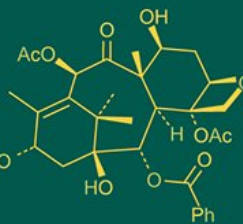
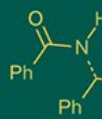


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Irrigation and fertigation studies in summer brinjal (*Solanum melongena* L.)

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Abstract

The experiment was carried out to study the effect of irrigation levels and fertigation schedules on growth and yield of summer brinjal (*Solanum melongena* L.) during the summer season of 2019-20 and 2020-21, at Instructional Farm, College of Horticulture, Akola. The research experiment laid out in Strip Plot Design consist of three irrigation levels viz., I₁ (60% of irrigation water requirement), I₂ (80% of irrigation water requirement) and I₃ (100% of irrigation water requirement) and three fertigation schedules viz., S₁ (RDF at 3 days interval), S₂ (RDF at 6 days interval) and S₃ (RDF at 9 days interval) with three replications. The results of the experiment revealed that, maximum plant height at 30 DAT (24.80 cm and 28.83 cm) and 120 DAT (84.36 cm and 86.50), plant spread at 30 DAT (20.20 cm and 24.20 cm) and 120 DAT (76.20 cm and 81.85 cm), number of branches at 30 DAT (5.20 and 6.80) and 120 DAT (12.00 and 13.07) and fruit yield per hectare (367.49 q/ha and 406.55 q/ha) recorded under application of 100% irrigation level along with fertigation schedule at 6 days interval recorded which was at par with treatment 80% irrigation level along with fertigation schedule at 6 days interval.

Keywords: Brinjal, irrigation, fertigation, fertigation scheduling

Introduction

Brinjal (*Solanum melongena* L.) belongs to the solanaceae family is a popular vegetable crop grown in the subtropics and tropics. India is regarded as centre of origin and diversity of brinjal. It is a typical day neutral plant. The brinjal responds well under slightly acidic soils, having pH in the range of 5.5 - 6.5. However, pH upto 7.5 is also suitable.

Water plays vital role in improving plant growth and crop production. It is the most limiting factor in Indian agricultural scenario. Water saving from drip irrigation system varied from 50 to 75% for different crops besides increasing the production of crops. Due to limiting factor, efficient use of available irrigation water is essential for increasing agricultural production for the alarming Indian population. Water availability for irrigation is going to be a major constraint for agriculture in near future. Hence, judicious use of the available water resources through more efficient methods of water application like drip irrigation under precision farming or cultivation becomes necessary to enhance yield and water use efficiency (Dunage *et al.*, 2010)^[1]. Irrigation is one of the essential inputs for brinjal cultivation where there is little or no rain during the growing season mainly in summer. Water being a limited resource, its efficient use is a basis for survival of agriculture all over the world. Amongst those pressurized irrigation methods, drip irrigation has proved its superiority over other methods of irrigation due to the direct application of water and nutrients in the vicinity of root zone. In precision agriculture, it is one of the most effective ways to supply water and nutrients to plant, which not only saves water but also increases the yield of fruits and vegetable crops. It places water into the root zone directly and minimize evaporation. It also restricts to grow the weeds and prevents the soil erosion. Drip irrigation under plastic mulch is an effective way of supplying water efficiently mainly in summer brinjal.

Fertigation facilitates a variety of benefits to the users like high crop productivity, quality, resource use efficiency, environmental safety, flexibility in field operations, effective weed management and successful crop cultivation in fields with undulating topography. Regular and unbalanced use of chemical fertilizers leads in the end to a decrease in the base saturation and to acidification of soil. Hence, judicious use of fertilizers needs to be

addressed. Fertigation facilitates the enhanced mobility, availability and uptake of applied nutrients because of higher soil moisture content and more frequent application of fertilizers, corresponding to quantitative and timely demand by the crops. Fertigation scheduling is a critical management input to ensure optimum soil nutrients status for proper plant growth and development as well as for optimum yield and economic benefits (Vijayakumar *et al.*, 2010) [8]. Therefore, it is essential to develop fertigation scheduling strategies under local climatic conditions to utilize scarce water resources efficiently and effectively. Appropriate fertigation scheduling is to increase fertilizer efficiencies by applying the balance amount of fertilizer needed to replenish the soil nutrients to desire level, saves nutrients resources and energy. Therefore, it is important to develop fertigation scheduling techniques under prevailing climatic conditions in order to utilize scarce nutrients resources effectively for crop production.

