



Research Article

STANDARDIZATION OF STAGE WISE WATER REQUIREMENT IN ACID LIME (*Citrus aurantifolia* Swingle) UNDER WESTERN MAHARASHTRA CV. PHULE SHARBATI

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Abstract: A field experiment on standardization of stage wise water requirement in acid lime (*Citrus aurantifolia* Swingle) under Western Maharashtra cv. Phule Sharbati was carried out at All India Coordinated Research Project on Fruits, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during the period from 2014-15 to 2018-19. The pooled results obtained that the effect of stage wise application of irrigation water on growth, yield and fruit quality of acid lime were significant. The maximum plant height (3.13 m), canopy volume (23.66 m³), fruit weight (47.60 g), number of fruits (805.54 fruits/tree), fruit yield (38.71 kg/tree and 10.71 t/ha), juice (49.08 %), acidity (6.85 %), ascorbic acid (32.85 mg/100 ml juice) and B:C ratio (1.56) were recorded in the treatment T4 i.e., application of irrigation water at 80:80:80:80:80 ER % from stage-I (January-February) to stage-VI (November-December). From the results it is recommended that irrigation at 80:80:80:80:80 ER % from stage-I (January-February) to stage-VI (November-December) is recommended for better growth, maximum yield and quality fruits with efficient and timely utilization of irrigation water in acid lime cv. Phule Sharbati for Western Maharashtra.

Keywords: Acid lime, Drip irrigation, Growth, Yield, Quality, Benefit:cost ratio

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Introduction

Acid lime (*Citrus aurantifolia* Swingle) is mainly grown in semi-arid climate of Maharashtra and adjoining states like Andhra Pradesh, Telangana, Karnataka and Gujarat in central India. The productivity of acid lime is very low (< 5-7 t/ha) because of surface gravity method of irrigation, poor soil-water-air equilibrium and soil application of fertilizers with micro-nutrient deficiencies [1]. Irrigation scheduling based on daily pan evaporation is the essential component affecting growth, yield and fruit quality mainly dependent on the constant and adequate supply of soil moisture in feeder root zone right from fruit set to fruit maturity of acid lime [2,3]. Acid lime being a perennial evergreen tree requires soil moisture and all required nutrients for higher orchard efficiency during the fruit growth stages. The inadequate moisture in critical stages of the crop hampers the fruit yield and quality drastically [4]. Acid lime is one of the important citrus fruit crops grown in India on an area of 2,40,000 hectares with total production of 25,55,000 MT and productivity of 10.64 MT/ha [5].

Material and Methods

The experiment was conducted at All India Coordinated Research Project on Fruits, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during the period from 2014-15 to 2018-19. The statistical design applied for the experiment was Randomized Block Design (RBD) with five treatments replicated four times. The trees of acid lime cv. Phule Sharbati were planted in medium black soil at the distance of 6 x 6 m. Nine years old uniform acid lime trees were selected for the experiment. Four trees were used for each treatment. Observations on growth, yield and fruit quality were recorded. The data were statistically analyzed following the standard procedure given by Panse and Sukhatme (1995) [6].

Results and Discussion

The pooled data (2014-15 to 2018-19) depicted in [Table-1] revealed that the

maximum plant height (3.13 m), canopy volume (23.66 m³), fruit weight (47.60 g), number of fruits (805.54 fruits/tree) and yield (38.71 kg/tree and 10.71 t/ha) were recorded in the treatment T4 i.e., application of irrigation water at 80:80:80:80:80 ER % from stage-I (January-February) to stage-VI (November-December) and was at par with the treatment T3 i.e., application of irrigation water at 60:80:80:80:80 ER % from stage-I (January-February) to stage-VI (November-December). The maximum growth and yield by application of irrigation water at 80:80:80:80:80 ER % from stage-I (January-February) to stage-VI (November-December) might have been due to its beneficial effects on photosynthesis and dry matter production. Similar increase in growth and yield by application of irrigation water at 80 ER % to all growth stages were reported by Srivastava et al. (2003) [7] in Nagpur mandarin, Balaganvi and Kumathe (2004) [8] in acid lime and Shirgure et al. (2014) [9] in Nagpur mandarin. There was reduction in growth and yield by application of irrigation water at 30:30:30:30:30 ER % (T5) from stage-I (January-February) to stage-VI (November-December) and recorded the minimum plant height (3.03 m), canopy volume (19.83 m³), fruit weight (41.48 g), number of fruits (759.50 fruits/tree) and yield (31.15 kg/tree and 8.62 t/ha).

