

## Comparison of Evapotranspiration with Pan Evaporation in Pigeonpea (*Cajanus cajan* L.) at Anand

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**Abstract :** The relationship between the ratio of actual evapotranspiration (ET) and pan evaporation (EP) with the leaf area index (LAI) of pigeonpea (*Cajanus cajan* cv. GT-100) at Anand was studied during 1992 and 1993. The peak values of ET and LAI, during 50% flowering to pod development stage of the crop, were 8.6 mm per day and 4.74, respectively. The linear relationship between one another was observed at the same time ( $R^2=0.70$ ). The 50% flowering phase of the crop was found to be critical phase of water requirement in pigeonpea. The seasonal ET and the water-use efficiency of the crop were 819 mm and 4.1 kg ha<sup>-1</sup> mm<sup>-1</sup>, respectively.

**Key words :** Pigeonpea, *Cajanus cajan*, evapotranspiration.

Pigeonpea (*Cajanus cajan*) is an important source of protein in the cereal diets of India. It is mainly grown in regions lying between 14° and 28°N latitude in India. About 90% of the world production of pigeonpea is contributed by India (Reddy and Virmani, 1980). Pigeonpea is generally grown as sole or mixed crop in the *kharif* season in Gujarat. The crop is mostly rainfed, and at the later stage utilizes the stored soil moisture. Pigeonpea has a specific characteristic of water use pattern throughout the growing season. This is largely determined by length of the growing season and the atmospheric evaporative demand (Greacen and Hignett, 1976).

The rates of evapotranspiration (ET), evaporation (EP) and their ratios ET/EP during different phenophases of pigeonpea and their effects on crop yield during 1992 and 1993 were studied.

### Materials and Methods

Lysimetric data were recorded using two weighing type lysimeters installed by Indian

Meteorological Department at Anand. Pan evaporation data were recorded from U.S.W.B. class A pan evaporimeter installed in the observatory which is adjacent to the experimental plot. Field experiment was conducted keeping the lysimeters in the centre of the experimental field during 1992 and 1993 by growing pigeonpea (Cv. GT-100) on sandy loam soil. The crop was planted on 7th July in 1992 and on 29th June in 1993. Periodic agronomical and leaf area observations were recorded at an interval of 15 days. The crop was harvested on 18th December in 1992 and on 14th December in 1993.

### Results and Discussion

The rates of ET and EP with advancement of growth of the crop are shown in Fig. 1. During the emergence and initial vegetative phase of the crop, up to 7 weeks after sowing (WAS), the ET was lower than the EP due to the low transpiration rate. This was because of low LAI during the initial vegetative phase of the crop. Later on the increasing trend of ET was observed during the flower in-

