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Effect of irrigation and fertigation on nutrient uptake and water requirement in acid lime (*Citrus aurantifolia* Swingle) CV. Phule Sharbati

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Abstract
The present investigation entitled "Fertigation Studies in Acid lime (*Citrus aurantifolia* Swingle) cv. Phule Sharbati" was conducted to study the effect of irrigation and fertigation scheduling in acid lime at "All India Coordinated Research Project on Fruits", Instruction Cum Research & Demonstration Farm, Department of Horticulture, MPKV., Rahuri, Dist. Ahmednagar (MS) during the year 2015-16 and 2016-17. The interaction effects irrigation level I_1-100% ETr through drip along with fertigation level F_1-90% RD through WSF significantly recorded the highest total nitrogen phosphorus in leaves as well as in soil. However, potash in leaves and in soil was found non significant. Maximum soil moisture content was recorded in I_1-100% ETr level of irrigation and The quantity of water applied (m^3/plant/year) recorded in I_1-100% ETr level of irrigation is almost 35% less than quantity of water applied (m^3/plant/year) in surface irrigation during both the year of investigation respetively.

Keywords: Acid lime, irrigation, fertigation, nutrient status, water requirement

Introduction
Acid lime (*Citrus aurantifolia* Swingle) belongs to the family "Rutaceae" a popular fruit crop grown in the subtropics and tropics. Acid lime is one of the most beneficial fruit when its come to its natural benefits and curative properties. In India the important citrus fruits grown are mandarins, sweet oranges and acid lime sharing 41 per cent, 23 per cent and 23 per cent respectively of total citrus fruit production in country. Area and production of acid lime in India during the year 2016-17 is recorded to be 259.3 thousand ha. and 2,789.0 thousand MT which is much higher than 2001-02 (161.3 thousand ha. and 1413.7 thousand MT) with increase in productivity from 8.8 MT/ha (2001-02) to 10.80 MT/ha (2016-17) (Annon, 2017) [2]. Efficient use of irrigation water and fertilizers through fertigation needs to be adopted on a large scale by the growers in India which improve nutrient uptake and increase yield of pant.

Material and Methods
The investigation was carried out at All India Coordinated Research Project on Fruits, Department of Horticulture, MPKV, Rahuri (Maharashtra) during 2015-16 and 2016-17 with a view to elicit the "Fertigation Studies in Acid lime (*Citrus aurantifolia* Swingle) cv. Phule Sharbati". The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications and ten treatments, In this investigation nine treatments included combinations of three Irrigation Levels (I) i.e I_1- 100% irrigation of the ETr., I_2- 75% irrigation of the ETr. and I_3- 50% irrigation of the ETr. with three Fertigation Levels (F) i.e. F_1- 90% of RDF, F_2- 80% of RDF and F_3- 70% of RDF through Drip irrigation and T_{10}- Control I_4- Conventional surface irrigation with 100% RDF as per the farmer practice. Irrigation was applied by drip irrigation on an alternate day. The reference crop evapotranspiration was calculated by using the FAO Penman-Monteith method. (Allen *et al.* 1998) [1].
The water to be applied was computed as:

$$V = ETr \times A \times F$$

Where,
V- Volume of water to be applied (litre/alternate day/ plant)
ETr- Crop evapotranspiration rate (mm)
A-Area of one plant (m^2)
F- Depend upon treatments (i.e. 0.8, 0.6 or 0.4).

Results & Discussion

The results presented in Table 1 & 2 indicate that the interaction effects i.e. T_1- irrigation level I_1-100% ETr through drip along with fertigation level F_1-90% RD through WSF significantly recorded the highest total nitrogen in leaves 1.89% and 1.96% and phosphorus in leaves 0.39% and 0.43% than rest of the treatment combinations during final stage of 2015-16 and 2016-17 respectively. T_7- irrigation level I_3-50% ETr through drip along with fertigation level F_1-90% RD through WSF significantly recorded the maximum available nitrogen (kg ha^{-1}) 441.13 kg and 472.49 kg respectively and T_3- irrigation level I_1-100% ETr through drip along with fertigation level F_3-70% RD through WSF significantly recorded the maximum available phosphorus (kg ha^{-1}) 10.02 kg and 10.35 kg during the final stages of 2015-16 and 2016-17. However, total potash in leaves as well as in soil was found non significant. The application of balance doses of nutrients has resulted in more availability of N, P & K in soil solution, whereas proper irrigation helps to increase the nutrient uptake and the same has been reflected in the leaves. Similar results were noted by Shirgure *et al.* (2003) [7] in acid lime, Panigrahi *et al.* (2008) [5] in Nagpur mandarin.

