

Water balance for pomegranate based on meteorological data

■ R.V. SHINDE, S.B. JADHAV AND S.N. PAWAR

Received : 12.01.2016; Revised : 09.03.2016; Accepted : 21.03.2016

See end of the Paper for authors' affiliation

Correspondence to :

R.V. SHINDE

Department of Basic Science and Computer Technology, College of Agriculture Engineering and Technology, Vasantnao Naik Marathwada Krishi Vidyapeeth, PARBHANI (M.S.) INDIA
Email : patil.ravi4590@gmail.com

■ **ABSTRACT** : Water balance of an area is an itemized statement of all gains, losses and changes of storage of water occurring in a given field within specified boundaries during aspecified period of time considering rainfall and evapotranspiration. Difference between rainfall (P) and pomegranate evapotranspiration (ET_p) gives weekly moisture excess and deficit. A negative value of this difference indicates water deficit, which means the amount by which the rainfall fails to supply the potential water need of tree. While positive difference is water excess, this is the amount of excess water available for soil moisture replenishment and also for a runoff. Weekly rainfall and evapotranspiration data of both the districts were analyzed statistically for Ambie, Mrig and Hasta bahar. Most of the weeks in Ambie bahar during fruit development period have negligible amount of rainfall which is good for quality point of view, but during fruit maturity period there was a greater amount of rainfall observed. Most of the weeks in Mrig bahar during flowering period have surplus rainfall and there after it very less during fruit development and maturity which is best combination for quality of fruits. Therefore, in general, it can be concluded that supplemental irrigation requirement in Mrigbahar was maximum followed by Hast and Ambiebahar.

■ **KEY WORDS** : Water balance, Pomegranate, Meteorological data

■ **HOW TO CITE THIS PAPER** : Shinde, R.V., Jadhav, S.B. and Pawar, S.N. (2016). Water balance for pomegranate based on meteorological data . *Internat. J. Agric. Engg.*, **9**(1) : 86-93.

The task of monitoring and controlling the field water balance is a valuable tool for efficient management of water and soil. Extent of water deficit and surplus for a given region is important in planning for water harvesting structures, artificial ground water recharge and adjusting agricultural operations in such a way so as to bring maximum synchronization between availability of water and critical stages of crop growth. Water deficit is a complex and non-linear phenomenon because it depends on several interacting climatologic factors such as precipitation, temperature, humidity, wind speed, bright sun shine hours, etc. Information of the period during which deficiency of moisture in soil are likely to occur is essential so that advance action can

be taken to avoid severe moisture stress to the crops. Choice of crop varieties with standing moisture stress, adoption of appropriate conservation measures and lifesaving irrigation through recycling surplus water may be possible measures by the advance information.

As the demand for irrigation increases, it becomes essential that the water be used more efficiently. Hence, the estimation of drought is of utmost importance in water resource planning, irrigation scheduling, irrigation system design, moisture deficit prediction, hydrological and climatic studies and irrigation development and management. Thus, there is a need for development of satisfactory means to estimate evapotranspiration.

■ METHODOLOGY

Location of study area :

The study was carried out for Latur and Osmanabad districts of Marathwada region. The details of stations are presented below.

Osamanabad :

It is located between 18°08' N latitude and 76°06' E longitude and at an altitude of 462 m above msl. the average annual rainfall is 801.91 mm.

Latur :

It is situated in subtropical zone at an altitude of 556 m above msl. Latur is intersected by 19°53' N latitude and 75°23' E longitude. Soil of Latur is medium black clay. the average annual rainfall is 754.2 mm.

Weekly water excess and deficit :

Difference between rainfall (P) and pomegranate evapotranspiration (ET_p) gives weekly moisture excess and deficit. A negative value of this difference indicates water deficit, which means the amount by which the rainfall fails to supply the potential water need of tree. While positive difference is water excess, this is the amount of excess water available for soil moisture replenishment and also for a runoff.

Water deficit (DEF) :

Water deficit only exists when (P- ET_p) is negative and is calculated by the following equation:

$$DEF = P - ET_p \quad \dots (1)$$

Water surplus (SUR) :

The water surplus is the amount of positive (P- ET_p) which remains in excess after recharging the soil to the field capacity and is calculated by the following equation:

$$SUR = P - ET_p \quad \dots (2)$$

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Weekly Bahar wise water balance in Latur and Osmanabad district :

Water balance of an area is an itemized statement of all gains, losses and changes of storage of water

occurring in a given field within specified boundaries during a specified period of time considering rainfall and evapotranspiration. Weekly rainfall and evapotranspiration data of both the districts were analyzed statistically for Ambie, Mrig and Hasta bahar.

