International Journal of Bioresource Science
Citation: IJBS: 6(2): 51-55, December 2019
DOI: 10.30954/2347-9655.02.2019.1

To Study About Yield and Yield Attribute Parameter on Tube Rose by Application of Different Irrigation Treatments in West Bengal

Arunabha Pal*, Rahul Adhikary, Rohit Garanayak and Monisankar Bera

Centurion University of Technology and Management, Parlakhemundi, Gajapati, Odisha, India

*Corresponding author: arunabha@cutm.ac.in

Received: 21-06-2019 **Revised:** 17-10-2019 **Accepted:** 23-11-2019

ABSTRACT

A field experimental was conducted at Departmental Experimental Field, Department of Soil and Water Conservation, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, during March, 2009 to March 2010 on "Water requirement of tuberose" with three varieties of tuberose (Prajwal, Calcutta Single, Calcutta Double) along with three irrigation treatments on IW/CPE 0.4, 0.8, 1.0. for the Prajwal, Calcutta single and Calcutta double, respectively. The different irrigation schedules regardless of the crop varieties on the number of spike per plot were significant. The maximum spike per plot was recorded at 1.0 IW/CPE which gave about 33.15 number of spike per plot, which was superior to 0.8 IW/CPE (32.25) and 0.4 IW/CPE (30.57). The lowest number of spike per plot was shown by the drier moisture regimes, while the highest number of spike per plot was recorded by the wetted moisture regimes. The economic analysis of tuberose showed that the higher net reruns was recorded at higher moisture regime (IW/CPE at 1.0) followed by intermediate moisture regime (IW/CPE at 0.8) and lower moisture regime (IW/CPE at 0.4).

Keywords: IW/CPE irrigation method, Yield

Tuberose (*Polianthes tuberosa* L.) is more popularly known as 'Rajanigandha' one of the most important commercially grown traditional flower crop in India. The lingering delightful fragrance and its excellent keeping quality are the predominant characteristic this crop. It is valued much by the aesthetic world beauty and fragrance. It occupies a very selective and prestigious position because of its pettiness, elegance and sweet pleasant fragrance. It has grained importance and cultivated commercially for its valued natural flower oil, for artistic garlands floral ornaments, bouquets, and button holes. The leaves are long narrow, liner, grass like bright green in color. The important part of plant is inflorescence (spike) and florets. The flowers are funnel shaped fragment, waxy white. The flowers are four types single, double semi-double and variegated. The long flower spikes are excellent as (Dalai *et al*. 1999) cut flower for room and table decoration.

Tube rose belongs to the family Amaryllidaceae and is native of Mexico. Tuberose is extensively cultivated in many part of topical and sub-tropical areas of the world like, France South Africa, China, Egypt, Italy, North Carolina, United states of America and many tropical and sub-tropical countries including India.

At present the total area under tuberose cultivation in the country is estimated at about 15,000ha (Singh and Singh, 2006). In India tube rose grown in large scale in West Bengal Karnataka, Tamil Nadu, Maharastra. Among the West Bengal occupied leading position in area 3000 ha (Biswas *et al.* 2002). In West Bengal Total production 25.6 cores spikes/ha with the productivity of 1, 26,000 spike/ha (Nabard, 1997). The tube rose commercial production in West Bengal.

MATERIALS AND METHODS

The experimental was conducted at Departmental Experimental Field, department of Soil and Water Conservation, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal to study Water Requirement of tuberose. The farm where the experiment was conducted is situated at 22°56′ North latitude and 88°32′ East longitude with an average elevation of 9.75 meter above Mean Sea Level. Tuberose (*Polianthes tuborosa* L.) is a perennial crop. The experiment on water requirement of tuberose was conducted during March, 2009 to March 2010. The planting job was completed on 9th March, 2009 during the *kharif* season.

