

Water Requirement of Pomegranate (*Punica granatum* L.) Orchards for Season December-July (Ambe Bahar)

Arun Bhagat¹, Pramod Popale²

¹PhD Scholar, Department of Irrigation and Drainage Engineering, Mahatma Phule Krishi Vidyapeeth, Rahuri – 413 722, India

²PhD Scholar, Department of Irrigation and Drainage Engineering, Mahatma Phule Krishi Vidyapeeth, Rahuri – 413 722, India

Abstract: Pomegranate evapotranspiration determined by the effects of various weather conditions were incorporated into reference crop evapotranspiration and crop characteristics into crop coefficient. The average ETr values over the 31 years were determined by Penman-Monteith method. The probability distributions that were fitted to ETr values are Log Normal, Gumbel and Weibull's probability distribution functions. Chi-square test was performed to know the probability distribution of best fit. ETr values at 10% to 90% probability level for Penman-Monteith method using probability distribution of best fit. The values of reference crop evapotranspiration, crop coefficient, area factor, water requirement and water to be applied would be useful for the irrigation water management of Pomegranate. The water applied through drip system at 90% efficiency to pomegranate plantation spaced at 3 x 4.5 m. The result revealed that, for Ambe bahar: the average amounts of water to be applied for the pomegranate tree of 1st to 5th year age at 70% probability level for Solapur district are 3.82, 10.63, 29.00, 40.07 and 49.89 l/d/tree respectively.

Keywords Reference Crop Evapotranspiration (ET_r), Crop Coefficient (kc), Pomegranate Evapotranspiration (ET_p), Ambe bahar, Water requirement

1. Introduction

In concern with pomegranate orchard, In Maharashtra Bahar is a local ward also widely used to express flowering seasons of horticulture crop. Here bahar ward used for flowering seasons of Pomegranate. Thus, flowering seasons are defined as: Ambe bahar flowering period (January - February) and harvesting period (June-July), Mrig bahar flowering period (June-July) and harvesting period (December-January) and Hasta bahar flowering period (September-October) and harvesting period (January-February) (NRCP., 2009). The crop coefficient values are influenced by local climatic condition and need to be measured locally. Therefore, in this study, the crop coefficient values of the Pomegranate crop under consideration have been estimated from the measurements of shaded area of Pomegranate orchards at solar noon hour at Solapur (Meshram, 2010). Water requirement of pomegranate bahar is estimated for Ambe bahar.

Probability Distribution Function

The irrigation planning based on the probabilistic approach, for this purpose it is necessary to know the ETr values at the different probability levels. Therefore, it is essential to know the probability distribution of ETr. In addition to this, probability analysis can be used for prediction of occurrence of future events from available records. Therefore, in this study it is planned to fit the three probability distribution functions to ETr data. The probability distributions that are used for reference crop evapotranspiration data are log normal, Gumbel and Weibull's. The chi-square test of goodness of fit used select best fit distribution.

Data Collection

Meteorological data: Daily parameters (i.e. maximum temperature (T_{max}, °C) and minimum temperature (T_{min}, °C), maximum relative humidity (RH_{max}, %) and minimum relative humidity (RH_{min}, %), pan evaporation (E_{pan}, mm), wind speed (WS, kmhr⁻¹) at height of 2.0 m, sun shine hours (SShr, hr), rainfall (R, mm) etc. collected from Indian Meteorological Department, Pune. Information regarding to pomegranate kc taken from PhD thesis submitted at CTAE, MPUAT, Udaipur (Meshram, 2010).

2. Materials and Methods

Estimation of Reference Crop Evapotranspiration (ET_r)

The weekly reference crop evapotranspiration estimated by using the standard method i.e. Penman- Monteith (Allen et al., 1998).

Probability Distribution Functions

- Gumbel Distribution
- Weibull (Maxima) Distribution
- Log Normal Distribution

Test for Goodness of Fit of Probability Distributions

Chi-square test used for testing goodness of fit test.

Selection of Best Fit Distribution

For each week different probability distribution functions were tested using Chi-square test. In this calculated Chi-square value was compared with table value and observed the significance at 5% level of significance. If the calculated Chi-square value was found less than the table value, that

distribution for respective week was considered as non significant. If more than one distribution was found fit for all weeks or months, then distribution with lowest Chi-square value were selected as best fit distribution for respective week. Out of these best fit distribution, the distribution best fit for more number of weeks was selected to determine the expected reference evapotranspiration rate at 10, 20, 30, 40, 50, 60, 70, 80, and 90 per cent probability levels for each week. The data were analyzed by VTFIT software.