Weekly water balance in Ambie, Mrig and Hasta bahar for pomegranate tree :

Weekly rainfall and pomegranate evapotranspiration data of Latur and Osmanabad districts were analyzed statistically and results are presented in Table 1, 2 and 3. From Table 1 gives the weekly water deficit and surplus of Ambie, Mrig and Hasta bahar for both the districts. Table 1 shows that Ambie bahar was water deficit with 78 and 80 per cent weeks were water deficit in Latur and Osmanabad, respectively. Total supplemental water requirement of pomegranate in Latur and Osmanabad districts was 1553.43 and 1331.46 mm, respectively. From Fig. 1. Reveals that most of the weeks in Ambie bahar during fruit development period have negligible amount of rainfall which is good for quality point of view, but during fruit maturity period there was a greater amount of rainfall observed.

Mrig bahar in Latur district had 78 per cent deficit weeks and 22 per cent of surplus weeks. Similarly in Osmanabad district there were 82 per cent deficit weeks and 18 per cent surplus weeks. Total water deficit in Mrig bahar was 1758.84 and 1543.3 mm in Latur and Osmanabad district, respectively. Most of the weeks in Mrig bahar during flowering period have surplus rainfall and, thereafter, it very less during fruit development and maturity which is best combination for quality of fruits.

From Table 2 observed that in Hasta bahar there was 80 per cent deficit weeks and 20 per cent surplus weeks in Latur, were as 82 per cent deficit and 18 per cent surplus weeks observed in Osmanabad district. Amount of irrigation required in Hasta bahar was 1719.36 and 1461.06 mm in Latur and Osmanabad district, respectively

Therefore, in general, it can be concluded that in supplemental irrigation requirement in Mrig bahar was maximum followed by Hasta and Ambie bahar.

Conclusion :

Under the water balanced study Ambie bahar was water deficit with 78 and 80 per cent weeks were water deficit in Latur and Osmanabad, respectively. Total

Table 1 : Weekly water balance of Ambie bahar in Latur and Osmanabad district

Week	Ambiebahar					
	Latur			Osmanabad		
	Rainfall	Etp	Water deficit	Rainfall	Etp	Water deficit
1	0.91	5.69	-4.78	0.63	5.20	-4.58
2	2.58	8.60	-6.02	0.70	7.95	-7.25
3	6.05	12.46	-6.41	0.91	10.96	-10.05
4	0.45	15.84	-15.38	0.00	14.28	-14.28
5	1.21	20.21	-19.01	0.36	18.14	-17.78
6	3.29	23.58	-20.29	0.36	21.26	-20.90
7	0.73	30.92	-30.19	0.39	26.56	-26.17
8	0.10	37.00	-36.90	0.00	32.59	-32.59
9	0.53	44.18	-43.65	0.44	35.97	-35.54
10	4.22	48.49	-44.27	1.09	43.29	-42.20
11	1.61	55.50	-53.88	0.55	48.16	-47.61
12	0.36	66.37	-66.00	0.56	55.96	-55.40
13	1.78	72.06	-70.28	0.73	60.92	-60.19
14	1.36	85.18	-83.81	7.02	68.60	-61.58
15	2.02	95.29	-93.27	0.80	78.31	-77.51
16	2.06	96.19	-94.12	0.90	76.54	-75.64
17	2.49	100.08	-97.59	0.50	82.02	-81.51
18	2.00	103.27	-101.27	2.00	91.71	-89.71
19	4.99	104.01	-99.02	1.81	90.29	-88.48
20	6.40	108.76	-102.36	6.58	88.01	-81.42
21	3.61	103.02	-99.41	9.91	80.79	-70.88
22	10.58	86.13	-75.55	18.85	69.70	-50.84
23	23.41	71.17	-47.76	28.20	59.30	-31.10
24	25.39	61.56	-36.17	26.48	51.59	-25.11
25	33.12	49.52	-16.41	20.56	46.72	-26.16
26	27.09	44.29	-17.19	27.41	41.26	-13.85
27	26.51	40.28	-13.77	45.10	37.51	7.58
28	40.79	37.02	3.77	30.47	36.08	-5.61
29	33.90	34.17	-0.27	29.93	33.96	-4.03
30	42.25	32.76	9.49	45.26	32.60	12.67
31	45.97	29.84	16.13	42.26	29.76	12.50
32	40.60	30.35	10.25	32.52	27.10	5.41
33	19.87	29.62	-9.75	24.89	27.94	-3.05
34	64.10	28.06	36.03	57.98	27.51	30.47
35	47.30	29.76	17.55	38.10	27.50	10.60
36	49.18	30.62	18.55	45.23	28.62	16.61
37	34.18	30.90	3.28	37.76	32.19	5.57
38	45.96	31.41	14.55	35.94	30.14	5.80
39	38.79	33.97	4.82	27.11	31.21	-4.10
40	26.25	34.24	-7.98	30.36	31.23	-0.87
41	18.83	38.34	-19.51	13.51	35.64	-22.13
42	34.12	38.19	-4.07	14.12	35.87	-21.74
43	10.97	38.02	-27.05	6.80	35.19	-28.39
44	7.52	36.95	-29.43	2.23	34.17	-31.95
45	5.98	36.29	-30.31	2.85	33.58	-30.73
46	1.24	35.26	-34.02	2.04	32.55	-30.51
47-52						
Total			1553.43			1331.46