Table 1: Physical properties of the soil

Depth (cm)	Bulk density (g/cc)	Particle density (g/cc)	Porosity (%)	Pore space (%)
0-15	1.5	2.99	49.05	52.14
15-25	1.3	2.93	52.81	54.41
25-35	1.4	3.19	53.79	56.67

Note: *Done by Keen Rackzoskii's box (Piper, 1966).*

Table 2: Physico-chemical properties of the soil

Particular	Value
Soil pH	6.32
Organic Carbon (g kg^{-1})	0.62

Note: *pH of soil by pH Meter in 1:2.5 soil water suspension and EC by Walkley and Black (Jackson, 1973).*

Table 3: Experimental details

Irrigation levels	: 0.4 IW/CPE (Depth of irrigation 3cm) 0.8 IW/CPE (Depth of irrigation 3cm) 1.0 IW/CPE (Depth of irrigation 3cm)
Varieties	: Prajwal Calcutta Single Calcutta Double
Number of replications	: 3
Design of experiment	: Factorial RBD
Total no. of plots	: 3 × 3 × 3 = 27
Size of each plot	: 1.2m × 1.0m = $1.2m^2$
Total plot area	: $32.4m^2$
Spacing between two plot	: 0.04m
Plant spacing	: 0.03m × 0.03 m
No of plants per plot	: 12

Water requirement of crops

Water requirement of a crop refers to the amount of water required to raise a successful crop in a given period. It comprises the water lost as evaporation from crop field, water transpired and metabolically used by crop plants, water lost during application which is economically unavoidable and the water used for special operations such as land preparation, puddling of soil, salt leaching and so on. The estimate of crop water requirement is one of the basic needs for crop planning in common areas and planning of any irrigation project.

$$ETc = Kc \times ETo \qquad \ldots(1)$$

Where, ETc = Crop water requirements to meet actual evaporation demand, Kc = Crop coefficient and ETo = Reference crop evapotranspiration

$$\text{Again, } ETo = Kpan \times Epan \qquad \ldots(2)$$

Where, ETo = Reference crop evapotranspiration, Kpan = Pan coefficient and Epan = Pan evaporation

The influence of the climate on crop water needs is given by the reference crop evapotranspiration (ETo). The ETo is usually expressed in millimetres per unit of time, i.e. mm/day, mm/month, or mm/season.

Equation (1) is used to compute the daily value of ETc. From the daily values, monthly values of ETc for each plant on any month can be compute by multiplying the daily values of ETc with number of days of that month, area occupied by each plant and the percentage of canopy area occupied by the plant.

Irrigation Requirement of different varieties of tuberose

The irrigation requirement of crop (IR) can be obtained from the following formula was given by Michael, 1970) and stated below:

$$IR = ETc - (M + Gw + ER) \qquad \ldots(3)$$

Where, M = Available soil moisture content in root zone of crops, Gw = Ground water contribution and ER = Effective rainfall

Ground water contribution (Gw) to meet the irrigation requirement of crop is neglected since in the area under study, water table lies more than 2.5 m below the ground water surface. It is assumed that the carry over moisture content before and after a decision period remain same as it is difficult to get the value of "M" under variable weather condition in farmers' field condition. Thus the net irrigation requirement (IR) is compute as,

$$IR = ETc - ER \quad \ldots(4)$$

So, monthly net volume of water to be applied as irrigation is,

$$V = (ETc - ER) \times A \times Wp \quad \ldots(5)$$

Where, V = Monthly irrigation requirement, A = Area occupied by each plant and Wp = Percentage of canopy area which is assumed as 50% during initial crop growth stage and 75% during other stage (Dhal, 1999;). The term ETc and ER are defined earlier.