Crop Coefficient (Kc)

The weekly crop coefficient values are used for different phenological stages i.e. new leaf initiation, crop development, crop maturity and crop harvesting (Meshram, 2010).

Pomegranate Evapotranspiration (ETp)

The weekly values of ETr and Kc used to obtain weekly values of ETp by equation for Ambe bahar

$$ETp = ETr \times Kc \times \text{Crop spacing} \times \text{Wetted Area} \times \text{Water Application efficiency}$$

Where,

ETp = Pomegranate evapotranspiration (mm/day)

ETr = Reference crop evapotranspiration (mm/day)

Kc = Crop coefficient of Pomegranate

Wetted area = 20% of crop spacing

Water application efficiency = 90% (drip system)

3. Results and Discussion

Estimation of ETr Values at Different Probability Levels

ETr values at different probability levels viz. 10, 20, 30, 40, 50, 60, 70, 80 and 90% were estimated by using these best probability distribution functions for all the weeks. In case of more than one distribution is the best fit, the distribution selected for estimating ETr values was in order of Log Normal, Gumbel and Weibull’s (Meshram, 2010a). As more than one distribution fits to many weeks, the best distribution for such week was considered as the distribution that gives the lowest values of chi-square at 5 per cent level of significance. For Ambe bahar, Log Normal distribution is the best fit for maximum weeks (24), followed by Gumbel (7), and Weibull’s (3). The values of ETr by Penman-Monteith method at different probability levels for Solapur for all the weeks are shown in Table 1. The percent values of water requirement determined with the help of VTFIT software and values at 70% probability is taken as most reliable (Meshram et al., 2010). The values calculated with the starting of Ambe bahar means 49th Standard Meteorological Week (SMW) and end on 31th Standard Meteorological Week. Weekly values of pomegranate evapotranspiration (ETp) at different probability levels are presented in Tables 2 to Table 6 for 1st to 5th year’s tree for Ambe bahar 35 crop weeks of phenological development stages for Solapur district and water requirement of pomegranate orchards for 1st to 5th year’s tree at 70% probability level shown in figure 1. It is seen from the tables that the weekly values of pomegranate evapotranspiration (ETp) are low during initial stage and tends to increase during crop development stages and also increases according to the age of the tree.

Table 1: Weekly ETr values for Ambe bahar at different probability levels by using best fit probability distribution functions

SMW	Distribution	10%	20%	30%	40%	50%	60%	70%	80%	90%
49	Log Normal	20.4	21.6	22.6	23.4	24.2	25.0	26.0	27.1	28.7
50	Log Normal	20.8	22.0	22.9	23.8	24.6	25.4	26.3	27.4	29.1
51	Log Normal	24.2	25.2	26.0	26.7	27.3	28.0	28.7	29.6	30.9
52	Gumbel	23.1	25.1	26.2	27.1	27.9	28.6	29.2	30.0	30.9
1	Log Normal	20.7	22.1	23.2	24.1	25.0	25.9	26.9	28.2	30.0
2	Log Normal	21.8	22.9	23.8	24.5	25.3	26.0	26.9	27.9	29.3
3	----									
4	Log normal	23.4	24.9	26.1	27.2	28.2	29.2	30.4	31.9	34.0
5	Log Normal	25.8	27.1	28.2	29.1	29.9	30.8	31.8	33.1	34.8
6	Log Normal	27.0	28.5	29.6	30.6	31.6	32.6	33.7	35.1	37.1
7	Gumbel	27.4	29.2	30.6	31.7	32.8	34.0	35.2	36.7	38.8
8	Gumbel	28.3	30.6	32.3	33.9	35.5	37.2	39.0	41.3	44.8
9	Log Normal	30.2	32.7	34.7	36.4	38.2	40.0	42.0	44.6	48.3
10	Weibulls	32.9	35.4	37.1	38.5	39.8	41.1	42.3	43.6	45.3
11	Log Normal	34.9	36.7	38.0	39.2	40.3	41.4	42.7	44.3	46.5
12	Gumbel	33.4	37.4	39.9	41.8	43.4	44.9	46.3	47.9	49.8
13	Weibulls	37.3	39.5	41.1	42.6	43.9	45.4	46.9	48.7	51.3
14	Gumbel	36.8	41.2	44.0	46.1	47.9	49.6	51.2	52.9	55.0
15	Log Normal	39.2	41.6	43.4	45.0	46.6	48.3	50.1	52.3	55.5
16	Gumbel	43.9	47.1	49.0	50.6	51.9	53.0	54.2	55.4	57.0
17	Log Normal	44.0	46.2	47.8	49.3	50.7	52.1	53.7	55.6	58.4
18	Log Normal	46.2	48.3	49.8	51.2	52.5	53.9	55.4	57.2	59.8
19	Log Normal	46.4	48.9	50.7	52.4	54.0	55.6	57.4	59.6	62.8
20	Log Normal	46.5	49.4	51.6	53.6	55.5	57.5	59.7	62.3	66.2
21	Log Normal	43.5	46.6	48.9	51.0	53.0	55.2	57.5	60.4	64.7
22	Log Normal	39.4	42.9	45.7	48.1	50.6	53.1	56.0	59.5	64.9