Table 2 : Weekly water balance of Mrig bahar in Latur and Osmanabad district

Week	Mrigbahar						
	Latur Rainfall	Latur Etp	Latur Water deficit	Osmanabad Rainfall	Osmanabad Etp	Osmanabad Water deficit	
31	45.97	4.86	41.10	42.26	4.85	37.41	
32	40.60	7.50	33.10	32.52	6.70	25.82	
33	19.87	9.99	9.88	24.89	9.42	15.46	
34	64.10	12.66	51.43	57.98	12.41	45.57	
35	47.30	15.78	31.53	38.10	14.58	23.53	
36	49.18	18.45	30.73	45.23	17.24	27.99	
37	34.18	21.97	12.22	37.76	22.88	14.88	
38	45.96	25.35	20.61	35.94	24.33	11.61	
39	38.79	30.28	8.51	27.11	27.82	-0.71	
40	26.25	33.42	-7.17	30.36	30.49	-0.13	
41	18.83	39.23	-20.40	13.51	36.46	-22.95	
42	34.12	42.19	-8.07	14.12	39.62	-25.50	
43	10.97	44.58	-33.61	6.80	41.26	-34.45	
44	7.52	47.15	-39.63	2.23	43.60	-41.38	
45	5.98	48.25	-42.27	2.85	44.65	-41.80	
46	1.24	46.88	-45.64	2.04	43.28	-41.24	
47	3.45	46.30	-42.84	2.26	40.95	-38.68	
48	0.00	46.75	-46.75	0.42	40.89	-40.47	
49	1.41	44.64	-43.23	0.45	40.10	-39.65	
50	0.20	43.75	-43.55	0.05	38.91	-38.86	
51	0.14	42.71	-42.57	0.05	39.67	-39.61	
52	0.00	48.35	-48.35	0.91	46.40	-45.49	
1	0.91	43.25	-42.34	0.63	39.56	-38.93	
2	2.58	43.40	-40.82	0.70	40.12	-39.42	
3	6.05	46.40	-40.35	0.91	40.83	-39.92	
4	0.45	44.94	-44.49	0.00	40.53	-40.53	
5	1.21	47.32	-46.11	0.36	42.46	-42.10	
6	3.29	47.16	-43.87	0.36	42.53	-42.16	
7	0.73	50.84	-50.11	0.39	43.67	-43.28	
8	0.10	52.47	-52.37	0.00	46.21	-46.21	
9	0.53	54.93	-54.40	0.44	44.72	-44.29	
10	4.22	52.63	-48.41	1.09	46.99	-45.90	
11	1.61	54.24	-52.62	0.55	47.07	-46.52	
12	0.36	57.29	-56.92	0.56	48.30	-47.74	
13	1.78	58.64	-56.85	0.73	49.58	-48.84	
14	1.36	63.69	-62.33	7.02	51.30	-44.28	
15	2.02	67.60	-65.58	0.80	55.55	-54.76	
16	2.06	68.24	-66.17	0.90	54.30	-53.40	
17	2.49	70.39	-67.91	0.50	57.69	-57.19	
18	2.00	73.51	-71.51	2.00	65.29	-63.28	
19	4.99	75.80	-70.82	1.81	65.81	-63.99	
20	6.40	79.26	-72.86	6.58	64.14	-57.56	
21	3.61	75.95	-72.34	9.91	59.56	-49.65	
22	10.58	63.51	-52.92	18.85	51.39	-32.53	
23	23.41	54.94	-31.53	28.20	45.77	-17.58	
24	25.39	48.80	-23.42	26.48	40.90	-14.42	
25	33.12	40.81	-7.69	20.60	38.50	-17.90	
26-31			Water tress period				
Total			1758.84			1543.3	