The pooled data (2014-15 to 2018-19) in respect of fruit quality depicted in [Table-2] revealed that, the maximum juice (49.08 %), acidity (6.85 %) and ascorbic acid (32.85 mg/100 ml juice) with minimum number of seeds/fruit (7.80) and rind thickness (1.36 mm) were recorded in the treatment T4 i.e., application of irrigation water at 80:80:80:80:80 ER % from stage-I (January-February) to stage-VI (November-December). The application of irrigation water at 80 ER % at all the growth stages enhanced the photosynthetic rate and auxins production which in turn improved the fruit quality of acid lime. These results are in conformity with the findings of Shirgure et al. (2004a) [10] in acid lime, Shirgure and Srivastava (2013) [11] in Citrus. There was non-significant difference between the treatments for TSS and weight of seeds/fruit.

Treatment details

Treatment	Stage-I (Jan-Feb)	Stage-II (Mar-April)	Stage-III (May-June)	Stage-IV (July-Aug)	Stage-V (Sept-Oct)	Stage-VI (Nov-Dec)
T ₁	30 ER (%)	40 ER (%)	30 ER (%)	40 ER (%)	30 ER (%)	40 ER (%)
T ₂	40 ER (%)	60 ER (%)	40 ER (%)	60 ER (%)	40 ER (%)	60 ER (%)
T ₃	60 ER (%)	80 ER (%)	60 ER (%)	80 ER (%)	60 ER (%)	80 ER (%)
T ₄	80 ER (%)	80 ER (%)	80 ER (%)	80 ER (%)	80 ER (%)	80 ER (%)
T ₅	30 ER (%)	30 ER (%)	30 ER (%)	30 ER (%)	30 ER (%)	30 ER (%)

(ER = Evaporation Replenishment)

Table-1 Effect of stage wise application of irrigation water on growth and yield in acid lime (Pooled mean 2014-15 to 2018-19)

Treatment	Plant height(m)	Canopy volume(m ³)	Fruit weight (g)	Number of fruits /tree	Yield (kg/tree)	Yield (t/ha)
T ₁	3.04	21.23	43.59	772.99	33.63	9.31
T ₂	3.04	20.83	45.29	782.66	35.37	9.79
T ₃	3.11	23.63	47.04	796.75	37.78	10.46
T ₄	3.13	23.66	47.6	805.54	38.71	10.71
T ₅	3.03	19.83	41.48	759.50	31.15	8.62
S. E. \pm	0.02	0.60	0.51	3.55	1.03	0.28
C. D. at 5 %	0.06	1.81	1.54	10.64	3.09	0.85

Table-2 Effect of stage wise application of irrigation water on fruit quality in acid lime (Pooled mean 2014-15 to 2018-19)

Treatment	Juice (%)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/100 ml juice)	Number of seeds / fruits	Weight of seeds / Fruit (g)	Rind thickness (mm)
T ₁	46.09	7.11	6.49	30.75	8.39	0.58	1.50
T ₂	47.16	7.08	6.56	30.27	8.36	0.56	1.48
T ₃	47.55	7.07	6.53	31.79	8.53	0.56	1.43
T ₄	49.08	7.46	6.85	32.85	7.80	0.51	1.36
T ₅	44.67	7.07	6.15	30.55	9.14	0.63	1.52
S. E. \pm	0.55	0.15	0.06	0.51	0.20	0.04	0.02
C. D. at 5 %	1.67	NS	0.19	1.53	0.61	NS	0.06

Table-3 Economics on effect of stage wise application of irrigation water in acid lime (2018-19)

Treatment	Total Expenditure (Rs/ha)	Yield (t/ha) Pooled mean	Gross monetary return (Rs/ha)	Net Profit (Rs/ha)	B:C ratio
T ₁	1,64,572=47	9.31	2,32,750=00	68,177=53	1.41
T ₂	1,66,634=00	9.79	2,44,750=00	78,116=00	1.46
T ₃	1,69,508=83	10.46	2,61,500=00	91,991=17	1.54
T ₄	1,70,593=78	10.71	2,67,750=00	97,156=22	1.56
T ₅	1,61,677=52	8.62	2,15,500=00	53,822=48	1.33