23	Weibulls	30.0	33.4	35.8	37.8	39.8	41.7	43.7	45.9	48.9
24	Log Normal	29.6	32.3	34.4	36.3	38.2	40.2	42.4	45.1	49.2
25	Log Normal	28.3	30.9	33.0	34.9	36.7	38.6	40.8	43.5	47.6
26	Log Normal	25.6	28.1	30.0	31.7	33.4	35.2	37.2	39.8	43.6
27	Log Normal	26.7	28.9	30.6	32.1	33.6	35.2	37.1	39.2	42.5
28	Log Normal	23.6	25.8	27.6	29.3	30.9	32.5	34.5	36.8	40.4
29	Gumbel	21.1	25.7	28.5	30.6	32.5	34.1	35.8	37.5	39.7
30	Log Normal	22.6	24.6	26.1	27.4	28.8	30.2	31.7	33.7	36.6
31	Log Normal	21.6	24.0	25.8	27.5	29.2	30.9	32.9	35.5	39.3

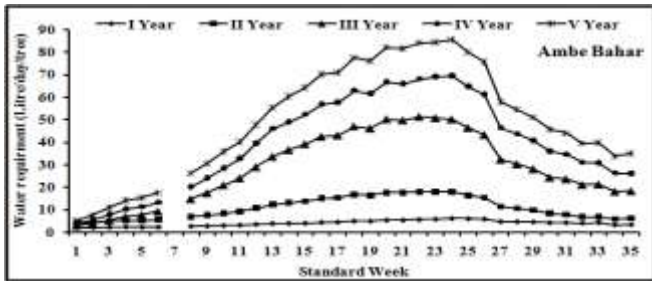


Figure 1: Water requirement of pomegranate orchards for 1st to 5th year's tree at 70% probability level

1st Year

Weekly values of pomegranate evapotranspiration (ETp) for Ambe bahar at different probability levels are presented in

Table 2: Pomegranate evapotranspiration (ETp) of Ambe bahar (litres/day/tree) for 1st year pomegranate tree at different probability levels