Table 3 : Weekly water balance of Hasta bahar in Latur and Osmanabad district

Week	Hasta bahar					
	Latur Rainfall	Latur Etp	Latur Water deficit	Osmanabad Rainfall	Osmanabad Etp	Osmanabad Water deficit
42	34.12	6.66	27.46	14.12	6.26	7.87
43	10.97	9.61	1.35	6.80	8.90	-2.09
44	7.52	12.32	-4.80	2.23	11.39	-9.16
45	5.98	15.26	-9.28	2.85	14.12	-11.27
46	1.24	17.63	-16.39	2.04	16.28	-14.24
47	3.45	19.62	-16.16	2.26	17.35	-15.09
48	0.00	23.38	-23.38	0.42	20.44	-20.02
49	1.41	25.35	-23.94	0.45	22.77	-22.32
50	0.20	27.43	-27.23	0.05	24.40	-24.35
51	0.14	29.68	-29.54	0.05	27.57	-27.51
52	0.00	36.06	-36.06	0.91	34.60	-33.69
1	0.91	36.04	-35.13	0.63	32.96	-32.34
2	2.58	39.88	-37.30	0.70	36.87	-36.17
3	6.05	47.69	-41.64	0.91	41.96	-41.05
4	0.45	50.08	-49.63	0.00	45.16	-45.16
5	1.21	53.75	-52.54	0.36	48.24	-47.87
6	3.29	55.65	-52.36	0.36	50.18	-49.82
7	0.73	61.84	-61.12	0.39	53.13	-52.74
8	0.10	65.17	-65.07	0.00	57.40	-57.40
9	0.53	70.46	-69.92	0.44	57.36	-56.93
10	4.22	69.78	-65.56	1.09	62.30	-61.21
11	1.61	74.42	-72.80	0.55	64.58	-64.03
12	0.36	79.64	-79.28	0.56	67.15	-66.59
13	1.78	78.42	-76.64	0.73	66.30	-65.57
14	1.36	82.88	-81.51	7.02	66.75	-59.73
15	2.02	85.52	-83.50	0.80	70.28	-69.48
16	2.06	84.68	-82.61	0.90	67.38	-66.49
17	2.49	84.81	-82.33	0.50	69.51	-69.00
18	2.00	84.89	-82.89	2.00	75.39	-73.39
19	4.99	83.74	-78.75	1.81	72.69	-70.88
20	6.40	84.79	-78.39	6.58	68.61	-62.03
21	3.61	77.70	-74.09	9.91	60.93	-51.02
22	10.58	62.78	-52.19	18.85	50.79	-31.94
23	23.41	51.20	-27.79	28.20	42.65	-14.46
24	25.39	46.03	-20.65	26.48	38.57	-12.10
25	33.12	38.06	-4.94	20.56	35.90	-15.34
26	27.09	35.01	-7.92	27.41	32.62	-5.21
27	26.51	32.46	-5.94	45.10	30.23	14.86
28	40.79	30.73	10.06	30.47	29.95	0.52
29	33.90	29.59	4.31	29.93	29.41	0.52
30	42.25	29.65	12.60	45.26	29.51	15.76
31	45.97	27.89	18.08	42.26	27.82	14.44
32	40.60	29.67	10.93	32.52	26.50	6.02
33	19.87	29.96	-10.10	24.89	28.27	-3.38
34	64.10	30.11	33.98	57.98	29.53	28.46
35-41						
Total			1719.36			1461.06