Materials and Methods

Field experiment

The field experiment was conducted at Instructional Farm, Department of Vegetable Science, College of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during summer season 2019-2020 and 2020-21. The climate of Akola is semi-arid and characterized by three distinct seasons viz. hot and dry summer from March to May, warm and rainy monsoon from June to October and mild cold winter from November to February. The normal mean monthly maximum temperature is 42.5°C during the hottest May, while, the normal mean monthly minimum temperature is 10.6°C in the coldest December.

Experiment was set out in strip plot design with three different irrigation levels i.e. Irrigation (I₁): 60 % of irrigation water requirement, Irrigation (I₂): 80 % of irrigation water requirement and Irrigation (I₃): 100 % of irrigation water requirement and three fertigation schedule viz., schedule (S₁) 3 days interval, schedule (S₂) 6 days interval and schedule (S₃) 9 days interval. Four week old seedlings of brinjal cv. Krishna were transplanted in second week of February with spacing 120*60 cm in broad bed furrow. Transplanting was done in the early morning hours. Light irrigation was applied just after the transplanting and the gap filling was done seven days after transplanting. The recommended fertilizer dose of 150:75:75 N:P:K kg/ha was taken.

The amount of water applied under drip irrigation was computed on the basis of crop coefficient, canopy factor, pan coefficient, area and pan evaporation and replenished at every alternate day considering the cumulative pan evaporation of two days. Water requirement was calculated by using Dick Krupp's formula

$$Q = A \times B \times C \times D$$

Where,

Q	= Water requirement per plant (lit/plant)
A	= $ET_o = E_{pan} \times K_p$ (mm)
B	= Crop coefficient (K_c)
C	= Canopy factor
D	= Canopy area allotted per plant (m^2)
E_{pan}	= Cumulative evaporation for two days
K_p	= Pan coefficient (0.8)

Statistical Analysis

The data on various parameters collected from the experiment were statistically analysed by analysis of variance (ANOVA) for strip plot design. Critical difference was worked out at five per cent probability level when the treatment differences were found significant and the values were furnished. The treatment differences that were not significant were denoted by non- significant.

Results and Discussion

Growth parameter

The data regarding plant height of brinjal (Table 1) at 30 DAT and 120 DAT was significantly influenced by the irrigation level and fertigation schedules. The data clearly indicated that, the maximum plant height of brinjal at 30 DAT (24.80 cm and 28.83 cm) and 120 DAT (84.36 cm and 86.50 cm) was found in the irrigation level I₃ (100 % irrigation water requirement) with fertigation schedule S₂ (RDF at 6 days interval) and similarly the minimum plant height (17.50 cm and 20.70 cm) and (71.47 cm and 74.30 cm) was found in the I₁S₃ (60% irrigation water requirement with RDF at 9 days interval). The decrease in plant height at 60% irrigation requirement was due to the development of water deficit in plant tissue resulting in decline in leaf water content as well as reduction in both cell volume and cell turgor. The increase in plant height due to 100% irrigation requirement through drip must be due to soil moisture always remains at field capacity because of that, plant absorbs more moisture and nutrients from soil which reflected in increase in cell turgidity and cell elongation. Similar results were recorded by the earlier worker Antony and Singandhupe in capsicum, Sezen *et al.* in bell paper, Al-Harbi *et al.* in okra, Chauhan *et al.* in chilli. This might be due to frequent supply of fertilizers through drip irrigation in the vicinity of root zone so that the nutritional requirement of crop is met leading to maximum absorption and translocation of nutrients resulting in increased cell size, cell elongation, cell multiplication and enhanced net assimilation rate, hence more plant height. These results were in accordance with Kadale and Shrikrishna (2002) [2] and Yasser *et al.* in tomato, Prabhakara *et al.* (2010) [4] and Reddy *et al.* (2016) [5] in chilli.