SMW	Probability levels								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
49	1.41	1.49	1.56	1.61	1.67	1.73	1.79	1.87	1.98
50	1.45	1.54	1.60	1.66	1.72	1.78	1.84	1.92	2.03
51	1.73	1.80	1.85	1.90	1.95	2.00	2.05	2.11	2.20
52	1.69	1.83	1.91	1.98	2.03	2.08	2.13	2.19	2.25
1	1.55	1.65	1.73	1.80	1.86	1.93	2.01	2.10	2.24
2	1.66	1.75	1.82	1.87	1.93	1.99	2.05	2.13	2.24
3	----	----	----	----	----	----	----	----	----
4	1.87	1.99	2.08	2.17	2.25	2.34	2.43	2.54	2.71
5	2.09	2.20	2.29	2.36	2.43	2.50	2.59	2.68	2.83
6	2.23	2.35	2.45	2.53	2.61	2.69	2.79	2.90	3.06
7	2.31	2.47	2.58	2.68	2.77	2.87	2.97	3.09	3.27
8	2.43	2.62	2.77	2.91	3.04	3.18	3.34	3.54	3.84
9	2.62	2.85	3.02	3.17	3.32	3.48	3.66	3.88	4.21
10	2.91	3.13	3.28	3.41	3.52	3.63	3.74	3.86	4.00
11	3.13	3.29	3.40	3.51	3.61	3.71	3.83	3.96	4.16
12	3.04	3.40	3.63	3.80	3.94	4.08	4.21	4.35	4.52
13	3.43	3.63	3.78	3.91	4.04	4.17	4.31	4.48	4.71
14	3.42	3.83	4.09	4.29	4.46	4.61	4.76	4.92	5.12
15	3.69	3.92	4.09	4.24	4.39	4.55	4.72	4.93	5.23
16	4.20	4.50	4.69	4.84	4.96	5.08	5.19	5.31	5.45
17	4.25	4.47	4.62	4.76	4.90	5.04	5.19	5.38	5.65
18	4.51	4.71	4.86	5.00	5.13	5.26	5.41	5.58	5.84
19	4.55	4.80	4.98	5.15	5.30	5.46	5.64	5.86	6.17
20	4.64	4.93	5.15	5.35	5.54	5.74	5.95	6.22	6.61
21	4.37	4.67	4.91	5.12	5.32	5.54	5.77	6.06	6.49
22	4.02	4.38	4.67	4.91	5.17	5.42	5.72	6.08	6.63
23	3.12	3.46	3.71	3.93	4.13	4.32	4.53	4.77	5.08
24	3.13	3.41	3.63	3.83	4.03	4.24	4.47	4.76	5.20
25	3.03	3.31	3.54	3.74	3.93	4.14	4.37	4.66	5.10
26	2.79	3.06	3.27	3.46	3.64	3.84	4.06	4.34	4.75
27	2.95	3.19	3.38	3.55	3.72	3.89	4.10	4.33	4.69
28	2.64	2.89	3.09	3.27	3.45	3.64	3.86	4.12	4.52
29	2.40	2.92	3.24	3.48	3.69	3.88	4.07	4.27	4.51
30	2.21	2.40	2.55	2.68	2.81	2.95	3.11	3.30	3.58
31	2.13	2.36	2.54	2.70	2.87	3.04	3.24	3.48	3.86
(l/y/tree)	97.59	105.2	110.8	115.6	120.2	124.8	129.9	135.9	144.7

Table 2 for 1st year tree. It is observed from the table that at 70 % probability level weekly pomegranate evapotranspiration (ETp) ranges from 1.79 to 5.95 litres/day/tree. Maximum values of pomegranate evapotranspiration (ETp) are observed in 20th and 21th weeks. These values are 6.22, 5.95, 5.54 and 4.93 litres/day/tree at probability levels 80%, 70%, 50% and 20%, respectively. Minimum values of the pomegranate evapotranspiration (ETp) are observed in 49th week. These are 1.87, 1.79, 1.67 and 1.49 litres/day/tree at probability levels 80%, 70%, 50% and 20%, respectively. The total pomegranate evapotranspiration (ETp) at 70% probability level over a period of 35 weeks of phenological stages in Ambe bahar is 129.90 litres/year/tree.

2nd Year

Weekly values of pomegranate evapotranspiration (ETp) for Ambe bahar at different probability levels are presented in Table 3 for 2nd year tree. It is observed from the table that at 70 % probability level weekly pomegranate evapotranspiration (ETp) ranges from 3.72 to 17.81 litres/day/tree. Maximum values of pomegranate evapotranspiration (ETp) are observed in 18th and 19th week.

These values are 18.39, 17.81, 16.89, 15.51 litres/day/tree at probability levels 80%, 70%, 50% and 20% respectively. Minimum values of the pomegranate evapotranspiration (ETp) are observed in 49th week. These are 3.88, 3.72, 3.46 and 3.09 litres/day/tree at probability levels 80%, 70%, 50% and 20%, respectively. The total pomegranate evapotranspiration (ETp) at 70% probability level over a period of 35 weeks of phenological stages in Ambe bahar is 361.40 litres/year/tree.