Average values of soil moisture content (%) presented in Table 3 shown that before and after irrigation were recorded maximum in I_1-100% ETr level of irrigation at M_1 (30 cm depth from the soil surface around the periphery of tree) and M_2 (45 cm depth from the soil surface around the periphery of tree), during both the years of investigation. It was also observed that the moisture content in I_1-100% ETr level of irrigation fairly maintained nearer to field capacity which indeed must had congenial condition in the root zone of crop during the growth and development period, which leads to higher uptake of nutrients and yield. This might be due to the quantity of applied water as per the water requirement of the acid lime considering the evapotranspiration demand. These results are in conformity with the findings of Panigrahi *et al.* (2010) [6] and Shirgure *et al.* (2014) [9] in Nagpur mandarin.

The quantity of water applied (m^3/plant/year) recorded in I_1-100% ETr level of irrigation is 21.41 and 19.24 almost 35% less than quantity of water applied (m^3/plant/year) in surface irrigation 33.24 and 33.30 during both the year of investigation respetively shown in Table 4.

Table 1: Nutrient status in leaves of acid lime as influenced by different levels of irrigation, fertigation and their interaction

Treatments	Total nitrogen in leaves (%)				Total phosphorus in leaves (%)				Total potash in leaves (%)			
	Initial 2015-16	Final 2015-16	Initial 2016-17	Final 2016-17	Initial 2015-16	Final 2015-16	Initial 2016-17	Final 2016-17	Initial 2015-16	Final 2015-16	Initial 2016-17	Final 2016-17
Irrigation Levels (I)												
I_1	1.48	1.79	1.79	1.87	0.31	0.39	0.39	0.41	1.53	1.69	1.69	1.76
I_2	1.44	1.75	1.75	1.81	0.29	0.34	0.34	0.37	1.52	1.57	1.57	1.66
I_3	1.32	1.40	1.40	1.39	0.29	0.30	0.30	0.31	1.62	1.54	1.54	1.57
SE (m) ±	0.10	0.08	0.08	0.04	0.00	0.00	0.00	0.00	0.05	0.03	0.03	0.03
CD at 5%	NS	0.24	0.24	0.12	0.01	0.01	0.01	0.01	NS	NS	NS	NS
Fertigation Levels (F)												
F_1	1.41	1.72	1.72	1.77	0.29	0.35	0.35	0.39	1.58	1.64	1.64	1.73
F_2	1.44	1.66	1.66	1.70	0.30	0.34	0.34	0.36	1.56	1.62	1.62	1.64
F_3	1.38	1.55	1.55	1.59	0.30	0.33	0.33	0.34	1.53	1.54	1.54	1.61
SE (m) +	0.10	0.08	0.08	0.04	0.00	0.00	0.00	0.00	0.05	0.03	0.03	0.03
CD at 5%	NS	0.24	0.24	0.12	NS	0.01	0.01	0.01	NS	NS	NS	NS
Interaction (I x F)												
T_1 -I_1F_1	1.51	1.89	1.89	1.96	0.32	0.39	0.39	0.43	1.58	1.75	1.75	1.82
T_2 -I_1F_2	1.60	1.88	1.88	1.92	0.31	0.39	0.39	0.41	1.52	1.70	1.70	1.77
T_3 -I_1F_3	1.32	1.59	1.59	1.72	0.31	0.38	0.38	0.40	1.50	1.63	1.63	1.68
T_4 -I_2F_1	1.41	1.79	1.79	1.87	0.28	0.35	0.35	0.39	1.52	1.60	1.60	1.73
T_5 -I_2F_2	1.51	1.78	1.78	1.83	0.29	0.34	0.34	0.37	1.53	1.58	1.58	1.60
T_6 -I_2F_3	1.41	1.69	1.69	1.71	0.30	0.33	0.33	0.35	1.52	1.52	1.52	1.65
T_7 -I_3F_1	1.32	1.41	1.41	1.51	0.29	0.31	0.31	0.34	1.65	1.58	1.58	1.65
T_8 -I_3F_2	1.23	1.32	1.32	1.31	0.29	0.30	0.30	0.31	1.62	1.58	1.58	1.55
T_9 -I_3F_3	1.41	1.36	1.36	1.35	0.29	0.30	0.30	0.28	1.58	1.47	1.47	1.50
SE (m) +	0.17	0.06	0.06	0.07	0.01	0.01	0.01	0.01	0.08	0.05	0.05	0.05
CD at 5%	NS	0.18	0.18	0.20	0.02	0.02	0.02	0.03	NS	NS	NS	NS
T_{10} -Control	1.23	1.38	1.38	1.46	0.30	0.32	0.32	0.33	1.58	1.62	1.62	1.67

Table 2: Nutrient status in soil of acid lime as influenced by different levels of irrigation, fertigation and their interaction