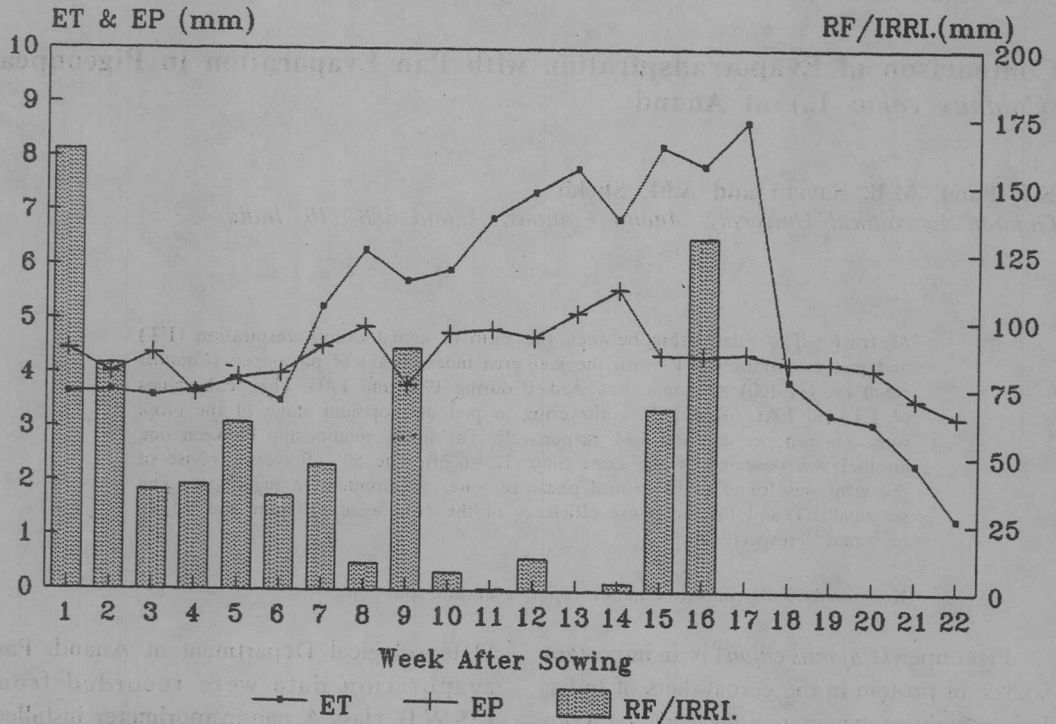


Fig. 1. Variation of evapotranspiration and evaporation during 1992-93.

initiation to grain formation phases of the crop (8 to 18 WAS) and it was higher than the EP and reached a peak value of 8.6 mm day<sup>-1</sup> during the pod development phase of

the crop (15 WAS). The ET was influenced by the available soil moisture as shown in Fig. 1. The rate of ET was also increased after the rains or with the application of the

Table 1. Evapotranspiration, pan evaporation, rainfall and irrigation during different phenophases of pigeonpea 1992-93

Phenological stage	No. of days	1992				1993			
		ET (mm)	EP (mm)	Rainfall (mm)	Irrigation (mm)	ET (mm)	EP (mm)	Rainfall (mm)	Irrigation (mm)
P1	8	30.7	43.2	12.7	67.0	21.9	45.0	9.0	39.0
P2	18	54.4	72.3	121.7	00.0	44.5	49.3	472.1	00.0
P3	25	86.9	93.9	208.5	00.0	90.5	120.1	34.7	00.0
P4	19	136.1	89.3	195.8	60.0	206.4	138.4	98.9	00.0
P5	13	150.3	85.3	00.0	64.0	74.1	66.8	45.2	00.0
P6	20	149.4	99.5	5.6	120.0	153.5	108.4	14.5	85.0
P7	35	230.9	163.3	00.0	125.0	208.4	132.7	61.0	73.0

P1 = Emergence to emergence of first trifoliolate.

P2 = Emergence of first trifoliolate to emergence of primary branches.

P3 = Emergence of primary branches to emergence of secondary branches.

P4 = Emergence of secondary branches to flower bud initiation.

P5 = Flower bud initiation to 50% flowering.

P6 = 50% flowering to 50% podding.

P7 = 50% pod development to physiological maturity.