Table-4 Stage wise mean water requirement of acid lime through drip irrigation system (litre/plant/stage) (Mean 2014-15 to 2018-19)

Treatment	Stage-I (Jan-Feb)	Stage-II (Mar-April)	Stage-III (May-June)	Stage-IV (July-Aug)	Stage-V (Sept-Oct)	Stage-VI (Nov-Dec)	Total
T ₁	669.60	1414.80	1105.20	702.00	568.80	763.20	5223.60
T ₂	892.80	2124.00	1472.40	1051.20	759.60	1144.80	7444.80
T ₃	1339.20	2833.20	2210.40	1400.40	1137.60	1526.40	10447.20
T ₄	1785.60	2833.20	2948.40	1400.40	1515.60	1526.40	12009.60
T ₅	669.60	1062.00	1105.20	525.60	568.80	572.40	4503.60

Table-5 Stage wise mean water requirement of acid lime through drip irrigation system (cm/plant/stage) (Mean 2014-15 to 2018-19)

Treatment	Stage-I (Jan-Feb)	Stage-II (Mar-April)	Stage-III (May-June)	Stage-IV (July-Aug)	Stage-V (Sept-Oct)	Stage-VI (Nov-Dec)	Total
T ₁	1.86	3.93	3.07	1.95	1.58	2.12	14.51
T ₂	2.48	5.9	4.09	2.92	2.11	3.18	20.68
T ₃	3.72	7.87	6.14	3.89	3.16	4.24	29.02
T ₄	4.96	7.87	8.19	3.89	4.21	4.24	33.36
T ₅	1.86	2.95	3.07	1.46	1.58	1.59	12.51

The economics of various treatments of irrigation levels and at different stages on benefit: cost ratio is shown in [Table-3]. The treatment T₄ i.e., application of irrigation water at 80:80:80:80:80 ER % from stage-I (January-February) to stage-VI (November-December) was found superior and recorded higher benefit: cost ratio (1.56) over rest of the treatments. Similar results were reported by Shirgure *et al.* (2002) [12] in acid lime and Barua and Hazarika (2014) [13] in Assam lemon.

The mean data (2014-15 to 2018-19) presented in [Table-4] and [Table-5] indicated the stage wise mean water requirement of acid lime cv. Phule Sharbati through drip irrigation system in litre/plant/stage and in cm/plant/stage, respectively. The total water applied at different treatments was in the range of 4503.60 litre / plant / stage (12.51 cm / plant / stage) to 12009.60 litre / plant / stage (33.36 cm / plant / stage) in drip method of irrigation i. e. from stage-I (January-February) to stage-VI (November-December). The total water required

was less in the treatment T₅ i.e., application of irrigation water at 30:30:30:30:30 ER % as compared to all other treatments. The quantity of water use was more during the summer months due to low relative humidity and higher temperature and transpiration. Irrigation was not given during rainy period due to lower cumulative pan evaporation than rainfall amount. Similar studies on water use in Citrus crops has been reported by Mageed *et al.* (1988) [14] in Kinnow mandarin, Shirgure *et al.* (2000) [15] and Shirgure *et al.* (2003) [16] in acid lime and Kumar *et al.* (2013) [17] in Sathgudi sweet orange.

Conclusion

Considering five years study of stage wise application of irrigation water, it is seen that the application of irrigation water at 80:80:80:80:80 ER % from stage-I (January-February) to stage-VI (November-December) was found better in promoting growth, yield and fruit quality in acid lime cv. Phule Sharbati.

Application of research: To study the effect of stage wise application of irrigation water on growth, yield and fruit quality of acid lime cv. Phule Sharbati.

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Research Category: ICAR-AICRP on Fruits Research trial

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Cultivar / Variety / Breed name: Acid lime (*Citrus aurantifolia* Swingle) cv. Phule Sharbati.

Conflict of Interest: None declared.

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Ethical Committee Approval Number: Nil

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