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ESTIMATING RAINFALL INTENSITY*

*PENAKSIRAN INTENSITAS CURAH HUJAN**

Tohari**

INTISARI

Penelitian ini dilaksanakan untuk mengembangkan tiga model intensitas curah-hujan yang secara berurutan berdasarkan asumsi bahwa (1) intensitas curah-hujan berbanding langsung dengan curah-hujan total per hari dan berbanding terbalik dengan keseragaman lama hujan per hari untuk tiap bulan dalam setahun, (2) intensitas curah-hujan berhubungan secara linier terhadap curah-hujan total per hari, dan (3) intensitas curah-hujan berhubungan secara asimtotik terhadap curah-hujan total per hari. Di samping itu, penelitian juga bertujuan untuk menguji kemampuan tiga model intensitas curah-hujan yang dikembangkan untuk menaksir intensitas curah-hujan di tiga lokasi, yang hanya tersedia data curah-hujan total harian.

Hasil penelitian menunjukkan bahwa intensitas curah-hujan dihitung menggunakan model r_{iA} = (10/t)(RR_i) dan model r_{iC} = 1,9975 (1,0 – exp (-0,0860 RR_i)) tidak berbeda secara nyata dan lebih tinggi daripada intensitas curah-hujan dihitung menggunakan model r_iB = 0,0299 RR_i. Persamaan intensitas curah-hujan model r_{iA} = (10/t) (RR_i) dan model r_{iC} = 1,9975 (1,0 – exp (-0,0860 RR_i)) mempunyai kemampuan setara untuk menaksir intensitas curah-hujan.

Kata kunci : model intensitas curah-hujan

ABSTRACT

The experiment was conducted to develop three models of rainfall intensity based on the respective assumption that (1) there is similarity in daily rainfall duration for each month of the year, (2) there is a linear relationship between rainfall intensity and total rainfall per day, and (3) there is an asymptotic relationship between rainfall intensity and total rainfall per day. The ability of three developed models in estimating rainfall intensity were tested in three locations where amount of rainfall per day data are available.

The results showed that estimate of rainfall intensity computed using model r_{iA} = (10/t)(RR_i) and r_{iC} = 1.9975 (1,0 – exp (-0.0860 RR_i)) did not differ significantly and these were higher than that of rainfall intensity computed using model r_{iB} = 0.0299 RR_i. Model r_{iA} = (10/t) (RR_i) and model r_{iC} = 1.9975 (1,0 – exp (-0.0860 RR_i)) had the same ability in estimating rainfall intensity.

Key words : rainfall intensity modelling

INTRODUCTION

The intensity of rainfall affects surface run-off, physical properties of soil, and modifies the final pattern of soil water recharge (Baver, 1972). Run-off occurs whenever the rate of rainfall exceeds the rate of infiltration (Hillel, 1980; Raghunath, 1985). In consequence, run-off varies with amount and intensity of rainfall (and frequently with rainfall duration, since infiltration rate, initially high, tends to decrease with time) and with surface conformation (Slatyer, 1967).

The rate of rainfall per day is usually not available at the farm sites. The most available rainfall data is the amount of rainfall per day only, even at the Agrometeorological Station. Although the rainfall data are available, either the amount and duration of rainfall per rainfall even or total rainfall and rainfall duration per day, but these data can not be directly used when the daily rainfall intensity is required in the short period of time. It is, then, reasonable to develop a mathematical model of rainfall intensity in relation to total rainfall per day which can be

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used to estimate the rainfall intensity when the amount of rainfall per day is available

MATERIALS AND METHODS

Three models of estimating rainfall intensity were used. These models described below.

1. Model A. On the assumption that there is similarity in daily rainfall duration for each month of the year, then rainfall intensity at each site was computed by dividing total rainfall per day at the site with average rainfall duration per day computed by month from the nearest weather station data, as presented in equation (1). For this study the data from Los Banos, Laguna (IRRI dryland weather station) was used.

$$r_{iA} = \frac{RR_i}{t} \times 10 \qquad (1)$$

where :

r_{iA} = rainfall intensity on day i computed using model A in mm/10 minutes

RR_i = total rainfal on day i in mm

t = average rainfall duration per day in minutes

2. Model B. On the assumption that there is a linear relationship between rainfall intensity and total rainfall per day, then the rainfall intensity Model B was computed as follows :

$$r_{iB} = b \times RR_i \qquad (2)$$

where :

r_{iB} = rainfall intensity on day i computed using model B in mm/10 minutes

b = regression coefficient

RR_i = total rainfall on day i in mm

Equation (2) was computed using the average rainfall intensity and total rainfall per day data obtained from the nearest weather station. For this study the data from Los banos, Laguna (IRRI dryland weather station) was used.