Table 3: Pomegranate evapotranspiration (ETp) of Ambe bahar (litres/day/tree) for 2nd year pomegranate tree at different probability levels

SMW	Probability levels								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
49	2.92	3.09	3.23	3.35	3.46	3.58	3.72	3.88	4.11
50	3.18	3.37	3.52	3.64	3.77	3.90	4.04	4.21	4.46
51	3.96	4.13	4.26	4.37	4.48	4.59	4.71	4.85	5.06
52	4.00	4.33	4.53	4.68	4.81	4.93	5.05	5.18	5.33
1	3.81	4.07	4.26	4.43	4.59	4.76	4.95	5.18	5.52
2	4.28	4.50	4.67	4.82	4.96	5.11	5.28	5.47	5.75
3	----	----	----	----	----	----	----	----	----
4	5.13	5.47	5.72	5.96	6.18	6.41	6.67	6.99	7.45
5	5.97	6.29	6.53	6.74	6.94	7.15	7.38	7.66	8.06
6	6.53	6.90	7.18	7.43	7.66	7.91	8.18	8.51	8.99
7	7.05	7.51	7.86	8.16	8.44	8.74	9.05	9.43	9.97
8	7.64	8.25	8.73	9.16	9.58	10.03	10.54	11.16	12.09
9	8.66	9.39	9.95	10.46	10.96	11.48	12.07	12.79	13.87
10	10.00	10.76	11.28	11.72	12.11	12.49	12.86	13.27	13.77
11	11.10	11.66	12.08	12.46	12.81	13.18	13.59	14.08	14.78
12	10.70	11.97	12.77	13.38	13.90	14.37	14.83	15.32	15.93
13	12.02	12.72	13.24	13.71	14.15	14.61	15.10	15.70	16.52
14	11.91	13.35	14.25	14.94	15.53	16.07	16.59	17.15	17.84
15	12.60	13.37	13.95	14.46	14.98	15.53	16.10	16.81	17.84
16	14.10	15.12	15.76	16.25	16.67	17.05	17.42	17.82	18.31
17	14.14	14.84	15.37	15.83	16.28	16.75	17.25	17.87	18.76
18	14.83	15.51	16.01	16.46	16.89	17.33	17.81	18.39	19.22
19	14.31	15.08	15.65	16.16	16.66	17.17	17.72	18.40	19.39
20	13.75	14.61	15.26	15.85	16.41	16.99	17.64	18.43	19.59
21	12.20	13.06	13.72	14.30	14.87	15.47	16.13	16.94	18.13
22	10.64	11.58	12.34	12.99	13.66	14.34	15.12	16.07	17.52
23	7.70	8.55	9.17	9.70	10.19	10.68	11.19	11.78	12.54
24	7.22	7.88	8.39	8.85	9.31	9.79	10.33	11.00	12.00
25	6.60	7.20	7.69	8.14	8.55	9.00	9.51	10.14	11.10
26	5.60	6.13	6.55	6.93	7.30	7.70	8.14	8.69	9.52
27	5.48	5.94	6.29	6.61	6.92	7.25	7.63	8.06	8.73
28	4.54	4.98	5.33	5.64	5.95	6.28	6.65	7.10	7.80
29	3.88	4.71	5.23	5.63	5.96	6.27	6.57	6.89	7.29
30	4.03	4.38	4.65	4.89	5.13	5.38	5.66	6.01	6.53
31	3.89	4.32	4.65	4.95	5.25	5.56	5.92	6.37	7.06
(l/y/tree)	274.4	295.0	310.1	323.0	335.3	347.8	361.4	377.6	400.8

3rd Year

Weekly values of pomegranate evapotranspiration (ETp) for Ambe bahar at different probability levels are presented in Table 4 for 3rd year tree. It is observed from the table that at 70% probability level weekly pomegranate evapotranspiration (ETp) ranges from 2.83 to 51.28 litres/day/tree. Maximum values of pomegranate evapotranspiration (ETp) are observed in 18th and 19th week.

These values are 52.95, 51.28, 48.64 and 44.67 litres/day/tree at probability levels 80%, 70%, 50% and 20%, respectively. Minimum values of the pomegranate evapotranspiration (ETp) are observed in 49th week. These are 2.96, 2.83, 2.64 and 2.36 litres/day/tree at probability levels 80%, 70%, 50% and 20%, respectively. The total pomegranate evapotranspiration (ETp) at 70% probability level over a period of 35 weeks of phenological stages in Ambe bahar is 986.17 litres/year/tree.