RESULTS AND DISCUSSION

The value of crop evapotranspiration (ETc) for three varieties were calculating Eq.(1). Values of ETo of Eq (1) were computed by pan evaporation method. Values of pan coefficient as used in pan evaporation method is assumed as 0.7. ETo values were computed on daily basis from which monthly values were calculated. The monthly crop water requirements for tuberose were calculated by multiplying Kc value with ETo for each month. The monthly ETc was converted to volumetric basis ETc requirement per plant by multiplying the ETc computed as above by the canopy area of each plant (Dhal, 1999) and shown in Table 6. All the rainfall that occurs during a crop growing season is not 100% effective. 70% of the rainfall was taken as ER. Monthly ER values were converted to depth basis and volumetric basis availability per plant by multiplying the ER computed as above by the canopy area of each plant during each crop growing stage and is shown in table 7 – 8. Finally, monthly irrigation requirement per plant was computed by using the data of ETc and ER.

Table 4: Irrigation requirement on three irrigation levels in three varieties of tuberose

Irrigation schedule	No. of irrigation	Depth of irrigation/plot (mm)	Total volume of irrigation/plot (m^3)
0.4 IW/CPE	8	240	0.288
0.8 IW/CPE	17	510	0.582
1.0 IW/CPE	21	630	0.630

Note: *Depth of irrigation (IW) applied in each irrigation 30 mm.*

In comparison with three irrigation levels based in IW/CPE ratio (Table 4), the total volume of irrigation water required for 0.4 IW/CPE ratio was 0.288 m^3 followed by 0.8 IW/CPE ratio was 0.582 m^3 and 1.0 IW/CPE was 0.630 m^3.

Plant height and Leaf/plant

The application of irrigation based on IW/CPE ratio revealed that plant height of tuberose consistently increased with the increasing moisture regimes (Table 5). However, the highest plant height of 54.97 and 105.12 was obtained with the irrigation at 1.0IW/CPE ratio, which was superior to other irrigation treatments.

Diameter of Spike and Flower/spike

The diameter of spike, irrespective of the varieties of tuberose, was not significant under the influenced of irrigation levels based on IW/CPE ratios (Table 6). Maximum diameter of spike (3.35 cm) was observed at 1.0 IW/CPE ratio and the minimum diameter of spike (3.25 cm) was shown at irrigation schedule of 0.4 IW/CPE ratios. The number of flower per spike, irrespective of the varieties of tuberose, was not significant under the influenced of irrigation levels based on IW/CPE ratios (Table 6). Maximum flower per spike (31.80) was observed at 1.0 IW/CPE ratio and the minimum number of flower/ spike (31.40) was recorded by irrigation schedule of 0.8 IW/CPE ratios.

Spike per plant

The different irrigation schedules regardless of the crop varieties on the number of spike per plot were significant (Table 7). The maximum spike per plot was recorded at 1.0 IW/CPE which gave about 33.15 number of spike per plot, which was superior to 0.8 IW/CPE (32.25) and 0.4 IW/CPE (30.57).

Table 5: Effects of irrigation levels on plant height and leaf per plant of three varieties of tuberose

Treatment	Plant height (cm)				Leaf/plant			
	Variety			Mean	Variety			Mean
	V1	V2	V3		V1	V2	V3	
I1	55.32	53.60	52.71	53.87	79.2	109.4	118.7	102.46
I2	55.61	53.22	52.75	53.86	86.8	108.0	118.9	104.54
I3	56.29	54.95	53.67	54.97	82.5	111.9	122.1	105.52
Mean	55.74	53.92	53.04	—	82.84	109.78	119.91	—
	I	V	I × V		I	V	I × V	
SEm(±)	0.27	0.27	0.47		1.76	1.76	3.04	
CD (5%)	0.81	0.81	NS		NS	5.26	NS	

Note: *I1 = Irrigation at 0.4 IW/CPE, I2 = Irrigation at 0.8% IW/CPE, I3 = Irrigation at 1.0 IW/CPE and V1 = Variety Prajwal, V2 = Variety Calcutta single, V3 = Variety Calcutta double*

Table 6: Effects of irrigation levels on diameter of spike and flower per spike of three varieties of tuberose