3. Model C. On the assumption that there is an asymptotic relationship between rainfall intensity and total rainfall per day, then the rainfall intensity Model C was computed as follows :

$$r_{iC} = b_o(1.0 - \exp(-b_1.RR_i)) \qquad (3)$$

where :

r_{iC} = rainfall intensity on day i computed using model C in mm/10 minutes

RR_i = total rainfall on day i in mm

b_o, b_1 = regression parameters

Equation (3) was computed using the average rainfall intensity and total rainfall per day data obtained from the nearest weather station. For this study the data from Los Banos, Laguna (IRRI dryland weather station) was used.

Three estimated models of rainfall intensity were, therefore, used to compute the intensity of rainfall at three sites where total rainfall per day data are available. These three sites were (1) Balite, Victoria, Laguna, (2) Banlic, Calamba, Laguna, and (3) Central Experimental Station of the University of the Philippines at Los Banos, College, Laguna. The estimated values of rainfall intensity were, then, analyzed using a completely randomized design to detect whether there was a significant effect of model used at 5% level of significance. Duncan's Multiple Range Test was used to decide which model significantly differed to the others (Gomez and Gomez, 1984).

RESULT AND DISCUSSIONS

Rainfall intensity model A. Based on the rainfall duration per day from IRRI dryland weather station which their range and mean rainfall characters are given in Table 1, the average rainfall duration per day for given month was computed. The results are presented in Table 2. It is clear that there was a significant difference in the average of rainfall duration per day for each month. Using the average rainfall duration derived from IRRI data, the computed rainfall intensity were then used as estimate of rainfall intensity in the three locations.

Table 1. Monthly minimum, maximum, and mean total rainfall per day (mm), rainfall duration per day (minutes) and rainfall intensity per day[#] (mm/10 minutes) and correlation coefficient (r) between total rainfall per day and other rainfall characters at IRRI dryland weather station Los Banos, Laguna

Months	Rainfall Characters	Minimum	Maximum	Mean	r[@]
July	Number of rainy day			17	
	Total rainfall per day	0.6	166.9	19.4	
	Rainfall duration	20.0	750.0	134.4	0.92329**
	Rainfall intensity	0.01667	4.23333	1.25497	0.30864ns
August	Number of rainy day			10	
	Total rainfall per day	0.6	32.3	6.7	
	Rainfall duration	20	120	58.5	0.62325*
	Rainfall intensity	0.07500	2.86667	1.00370	0.71743**
September	Number of rainy day			20	
	Total rainfall per day	0.4	114.7	11.9	
	Rainfall duration	10.0	520.0	150.5	0.47993*
	Rainfall intensity	0.07619	3.47576	0.93611	0.67752**
October	Number of rainy day			20	
	Total rainfall per day	0.3	90.0	15.4	
	Rainfall duration	10.0	1010.0	278.5	0.75232**
	Rainfall intensity	0.08667	3.80000	0.91256	0.16373ns
November	Number of rainy day			14	
	Total rainfall per day	0.6	20.7	6.4	
	Rainfall duration	20.0	480.0	143.2	0.14488ns
	Rainfall intensity	0.13333	4.14000	0.85550	0.77146**
December	Number of rainy day			12	
	Total rainfall per day	0.5	22.6	8.8	
	Rainfall duration	10.0	650.0	169.2	0.65842*
	Rainfall intensity	0.10000	2.13333	0.60596	0.55398*
January	Number of rainy day			4	
	Total rainfall per day	0.4	1.8	1.2	
	Rainfall duration	30.0	110.0	57.5	0.23936ns
	Rainfall intensity	0.11818	0.45000	0.24538	0.73338ns

[@]** - significant at 1% level of significance; * - significant at 5% level of significance; ns – not significant ; [#] - computed only for rainy day

Table 2. Average rainfall duration per day (minutes) during the months of july, August, September, October, November, December 1985 and January 1986 at IRRI dryland weather station, Los Banos, Laguna

Months	Number of Rainy Day	Average Rainfall Duration[@]
July	17	134.4 ab
August	10	58.5 b
September	20	150.5 ab
October	20	278.5 a
November	14	143.2 ab
December	12	169.2 ab
January	4	57.5 b