Table 4: Pomegranate evapotranspiration (ETp) of Ambe bahar (litres/day/tree) for 3rd year pomegranate tree at different probability levels

SMW	Probability levels								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
49	2.22	2.36	2.46	2.55	2.64	2.73	2.83	2.96	3.14
50	2.93	3.11	3.24	3.35	3.47	3.59	3.72	3.87	4.10
51	4.33	4.51	4.65	4.77	4.89	5.01	5.14	5.30	5.52
52	5.36	5.80	6.06	6.27	6.45	6.61	6.77	6.94	7.14
1	5.82	6.22	6.51	6.77	7.02	7.28	7.57	7.92	8.44
2	7.45	7.84	8.13	8.39	8.64	8.90	9.19	9.53	10.01
3	----	----	----	----	----	----	----	----	----
4	11.22	11.96	12.52	13.03	13.52	14.03	14.60	15.29	16.30
5	14.03	14.77	15.34	15.83	16.30	16.79	17.34	18.00	18.95
6	16.63	17.56	18.27	18.90	19.51	20.13	20.82	21.66	22.88
7	18.62	19.85	20.76	21.55	22.30	23.07	23.91	24.91	26.33
8	20.95	22.61	23.92	25.10	26.26	27.50	28.88	30.59	33.12
9	24.05	26.08	27.64	29.06	30.45	31.90	33.53	35.54	38.54
10	28.36	30.51	32.00	33.24	34.35	35.42	36.49	37.64	39.06
11	31.95	33.56	34.77	35.84	36.87	37.93	39.09	40.50	42.53
12	30.62	34.26	36.53	38.27	39.75	41.10	42.42	43.83	45.56
13	34.19	36.18	37.67	38.99	40.25	41.55	42.96	44.64	46.98
14	33.77	37.85	40.41	42.37	44.03	45.54	47.02	48.61	50.57
15	36.04	38.24	39.90	41.37	42.84	44.40	46.06	48.08	51.02
16	40.61	43.55	45.40	46.81	48.01	49.10	50.17	51.31	52.72
17	40.71	42.74	44.26	45.60	46.90	48.23	49.69	51.47	54.03
18	42.72	44.67	46.12	47.41	48.64	49.90	51.28	52.95	55.36
19	40.94	43.14	44.79	46.24	47.66	49.11	50.71	52.65	55.48
20	39.06	41.50	43.36	45.02	46.62	48.27	50.11	52.36	55.64
21	35.06	37.52	39.41	41.10	42.74	44.44	46.34	48.67	52.10
22	30.39	33.09	35.25	37.11	39.03	40.96	43.20	45.90	50.07
23	22.14	24.59	26.37	27.89	29.30	30.70	32.18	33.85	36.04
24	21.07	22.99	24.49	25.84	27.17	28.57	30.14	32.10	35.03
25	19.41	21.19	22.63	23.93	25.17	26.47	27.98	29.83	32.64
26	16.68	18.28	19.52	20.65	21.76	22.94	24.26	25.91	28.38
27	16.90	18.31	19.40	20.37	21.34	22.34	23.51	24.86	26.93
28	14.33	15.73	16.81	17.80	18.77	19.80	20.97	22.42	24.60
29	12.50	15.17	16.83	18.11	19.19	20.18	21.16	22.18	23.46
30	12.79	13.89	14.74	15.51	16.27	17.07	17.96	19.06	20.71
31	11.94	13.25	14.26	15.18	16.10	17.07	18.17	19.56	21.65
(l/y/tree)	745.8	802.9	844.4	880.2	914.2	948.6	986.2	1030	1095

4th Year

Weekly values of pomegranate evapotranspiration (ETp) for Ambe bahar at different probability levels are presented in Table 5 for 4th year tree. It is observed from the table that at 70% probability level weekly pomegranate evapotranspiration (ETp) ranges from 3.94 to 69.41 litres/day/tree. Maximum values of pomegranate evapotranspiration (ETp) are observed in 19th and 20th week.

These values are 72.52, 69.41, 64.57 and 57.49 litres/day/tree at probability levels 80%, 70%, 50% and 20%, respectively. Minimum values of the pomegranate evapotranspiration (ETp) are observed in 49th week and these are 4.11, 3.94, 3.67 and 3.28 litres/day/tree at probability levels 80%, 70%, 50% and 20% respectively. The total pomegranate evapotranspiration (ETp) at 70% probability level over a period of 35 weeks of phenological stages in Ambe bahar is 1362.41 litres/year/tree.

