization and progesterone rates had insignificant effect on volume of absorbed water by tuberose spikes in vase life at different days, except volume of absorbed water at 11 and 13 days in first season only and volume of absorbed water at 9 days in both seasons which showed significant increase in volume of absorbed water by spikes in vase life.

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تأثير معدلات الري بالتنقيط والتسميد العضوي والبروجستيرون على النمو والتزهير وصفات ما بعد القطف لنباتات التبروز تحت ظروف الاراضى الرملية

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اجري هذا البحث خلال موسمين صيفين متتاليين لعامي ٢٠٠٣ و ٢٠٠٤ في مزرعة التجارب بمحطة بحوث البساتين بالقصاصين ، محافظة الإسماعيلية ، لدراسة تأثير ثلاث مستويات للري بالتنقيط وهى ١٨٢٠و ٣٦٤٠و ٥٤٦٠ م^{٣}/فدان وثلاث مستويات للتسميد العضوي وهى ٠ و ١٥ و ٣٠ م^{٣} سماد بلدي/فدان وثلاث مستويات من البروجستيرون وهى ٠,٠ و ٠,٥ و ١,٠ جزء في المليون على النمو والتزهير وصفات ما بعد القطف لنباتات التبروز المزروعة تحت ظروف الاراضى الرملية.

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الزهري، وطول مدة البقاء في الزهرية، حجم الماء الممتص معنويا بزيادة إضافة السماد البلدي حتى ٣٠ م^{٣}/فدان، وكذلك بزيادة معدل الري إلي ٥٤٦٠م^{٣} /فدان.

رش نباتات التبروز بالبروجستيرون بمعدل ١ جزء في المليون مرتين في الموسم عند عمر ٤٥ ، ٦٠ يوم من الزراعة ادى لزيادة معنوية فى ارتفاع النبات، وعدد الأوراق/ الشمراخ الزهري، وعدد الشماريخ الزهرية/ نبات، وطول الشمراخ الزهري، وقطر الشمراخ الزهري، وعدد النورات الزهرية/ الشمراخ الزهري، وطول مدة البقاء في الزهرية، وحجم الماء الممتص.