The data regarding plant spread of brinjal (Table 2) at 30 DAT and 120 DAT were significantly influenced by the irrigation level and fertigation schedules. The data clearly indicated that, the maximum plant spread at 30 DAT (20.20 cm and 24.20) and 120 DAT (76.20 and 81.55) were found in the irrigation level I₃ (100% irrigation water requirement) with fertigation schedule S₂ (RDF at 6 days interval) and similarly the minimum plant spread (16.00 and 80.40) and (65.07 and 73.87) were found in the I₁S₃ (60% irrigation water requirement with RDF at 9 days interval). This might be due to sufficient soil moisture available for pronounced crop growth which supported in maximum absorbance of moisture and nutrients by crop and reflected in maximum plant height, more number of branches and leaves which leads to increased plant spread. Adequate and frequent supply of fertilizers through drip irrigation in the vicinity of root zone so that with optimum level of irrigation which enhances the nutrient use efficiency of added nutrients which further increases physiological and biochemical activities for healthy crop growth. Similar

results are recorded by Gupta *et al.* (2009) ^[6] in capsicum and Danawale (2013) ^[7] in tomato.

The data regarding number of branches (Table 3) at 30 DAT and 120 DAT was significantly influenced by the irrigation level and fertigation schedules. The data clearly indicated that, the maximum number of branches at 30 DAT (5.20 and 6.80) and 120 DAT (12.00 and 13.07) was found in the irrigation level I3 (100 % irrigation water requirement) with fertigation schedule S2 (RDF at 6 days interval) and similarly the minimum number of branches (3.00 and 3.70) and (9.10 and 9.40) was found in the I1S3 (60% irrigation water requirement with RDF at 9 days interval). This is might be due to the fact that, crop fulfil its demand of water and nutrient due to optimum irrigation and nutrient supply near the root zone of plant, which might ultimately affect on plant growth and number of branches. The results are agreement with the finding of Vijaykumar in brinjal, Danawale (2013) ^[7] in tomato, Dahiphale (2021) ^[9] in cauliflower and Thange (2023) ^[10] in watermelon.

The treatment combination 100% irrigation requirement with RDF at every 6 days interval up to 130 days after transplanting registered maximum fruit yield per hectare (367.49 and 406.55) which was at par with treatment 80% irrigation water requirement with RDF at 6 days interval. Similarly the minimum fruit yield per hectare (267.40 and 284.29) was found in the I1S3 (60% irrigation water requirement with RDF at 9 days interval). This might be due to 100% irrigation requirement, brinjal crop experienced non stress condition owing to its luxuriant growth, more absorbed PAR, photosynthesis rate and dry matter accumulation with nutrient application. Frequent fertigation in smaller quantity results in enhanced nutrient use efficiency resulted increase fruit yield per plant and fruit yield per hectare. This results are in confirmity with Rajput and Patel (2006) ^[11] in onion, Gupta *et al.* (2009) ^[6] in capsicum, Vijaykumar in brinjal, Danawale (2013) ^[7] in tomato, Der *et al.* (2018) ^[12] in garlic, Maind *et al.* (2018) ^[13] in chilli.