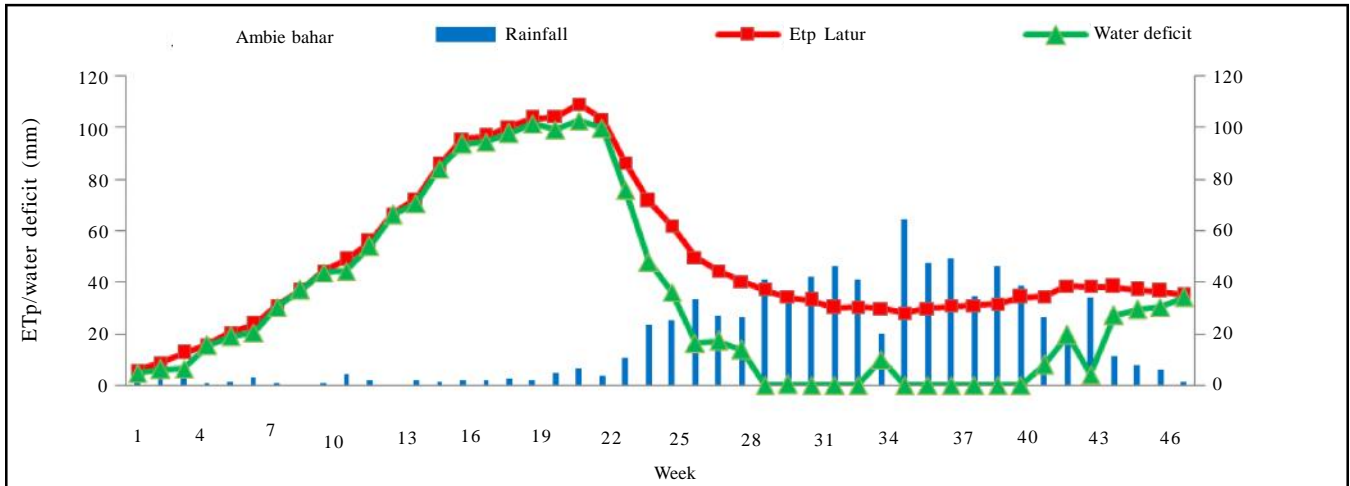


Fig. 1 : Weekly water balance variation of Ambie bahar in Latur district

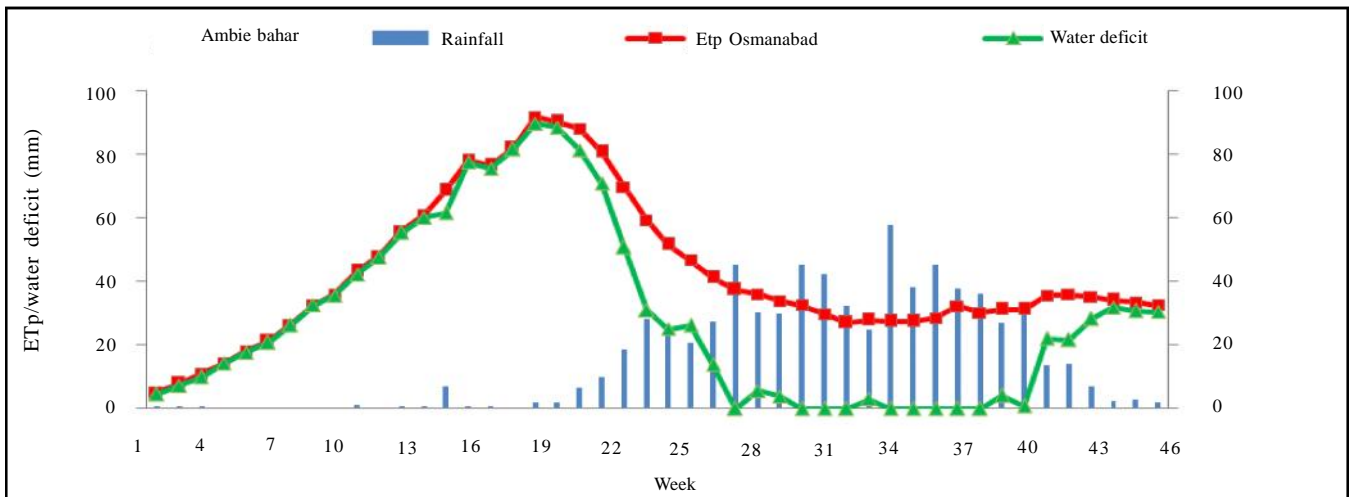


Fig. 2 : Weekly water balance variation of Ambie bahar in Osmanabad district

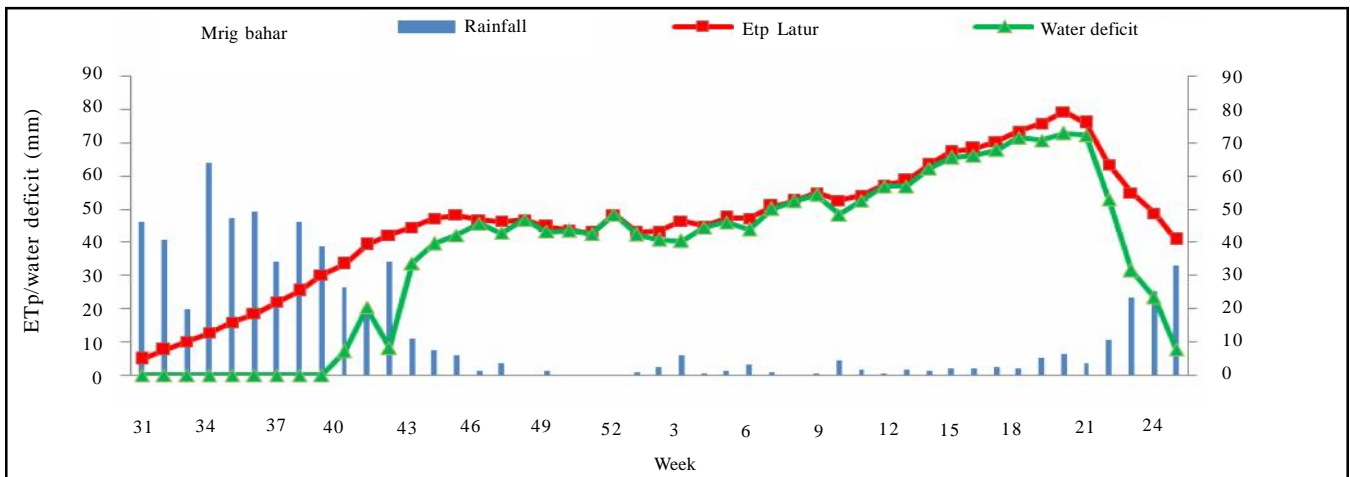


Fig. 3 : Weekly water balance variation of Mrig bahar in Latur district

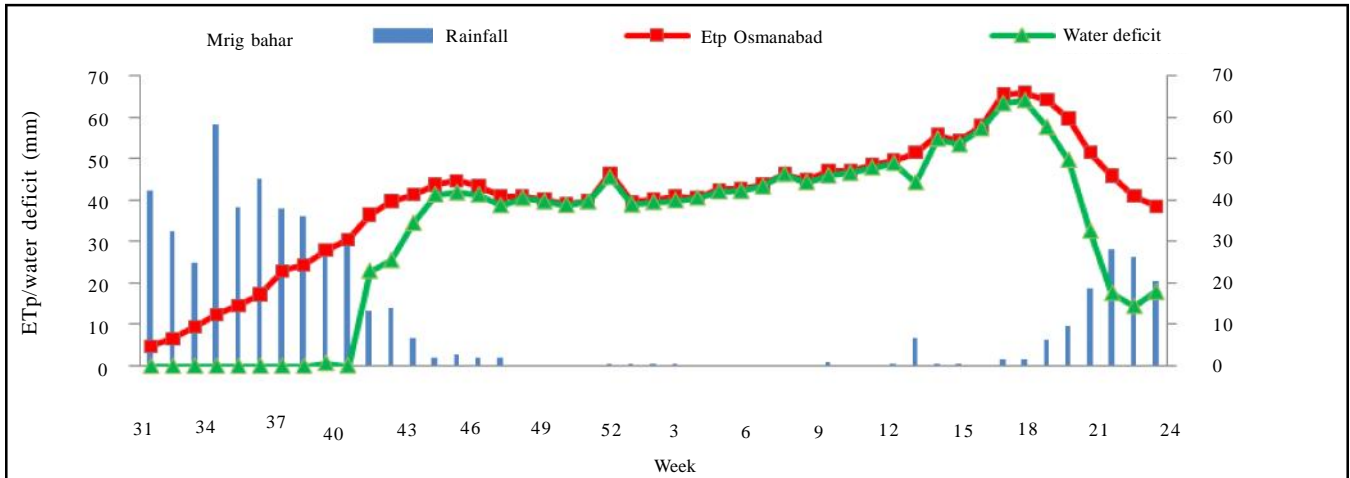


Fig. 4 : Weekly water balance variation of Mrig bahar in Latur district

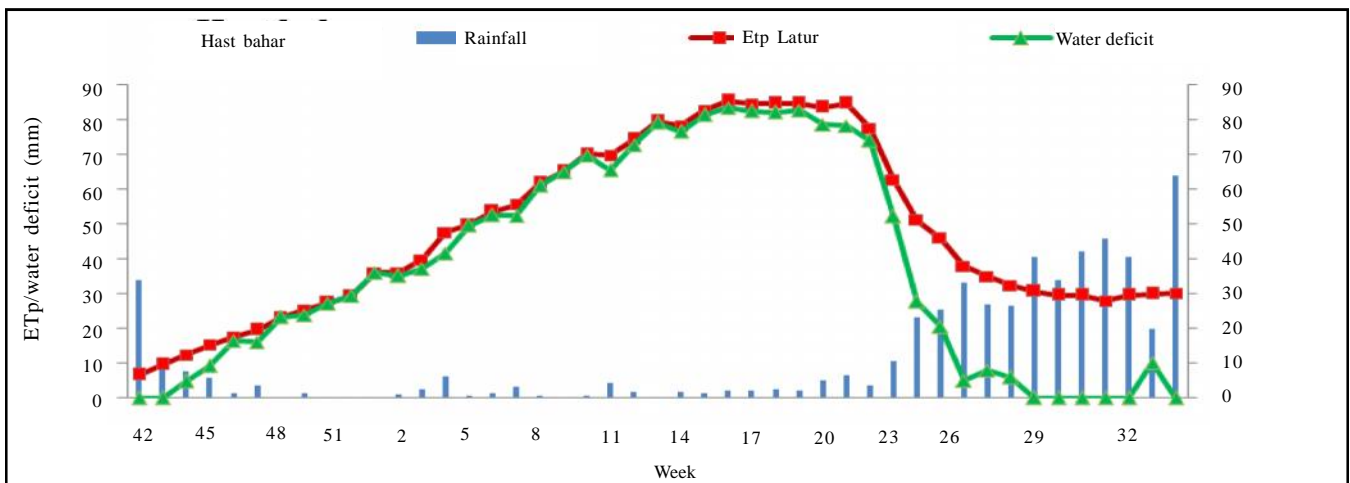


Fig. 5 : Weekly water balance variation of Hasta bahar in Latur district

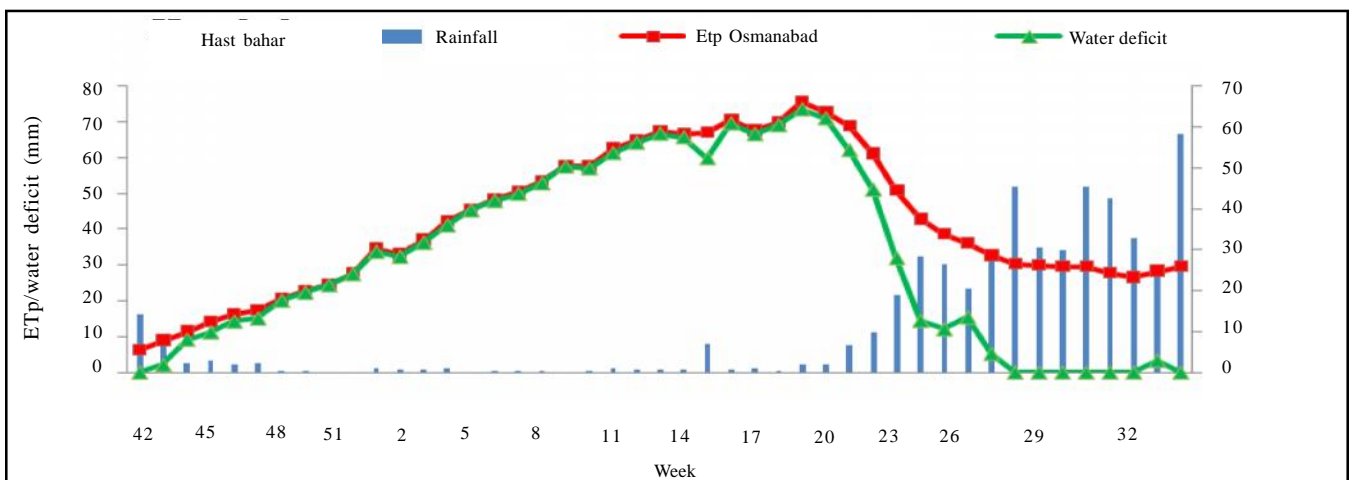


Fig. 6 : Weekly water balance variation of Hasta bahar in Osmanabad district

supplemental water requirement of pomegranate in Latur and Osmanabad districts was 1553.43 and 1331.46 mm, respectively. Mrigbahar in Latur district had 78 per cent deficit weeks and 22 per cent of surplus weeks. Similarly in