Treatment	Diameter of spike (cm)				Flower/spike			
	Variety			Mean	Variety			Mean
	V1	V2	V3		V1	V2	V3	
I1	3.1	3.3	3.4	3.27	30.8	31.5	32.5	31.60
I2	3.2	3.4	3.4	3.33	30.3	31.4	32.6	31.39
I3	3.1	3.3	3.5	3.35	29.6	31.6	34.3	31.84
Mean	3.15	3.36	3.41	-	30.22	31.50	33.12	-
	I	V	I x V		I	V	I x V	
SEm(±)	0.05	0.05	0.08		0.38	0.38	0.66	
CD (5%)	NS	0.14	NS		NS	1.14	NS	

Note: *I1 = Irrigation at 0.4 IW/CPE, I2 = Irrigation at 0.8% IW/CPE, I3 = Irrigation at 1.0 IW/CPE and V1 = Variety Prajwal, V2 = Variety Calcutta single, V3 = Variety Calcutta double.*

Table 7: Effects of irrigation levels on spike per plot of three varieties of tuberose

Treatment	Spike /plot			
	Variety			Mean
	V1	V2	V3	
I1	26.30	31.90	33.50	30.57
I2	30.75	32.60	33.40	32.25
I3	31.95	32.65	34.84	33.15
Mean	29.67	32.38	33.91	
	I	V	I × V	
SEm(±)	0.21	0.15	0.41	
CD (5%)	0.64	0.45	1.22	

Note: *I1 = Irrigation at 0.4 IW/CPE, I2 = Irrigation at 0.8% IW/CPE, I3 = Irrigation at 1.0 IW/CPE and V1 = Variety Prajwal, V2 = Variety Calcutta single, V3 = Variety Calcutta double*

Economics

The economic analysis of tuberose under three irrigation levels is given in Table 9 for computing the net profit and benefit cost ratio, the prevailing cost of cultivation and the gross return from the flower crop as per market value was taken into consideration.

The result showed that the higher net reruns was recorded at higher moisture regime (IW/CPE at 1.0) followed by intermediate moisture regime (IW/CPE at 0.8) and lower moisture regime (IW/CPE at 0.4). However, the benefit-cost ratio was just opposite to net return values. This indicated that the economic yield of tuberose was not high enough in response to the higher irrigation regimes, thereby giving

Table 8: Water use and water use efficiency of tuberose under different irrigation regimes

Treatment	*Profile contribution (mm)	Irrigation (mm)	Rainfall (mm)	Total water use (mm)	Economic yield (spike/ plot)	Water use efficiency (spike/ plot/cm)
0.4 IW/CPE	22.70	240	1319	1581.7	30.57	0.193
0.8 IW/CPE	32.10	510	1319	1861.1	32.25	0.173
1.0 IW/CPE	35.70	630	1319	1984.7	33.15	0.167

**AICRP on Water Management, BCKV, 2009-2010, PP: 40-46.*

lesser gross return as well as the net return values as compared to the lower moisture regime.

Table 9: Economics of tuberose cultivation under different moisture regimes

Particulars	Irrigation levels		
	0.4 IW/ CPE	**0.8 IW/ CPE**	**1.0 IW/ CPE**
Cost of Cultivation (₹/ha)	125000	135000	140000
Yield (Spike/ha)	254750	268750	276250
Selling price (₹/ spike)	0.75	0.75	0.75
Gross return (₹/ha)	191062	201562	207187
Net return (₹/ha)	66062	66562	67187
Benefit : cost ratio	0.53 : 1	0.49 : 1	0.48 : 1

SUMMERY AND CONCLUSION

The higher water use was observed at higher levels of irrigation water application. Conversely, the highest water use efficiency was observed at lower levels of irrigation application in comparison to higher levels of irrigation ascribed due to more application of irrigation water to crop.

The economic analysis of tuberose showed that the higher net reruns was recorded at higher moisture regime (IW/CPE at 1.0) followed by intermediate moisture regime (IW/CPE at 0.8) and lower moisture regime (IW/CPE at 0.4). However, the benefit-cost ratio was just opposite to net return values.

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