Table 1: Effect of irrigation levels and fertigation schedules on plant height

Plant height (cm) at 30 DAT												
Treatment	2019-20				2020-21				Pooled			
	Fertigation schedules (S)				Fertigation schedules (S)				Fertigation schedules (S)			
Irrigation levels (I)	S1 3 Days	S2 6 Days	S3 9 Days	Mean	S1 3 Days	S2 6 Days	S3 9 Days	Mean	S1 3 Days	S2 6 Days	S3 9 Days	Mean
I1 60%	18.50	19.40	17.50	18.47	21.90	23.10	20.70	21.90	20.20	21.25	19.10	20.18
I2 80%	21.20	24.03	20.60	21.94	24.70	27.68	23.70	25.36	22.95	25.86	22.15	23.65
I3 100%	22.10	24.80	21.80	22.90	25.70	28.83	25.09	26.54	23.90	26.82	23.44	24.72
Mean	20.60	22.74	19.97		24.10	26.54	23.16		22.35	24.64	21.56	
	I	S	IXS		I	S	IXS		I	S	IXS	
F'test	Sig	Sig	Sig		Sig	Sig	Sig		Sig	Sig	Sig	
SE(m)±	0.10	0.06	0.19		0.10	0.11	0.25		0.09	0.09	0.14	
CD at 5%	0.40	0.22	0.62		0.41	0.45	0.81		0.24	0.24	0.40	
Plant height (cm) at 120 DAT												
I1 60%	73.01	75.30	71.47	73.26	76.75	77.81	74.30	76.29	74.88	76.56	72.88	74.77
I2 80%	76.97	83.00	77.09	79.02	78.47	85.63	78.43	80.84	77.72	84.31	77.76	79.93
I3 100%	81.20	84.36	79.40	81.65	84.30	86.50	81.40	84.07	82.75	85.43	80.40	82.86
Mean	77.06	80.89	75.99		79.84	83.31	78.04		78.45	82.10	77.02	
	I	S	IXS		I	S	IXS		I	S	IXS	
F'test	Sig	Sig	Sig		Sig	Sig	Sig		Sig	Sig	Sig	
SE(m)±	0.38	0.39	0.51		0.30	0.75	0.84		0.30	0.30	0.52	
CD at 5%	1.50	1.51	1.66		1.18	2.96	2.74		0.86	0.86	1.49	

Table 2: Effect of irrigation levels and fertigation schedules on plant spread

Plant spread (cm) at 30 DAT												
Treatment	2019-20				2020-21				Pooled			
	Fertigation schedules (S)				Fertigation schedules (S)				Fertigation schedules (S)			
Irrigation levels (I)	S1 3 Days	S2 6 Day	S3 9 Days	Mean	S1 3 Days	S2 6 Day	S3 9 Days	Mean	S1 3 Days	S2 6 Day	S3 9 Days	Mean
I1 60%	16.80	17.00	16.00	16.60	19.20	19.80	18.40	19.13	18.00	18.40	17.20	17.87
I2 80%	17.60	19.57	17.08	18.08	20.80	23.40	21.60	21.93	19.20	21.48	19.34	20.01
I3 100%	18.80	20.20	18.40	19.13	22.80	24.20	20.20	22.40	20.80	22.20	19.3	20.77
Mean	17.73	18.92	17.16		20.93	22.47	20.07		19.33	20.69	18.61	
	I	S	IXS		I	S	IXS		I	S	IXS	
F'test	Sig	Sig	Sig		Sig	Sig	Sig		Sig	Sig	Sig	
SE(m)±	0.09	0.09	0.17		0.08	0.06	0.19		0.13	0.13	0.23	
CD at 5%	0.33	0.36	0.55		0.30	0.25	0.62		0.38	0.38	0.66	
Plant spread (cm) at 120 DAT												
I1 60%	66.20	68.17	65.07	66.48	74.62	76.20	73.87	74.90	70.41	72.18	69.47	70.69
I2 80%	71.30	75.28	70.00	72.19	78.83	81.26	76.50	78.86	75.06	78.27	73.25	75.53
I3 100%	73.54	76.20	72.80	74.18	79.20	81.85	78.30	79.78	76.37	79.02	75.55	76.98
Mean	70.35	73.22	69.29		77.55	79.77	76.22		73.95	76.49	72.76	
	I	S	IXS		I	S	IXS		I	S	IXS	
F'test	Sig	Sig	Sig		Sig	Sig	Sig		Sig	Sig	Sig	
SE(m)±	0.37	0.23	0.31		0.24	0.24	0.32		0.23	0.23	0.39	
CD at 5%	1.43	0.90	1.02		0.96	0.93	1.05		0.66	0.66	1.120	