Osmanabad district there were 82 per cent deficit weeks and 18 per cent surplus weeks. Most of the weeks in Mrig bahar during flowering period have surplus rainfall and, thereafter, it very less during fruit development and maturity which is best combination for quality of fruits. Hast bahar there was 80 per cent deficit weeks and 20 per cent surplus weeks in Latur, were as 82 per cent deficit and 18 per cent surplus weeks observed in Osmanabad district. Amount of irrigation required in Hast bahar was 1719.36 and 1461.06 mm in Latur and Osmanabad district, respectively.

Authors' affiliations:

S.B. JADHAV, Department of Irrigation and Drainage Engineering, College of Agriculture Engineering and Technology, Vasantnaik Marathwada Krishi Vidyapeeth, PARBHANI (M.S.) INDIA
S.N.PAWAR, Department of Basic Science and Computer Technology, College of Agriculture Engineering and Technology, Vasantnaik Marathwada Krishi Vidyapeeth, PARBHANI (M.S.) INDIA

■ REFERENCES

- Barros, R., Isidoro, D. and Argues, R. (2011).** Long-term water balances in La Violada irrigation district (Spain): I. Sequential assessment and minimization of closing errors. *Agric. Water Mgmt.*, **102** : 35– 45.
- Dabral, P.P. (2000).** Excess-deficit analysis of rainfall for water management and planning in Tarai region of West Bengal. *Indian J. Soil Cons.*, **28** (2) : 175-177.
- El-Amami, H., Zairi, A., Pereira, L. S., Machado, T., Slatni, A. and Rodrigues, P. (2001).** Deficit irrigation of cereals and horticultural crops: Economic analysis. *Agric. Engg. Internat. CIGR J. Scientif. Res. & Develop.*, **3** : 1-11.
- Kothari, A. K., Jat, M. L. and Balyan, J. K. (2007).** Water balance based crop planning for Bhilwara district of Rajasthan. *Indian J. Soil Cons.*, **35** : 178-183.
- Meshram, D.T., Gorantiwar, S.D., Jadhav, V.T. and Ram, Chandra (2011).** Evaluation of ET models to study water requirement of Pomegranate (*Punica granatum L.*) for Satara district of Maharashtra. *Indian J. Soil Cons.*, **39** (2):141-148.
- Moroizumi, T., Hiromasa, H. and Sukchan, S. (2009).** Soil water content and water balance in rainfed fields in Northeast Thailand. *Agric. Water Mgmt.*, **96**: 160–166.
- Salam, M.A. and Mazrooe, S.A. (2006).** Evapotranspiration estimates and water balance of Kuwait. *J. Agro meteorol.*, **8** : 243 - 247.
- Singh, R.K., Murthy, N.S. and Arya, M.P. (2004).** Water balance components and effect of soil moisture on yield of wheat in mid Himalayan region of Uttaranchal. *J. Agrometeorology*, **6** : 234-237.
- Zohreh, I. (2010).** Modeling and analysis of actual evapotranspiration using data driven and wavelet techniques. Degree of Master of Science, Department of Civil and Geological Engineering, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.


 ★ ★ ★ ★ ★ of Excellence ★ ★ ★ ★ ★