Treatments	Available nitrogen (kg ha^{-1})				Available phosphorus (kg ha^{-1})				Available potash (kg ha^{-1})			
	Initial 2015-16	Final 2015-16	Initial 2016-17	Final 2016-17	Initial 2015-16	Final 2015-16	Initial 2016-17	Final 2016-17	Initial 2015-16	Final 2015-16	Initial 2016-17	Final 2016-17
Irrigation Levels (I)												
I_1	360.29	388.52	388.52	409.42	8.74	9.34	9.34	9.80	379.56	399.47	399.47	408.18
I_2	373.88	412.91	412.91	441.83	8.69	9.36	9.36	9.81	364.62	387.02	387.02	401.96
I_3	386.42	427.19	427.19	459.53	8.22	8.63	8.63	9.01	379.56	409.69	409.69	435.56
SE (m) ±	13.66	8.33	8.33	7.87	0.34	0.21	0.21	0.22	7.54	7.31	7.31	5.54
CD at 5%	NS	24.76	24.76	23.37	NS	0.63	0.63	0.67	NS	NS	NS	NS
Fertigation Levels (F)												
F_1	378.76	417.44	417.44	444.62	8.35	8.98	8.98	9.48	383.29	408.18	408.18	424.36

F_2	372.84	410.82	410.82	440.43	8.43	9.07	9.07	9.53	363.38	382.31	382.31	403.20
F_3	369.00	400.36	400.36	425.73	8.86	9.28	9.28	9.65	377.07	405.69	405.69	418.13
SE (m) +	13.66	8.33	8.33	7.87	0.34	0.21	0.21	0.22	7.54	7.31	7.31	5.54
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction (I x F)												
T_1 -I_1F_1	366.91	398.27	398.27	419.18	8.09	8.76	8.76	9.45	399.47	418.13	418.13	429.33
T_2 -I_1F_2	360.64	390.95	390.95	411.86	8.56	9.24	9.24	9.69	347.20	365.87	365.87	380.80
T_3 -I_1F_3	353.32	376.32	376.32	397.23	9.58	10.02	10.02	10.35	392.00	414.40	414.40	414.40
T_4 -I_2F_1	362.73	412.91	412.91	442.18	8.62	9.28	9.28	9.77	354.67	384.53	384.53	399.47
T_5 -I_2F_2	377.37	412.91	412.91	444.27	8.71	9.45	9.45	9.90	373.33	380.80	380.80	399.47
T_6 -I_2F_3	381.55	412.91	412.91	439.04	8.73	9.36	9.36	9.77	365.87	395.73	395.73	406.93
T_7 -I_3F_1	406.63	441.13	441.13	472.49	8.35	8.91	8.91	9.23	395.73	421.87	421.87	444.27
T_8 -I_3F_2	380.50	428.59	428.59	465.17	8.02	8.54	8.54	8.99	369.60	400.27	400.27	429.33
T_9 -I_3F_3	372.14	411.86	411.86	440.93	8.28	8.45	8.45	8.82	373.33	406.93	406.93	433.07
SE (m) +	13.66	9.43	9.43	9.62	0.58	0.22	0.22	0.20	13.07	14.67	14.67	13.59
CD at 5%	NS	27.89	27.89	28.83	NS	0.64	0.64	0.57	NS	NS	NS	NS
T_{10} -Control	417.09	442.18	442.18	458.90	7.93	8.34	8.34	8.62	384.53	399.47	399.47	414.40

Table 3: Soil moisture content (%) as influenced by the different levels of irrigation