Table 3: Effect of irrigation levels and fertigation schedules on number of branches

Number of branches at 30 DAT												
Treatment	2019-20				2020-21				Pooled			
	Fertigation schedules (S)				Fertigation schedules (S)				Fertigation schedules (S)			
Irrigation levels (I)	S1 3 Days	S2 6 Days	S3 9 Days	Mean	S1 3 Days	S2 6 Days	S3 9 Days	Mean	S1 3 Days	S2 6 Days	S3 9 Days	Mean
I1 60%	3.40	3.60	3.00	3.33	4.00	4.40	3.70	4.03	3.70	4.00	3.35	3.68
I2 80%	4.20	4.90	3.80	4.30	5.60	6.30	4.80	5.57	4.90	5.60	4.30	4.93
I3 100%	4.60	5.20	4.20	4.67	6.00	6.80	5.60	6.13	5.30	6.00	4.90	5.40
Mean	4.07	4.57	3.67		5.20	5.83	4.70		4.63	5.20	4.18	
	I	S	IXS		I	S	IXS		I	S	IXS	
F'test	Sig	Sig	Sig		Sig	Sig	Sig		Sig	Sig	Sig	
SE(m)±	0.03	0.03	0.07		0.02	0.03	0.07		0.05	0.05	0.09	
CD at 5%	0.10	0.11	0.22		0.08	0.10	0.21		0.15	0.15	0.26	
Number of branches at 120 DAT												
I1 60%	10.50	10.20	9.10	9.93	10.40	10.80	9.40	10.20	10.45	10.50	9.25	10.07
I2 80%	11.60	11.80	10.60	11.33	11.40	12.78	10.70	11.63	11.50	12.29	10.65	11.48
I3 100%	11.70	12.00	11.50	11.73	12.00	13.07	11.80	12.29	11.85	12.53	11.65	12.01
Mean	11.27	11.33	10.40		11.27	12.21	10.63		11.27	11.77	10.52	
	I	S	IXS		I	S	IXS		I	S	IXS	
F'test	Sig	Sig	Sig		Sig	Sig	Sig		Sig	Sig	Sig	
SE(m)±	0.04	0.03	0.10		0.06	0.04	0.14		0.07	0.07	0.12	
	0.15	0.13	0.32		0.23	0.16	0.44		0.19	0.19	0.33	

Table 4: Effect of irrigation levels and fertigation schedules on fruit yield per hectare

Yield (q/ha)												
Treatment	First year				Second year				Pooled			
	Fertigation schedules (S)				Fertigation schedules (S)				Fertigation schedules (S)			
Irrigation levels (I)	S1 3 Days	S2 6 Day	S3 9 Days	Mean	S1 3 Days	S2 6 Day	S3 9 Days	Mean	S1 3 Days	S2 6 Day	S3 9 Days	Mean
I1 60%	293.42	314.72	267.40	291.84	324.37	344.41	301.19	323.33	308.90	329.57	284.29	307.59
I2 80%	323.21	361.50	292.60	325.77	345.08	398.46	327.25	356.93	334.15	379.98	309.92	341.35
I3 100%	348.74	367.49	322.12	346.12	382.72	406.55	357.53	382.27	365.73	387.02	339.83	364.19
Mean	321.79	347.90	294.04		350.72	383.14	328.66		336.26	365.52	311.35	
	I	S	IXS		I	S	IXS		I	S	IXS	
F'test	Sig	Sig	Sig		Sig	Sig	Sig		Sig	Sig	Sig	
SE(m)±	2.19	2.00	3.39		4.2	2.9	4.8		2.78	2.31	3.87	
CD at 5%	8.59	7.86	11.05		16.6	11.4	15.5		10.90	9.08	12.61	

Conclusion

The results of data revealed that for obtaining better plant height, plant spread, number of branches and fruit yield of brinjal per hectare 80 % of irrigation water requirement with recommended dose of fertilizer in 6 days interval through fertigation was found to be significant.

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