Table 5: Pomegranate evapotranspiration (ETp) of Ambe bahar (litres/day/tree) for 4th year pomegranate tree at different probability levels

SMW	Probability levels								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
49	3.09	3.28	3.42	3.55	3.67	3.80	3.94	4.11	4.36
50	4.43	4.69	4.89	5.07	5.24	5.42	5.62	5.85	6.20
51	6.64	6.93	7.14	7.33	7.51	7.69	7.89	8.13	8.48
52	8.18	8.86	9.26	9.58	9.85	10.10	10.34	10.60	10.91
1	8.65	9.25	9.68	10.07	10.44	10.83	11.25	11.78	12.54
2	10.71	11.26	11.68	12.06	12.41	12.78	13.20	13.69	14.39
3	----	----	----	----	----	----	----	----	----
4	15.52	16.55	17.33	18.04	18.71	19.42	20.20	21.16	22.56
5	19.58	20.61	21.39	22.08	22.75	23.43	24.19	25.11	26.43
6	22.66	23.93	24.89	25.75	26.57	27.42	28.37	29.51	31.17
7	25.54	27.23	28.48	29.56	30.59	31.65	32.80	34.17	36.13
8	28.69	30.96	32.76	34.38	35.97	37.66	39.55	41.89	45.36
9	32.95	35.73	37.87	39.81	41.71	43.70	45.93	48.70	52.81
10	38.05	40.93	42.93	44.58	46.08	47.51	48.95	50.50	52.40
11	42.64	44.79	46.40	47.83	49.20	50.62	52.17	54.05	56.76
12	41.04	45.92	48.96	51.29	53.28	55.10	56.86	58.75	61.07
13	45.81	48.47	50.47	52.24	53.93	55.66	57.55	59.81	62.94
14	45.11	50.57	53.98	56.59	58.82	60.84	62.82	64.94	67.56
15	48.11	51.06	53.27	55.23	57.20	59.28	61.49	64.19	68.12
16	53.85	57.75	60.19	62.07	63.65	65.10	66.52	68.03	69.90
17	53.98	56.67	58.68	60.46	62.18	63.95	65.89	68.24	71.64
18	56.64	59.22	61.15	62.85	64.49	66.16	68.00	70.21	73.40
19	55.57	58.55	60.79	62.77	64.69	66.67	68.84	71.47	75.31
20	54.10	57.49	60.06	62.35	64.57	66.87	69.41	72.52	77.07
21	48.93	52.37	55.00	57.37	59.65	62.03	64.69	67.94	72.72
22	43.00	46.82	49.87	52.49	55.22	57.95	61.11	64.93	70.82
23	31.86	35.39	37.94	40.13	42.16	44.18	46.30	48.71	51.86
24	30.47	33.24	35.40	37.36	39.28	41.31	43.58	46.41	50.65
25	28.24	30.84	32.93	34.83	36.62	38.52	40.72	43.41	47.50
26	24.70	27.06	28.90	30.57	32.22	33.95	35.91	38.35	42.01
27	24.84	26.90	28.50	29.94	31.36	32.83	34.55	36.54	39.58
28	21.20	23.26	24.86	26.33	27.77	29.29	31.01	33.16	36.38
29	18.12	21.99	24.39	26.25	27.81	29.25	30.66	32.15	33.99
30	18.65	20.25	21.50	22.62	23.73	24.89	26.19	27.79	30.20
31	17.03	18.89	20.33	21.65	22.96	24.34	25.92	27.89	30.88
(l/y/tree)	1028	1107	1165	1215	1262	1310	1362	1424	1514

5th Year/Mature Plant

Weekly values of pomegranate evapotranspiration (ETp) for Ambe bahar at different probability levels are presented in Table 6 for 5th year tree. It is observed from the table that at 70% probability level weekly pomegranate evapotranspiration (ETp) ranges from 4.87 to 85.52 litres/day/tree. Maximum values of pomegranate evapotranspiration (ETp) are observed in 20th week.

These values are 89.35, 85.52, 79.56 and 70.83 litres/day/tree at probability levels 80%, 70%, 50% and 20%, respectively. Minimum values of the pomegranate evapotranspiration (ETp) are observed in 31st week. These are 5.08, 4.87, 4.54 and 4.05 litres/day/tree at probability levels 80%, 70%, 50% and 20%, respectively. The total pomegranate evapotranspiration (ETp) at 70% probability level over a period of 35 weeks of phenological stages in Ambe bahar is 1696.42 litres/year/tree.