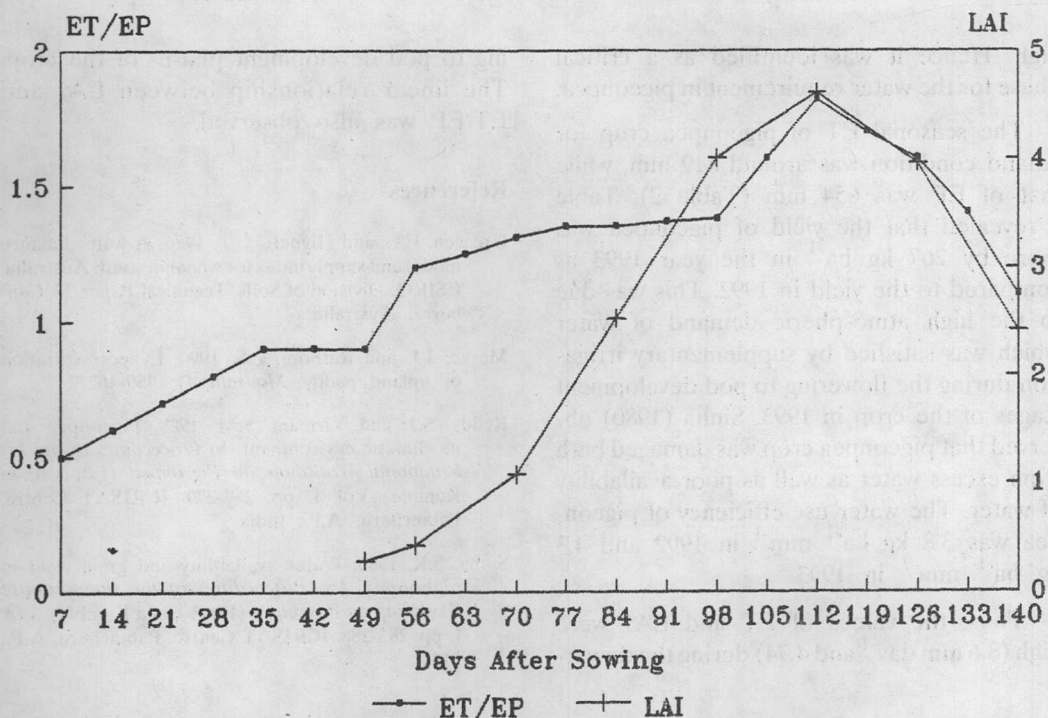


Fig. 2. Temporal profile of ET/EP and LAI during 1992-93.

irrigation. The trend of the LAI and the ratios of ET/EP were continued along with the trend of crop growth period (Fig. 2), and attained a peak value of 4.74 and 1.84, respectively, during the flowering to pod development phases (16 WAS) of the crop.

The increasing trend of ET during the pod development phase of the crop was due to increase in LAI. The ET declined sharply

after 126 days (18 WAS) because of senescence of the leaves (Maske and Rathore, 1990). The ratio of ET/EP was regressed with the values of LAI and the linear relation was observed as  $Y = -4.0944 + 4.8957 \cdot ET/EP$  with  $R^2 = 0.70$ .

The phenophasewise values of ET and EP are presented in Table 1. The ET demand by the crop at the 50% flowering stage was

Table 2. Evapotranspiration parameters, crop yield and water-use efficiency for pigeonpea during the two crop seasons

Parameters	Season		Mean
	1992	1993	
Seasonal evapotranspiration (mm)	839.0	799.5	819.3
Evaporation (mm)	649.9	660.7	653.8
Rainfall (mm)	544.3	735.4	639.9
Irrigation water supplied (mm)	436.0	217.0	326.5
Crop duration (days)	147	147	147
Crop yield ( $\text{kg ha}^{-1}$ )	3195	3462	3329
Water-use efficiency ( $\text{kg ha}^{-1} \text{mm}^{-1}$ )	3.8	4.3	4.1

high. Hence it was identified as a critical phase for the water requirement in pigeonpea.

The seasonal ET of pigeonpea crop for Anand condition was around 819 mm, while that of EP was 654 mm (Table 2). Table 2 revealed that the yield of pigeonpea was more by 267 kg ha<sup>-1</sup> in the year 1993 as compared to the yield in 1992. This was due to the high atmospheric demand of water which was satisfied by supplementary irrigation during the flowering to pod development stages of the crop in 1993. Sinha (1980) observed that pigeonpea crop was damaged both from excess water as well as poor availability of water. The water-use efficiency of pigeonpea was 3.8 kg ha<sup>-1</sup> mm<sup>-1</sup> in 1992 and 4.3 kg ha<sup>-1</sup> mm<sup>-1</sup> in 1993.

Thus, the values of ET and LAI were high (8.6 mm day<sup>-1</sup> and 4.74) during the flower-

ing to pod development phases of the crop. The linear relationship between LAI and ET/EP was also observed.

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