Irrigation Levels	**2015-16**						**2016-17**					
	Before irrigation											
	I_1- 100% Irrigation		**I_2- 75% Irrigation**		**I_3- 50% Irrigation**		**I_1- 100% Irrigation**		**I_2- 75% Irrigation**		**I_3- 50% Irrigation**	
Months	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2
May	31.39	30.10	29.82	30.74	27.46	26.32	31.78	30.21	29.97	28.82	27.58	26.45
June	31.67	31.28	31.10	29.81	28.62	26.44	31.73	30.37	31.23	29.94	28.74	26.58
July	33.21	32.58	32.68	31.44	30.37	28.53	33.32	32.70	32.79	31.59	30.50	28.67
August	34.25	32.96	33.80	32.78	30.86	28.47	34.36	33.11	33.96	32.88	30.99	28.59
September	34.31	33.77	33.42	32.63	31.24	29.29	34.42	33.89	32.56	32.71	31.36	29.40
October	34.13	33.56	32.96.	31.17	31.07	28.18	34.24	33.66	32.13	31.29	31.18	28.27
November	33.34	32.67	31.48	30.33	29.29	27.73	33.49	32.81	31.62	30.44	29.43	27.86
December	33.05	32.51	31.24	29.79	29.60	27.92	33.16	32.59	31.39	29.92	29.71	28.07
January	32.82	32.13	30.72	28.91	28.37	27.43	32.98	32.24	30.87	29.05	28.48	27.61
February	31.54	31.04	29.30	28.22	27.22	26.38	31.67	31.17	29.45	28.34	27.33	26.49
March	31.17	31.27	28.41	27.32	26.78	26.19	31.27	30.38	28.57	27.47	26.89	25.31
April	31.25	31.39	27.78	27.11	26.81	26.26	31.37	30.52	27.93	27.26	26.97	25.38
	After irrigation											
Months	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2	M_1	M_2
May	35.17	33.93	33.41	34.04	31.27	29.47	35.29	34.06	33.49	32.16	31.38	29.56
June	35.38	34.16	34.70	32.92	32.25	29.58	35.53	34.27	34.89	33.11	32.42	29.69
July	36.08	35.42	35.83	34.16	34.69	31.32	36.19	35.54	35.91	34.32	34.87	31.44
August	37.48	35.81	36.62	35.52	35.92	32.09	37.65	35.94	36.71	35.66	36.05	32.22
September	37.61	36.20	36.79	35.67	35.77	32.98	37.74	36.29	36.93	35.75	35.88	33.09
October	37.52	36.44	35.78	34.29	34.99	32.07	37.62	36.57	35.89	34.40	35.12	32.21
November	36.92	35.72	35.11	33.61	34.27	32.39	37.08	35.86	35.23	33.70	34.39	32.52
December	36.74	35.60	34.92	32.83	33.61	31.13	36.86	35.81	35.05	32.89	33.73	31.26
January	35.93	34.89	34.17	32.34	32.44	31.22	36.09	34.99	34.38	32.48	32.56	31.34
February	35.26	34.12	33.50	31.74	32.38	29.46	35.39	34.28	33.71	31.83	32.49	29.58
March	34.68	33.18	32.73	31.06	31.14	28.77	34.78	33.31	32.86	31.19	31.29	28.86
April	34.78	33.06	32.20	30.95	31.02	29.10	34.91	33.17	32.33	33.07	31.21	29.24

(M_1- 30 cm depth from the soil surface around the peripheri of tree and M_2- 45 cm depth from the soil surface around the peripheri of tree)

Table 4: Water applied (m^3 $plant^{-1}$ $year^{-1}$) as influenced by the different levels of irrigation

Year	**Irrigation Levels**			
	I_1 (100% Irrigation)	**I_1 (75% Irrigation)**	**I_1 (50% Irrigation)**	**I_4 Control (Surface Irrigation)**
2015-16	21.41	16.06	10.71	33.24
2016-17	19.24	14.43	9.62	33.30

Reference

1. Allen RG, Pariera LS, Raes Smith M. Crop evapotraspiration: Guidelines for computing crop requirement. Irrigation and Drainage Paper No. 56, FAO, Rome, Italy, 1998.
2. Anonymous. Area, production and productivity of vegetable crops in India. National Horticulture Database, 2017; 2:47-52.
3. Balaganvi S, Kumathe SS. Effect of different levels of drip irrigation and fertiliser application on growth, yield and quality parameters of Kagzi lime. Karnataka J Agri. Sci. 2004; 17(3):626-628.
4. Goramnagar HB, Nagare PK, Bharad SG, Paithankar Dinesh. Effect of micro-irrigation and fertigation on growth parameter and fruit yield of acid lime. Int. J of Chem. Studies. 2017; 5(6):15-18.

5. Panigrahi P, Huchche AD, Srivastava AK, Singh Shyam. Effect of drip irrigation and plastic mulch on performance of Nagpur mandarin (*Citrus reticulata* Blanco) grown in central India. Ind. J Agril. Sci. 2008; 78(12):1005-1009.
6. Panigrahi P, Huchche AD, Srivastava AK, Singh S. Optimizing growth, yield and water use efficiency (WUE) in Nagpur mandarin (*Citrus reticulata* Blanco) under drip irrigation and plastic mulch. Indian J Soil Cons. 2010; 38(1):42-45.
7. Shirgure PS, Shrivastava AK, Shyam Singh. Irrigation scheduling and fertigation in acid lime (*Citrus aurantifolia* Swingle), Indian J of Agril. Sciences. 2003; 73(7):36-37.
8. Shirgure PS, Shrivastava AK, Shyam Singh. Integrated water and nutrient management in acid lime. Ind. J of Soil Cons. 2004; 32(2):148-151.
9. Shirgure PS, Srivastava AK, Huchche AD. Water requirements in growth stages and effects of deficit irrigation on fruit productivity of drip irrigated Nagpur mandarin (*Citrus reticulata*). Indian J Agril. Sci. 2014; 84(3):317-322.