Table 6: Pomegranate evapotranspiration (ETp) of Ambe bahar (litres/day/tree) for 5th year pomegranate tree at different probability levels

SMW	Probability levels								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
49	3.82	4.05	4.23	4.38	4.54	4.69	4.87	5.08	5.39
50	5.95	6.30	6.57	6.81	7.04	7.28	7.54	7.86	8.33
51	9.04	9.42	9.71	9.97	10.21	10.46	10.74	11.06	11.54
52	11.10	12.02	12.56	13.00	13.36	13.70	14.02	14.37	14.80
1	11.72	12.54	13.12	13.64	14.14	14.67	15.25	15.96	17.00
2	14.10	14.83	15.38	15.87	16.35	16.83	17.38	18.03	18.95
3	----	----	----	----	----	----	----	----	----
4	20.01	21.33	22.34	23.25	24.12	25.03	26.04	27.27	29.08
5	24.64	25.94	26.93	27.80	28.63	29.49	30.45	31.60	33.27
6	28.54	30.14	31.35	32.43	33.47	34.54	35.73	37.17	39.25
7	31.14	33.20	34.72	36.04	37.30	38.60	39.99	41.66	44.05
8	34.58	37.32	39.48	41.43	43.35	45.39	47.66	50.49	54.68
9	39.60	42.94	45.51	47.85	50.14	52.53	55.21	58.53	63.47
10	46.85	50.40	52.86	54.90	56.74	58.50	60.27	62.18	64.52
11	52.53	55.18	57.17	58.93	60.62	62.36	64.27	66.59	69.93
12	50.50	56.50	60.24	63.11	65.56	67.79	69.97	72.29	75.15
13	56.41	59.69	62.15	64.33	66.42	68.55	70.88	73.66	77.51
14	55.60	62.33	66.54	69.76	72.50	74.99	77.43	80.05	83.27
15	59.36	62.99	65.72	68.14	70.56	73.14	75.86	79.19	84.04
16	66.49	71.31	74.32	76.64	78.60	80.38	82.14	84.01	86.31
17	66.71	70.03	72.52	74.72	76.84	79.03	81.42	84.34	88.54
18	70.06	73.25	75.64	77.75	79.77	81.83	84.11	86.84	90.79
19	67.99	71.64	74.38	76.80	79.14	81.56	84.22	87.44	92.14
20	66.66	70.83	74.00	76.82	79.56	82.38	85.52	89.35	94.96
21	60.42	64.67	67.92	70.83	73.65	76.59	79.87	83.88	89.79
22	53.19	57.92	61.70	64.94	68.31	71.69	75.60	80.33	87.62
23	39.78	44.18	47.37	50.10	52.64	55.16	57.81	60.81	64.74
24	38.08	41.55	44.25	46.70	49.10	51.63	54.48	58.01	63.31
25	35.29	38.54	41.16	43.53	45.77	48.14	50.88	54.25	59.36
26	31.28	34.27	36.61	38.72	40.81	43.01	45.49	48.58	53.22
27	31.52	34.14	36.17	37.99	39.79	41.66	43.85	46.37	50.22
28	26.95	29.57	31.61	33.47	35.30	37.24	39.43	42.16	46.25
29	23.37	28.36	31.47	33.86	35.88	37.73	39.55	41.48	43.85
30	23.90	25.96	27.56	29.00	30.41	31.91	33.57	35.63	38.71
31	22.96	25.47	27.41	29.19	30.96	32.82	34.94	37.61	41.64
(l/y/tree)	1281	1378	1450	1512	1571	1631	1696	1774	1886

4. Conclusions

- The maximum and minimum values of weekly water to be applied to pomegranate tree at 70% probability level for Solapur district; For Ambe bahar: 1.79 to 5.95 l/d/tree for 1st year, 3.72 to 17.81 l/d/tree for 2nd year, 2.83 to 51.28 l/d/tree for 3rd year, 3.94 to 69.41 l/d/tree for 4th year, and 4.87 to 85.52 l/d/tree for 5th year respectively.
- The average amounts of water to be applied for the pomegranate tree of 1st to 5th year age at 70% probability level for Solapur district; For Ambe bahar: 3.82, 10.63, 29.00, 40.07 and 49.89 l/d/tree respectively.
- The total weekly water to be applied to pomegranate tree at 70% probability level for 1st to 5th year; For Ambe bahar: 129.90, 361.4, 986.17, 1362.41 and 1696.42 litres/year/tree respectively.

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Author Profile



Arun Bhagat received B.Tech. (Agri. Engg.) from MPKV (MS) in 2010 and M.E. (Irrigation Water Management) from Maharana Pratap University of Agriculture and Technology, Udaipur (RJ) India in 2012. Currently pursuing PhD at MPKV, Rahuri (MS), India.