[@]In a column, means followed by a common letter are not significantly different at 5% level by DMRT

Rainfall intensity model B and C. Based on rainfall data from IRRI which their range and mean rainfall characters are given in Table 1, the linear and non-linear regression between rainfall intensity and total rainfall per day was computed. The results are as follows :

$$r_{iB} = 0.0299\ RR_i\ (r = 0.57^{**})$$

$$r_{iC} = 1.9975\ (1.0 - \exp(-0.0860\ RR_i))\ (r = 0.50^{**})$$

These above-mentioned equations indicate that a significant portion of the variability in rainfall intensity can be explained by total rainfall per day. Using regression equation derived from IRRI data, the intensity of rainfall for the three test sites were computed. These computed rainfall intensity were then used as estimate of rainfall intensity in the three locations.

The intensity of rainfall computed using three models: $r_{iA} = (10/t)(RR_i)$, $r_{iB} = 0.0299\ RR_i$ and $r_{iC} = 1.9975\ (1.0 - \exp(-0.0860\ RR_i))$ for the three locations are given in Table 3. It should be noted that rainfall intensity computed using model A and C did not differ significantly in the three sites. These estimates were significantly higher than that of rainfall intensity computed using model B (Table 4). This indicates that model $r_{iA} = (10/t)(RR_i)$ and $r_{iC} = 1.9975\ (1.0 - \exp(-0.0860\ RR_i))$ had the same ability in estimating rainfall intensity and differed significantly as compared to model $r_{iB} = 0.0299\ RR_i$.

Table 3. Average rainfall intensity[#] (mm/10 minutes) computed using three estimation models of rainfall intensity in three location during the course of study

Location	Months	Rainfall	Intensity	Model
		r_{iA}	r_{iB}	r_{iC}
Balite, Victoria, Laguna	August	1.11	0.20	0.85
	September	0.98	0.44	1.34
	October	0.69	0.57	1.20
	November	0.67	0.29	0.98
	December	0.65	0.33	1.02
Banlic, Calamba, Laguna	July	1.17	0.47	1.01
	August	1.05	0.18	0.64
	September	0.85	0.38	1.00
	October	0.46	0.38	0.90
	November	0.37	0.16	0.64
	December	0.54	0.27	1.00
	January	0.38	0.19	0.85
Central Experimental Station, Los Banos, Laguna	July	1.53	0.62	0.94
	August	0.82	0.15	0.58
	September	0.75	0.34	0.66
	October	0.63	0.52	1.05
	November	0.57	0.22	0.78
	December	0.48	0.24	0.85
	January	0.14	0.03	0.13

[#] - computed only for rainy day

Table 4. Predicted rainfall intensity# (mm/10 minutes) computed using three estimation models of rainfall intensity in three location during the course of study

Location	Rainfall	Intensity	Model[@]
	r_{iA}	r_{iB}	r_{iC}
Balite, Victoria, Laguna	0.82 a	0.37 b	1.08 a
Banlic, Calamba, Laguna	0.69 a	0.29 b	0.86 a
CES, Los Banos, Laguna	0.70 a	0.30 b	0.72 a

[@] In row, means followed by a common letter are not significantly different at 5% level by DMRT

[#] - computed only for rainy day

CONCLUSION

The results showed that :

1. The estimate of rainfall intensity computed using $r_{iA} = (10/t)(RR_i)$ and $r_{iC} = 1.9975\ (1.0 - \exp(-0.0860\ RR_i))$ did not differ significantly and these were higher than that of rainfall intensity computed using model $r_{iB} = 0.0299\ RR_i$; and
2. Model $r_{iA} = (10/t)(RR_i)$ and $r_{iC} = 1.9975\ (1.0 - \exp(-0.0860\ RR_i))$ had the same ability in estimating rainfall intensity.

It should be noted, however, that this model was only developed in the vicinity of the University of the Philippines at Los Banos. It is, therefore, recommended that a follow-up study be instituted in other locations with different environmental conditions.

LITERATURE CITED

Baver, L.D. 1972. *Soil physics*. Third Edition. John Wiley & Sons, New York. 489 p.

Gomez, K.A. and A.A. Gomez. 1984. *Statistical procedures for agricultural research*. Second Edition. John Wiley and Sons, New York. 680 p.

Hillel, D. 1980. *The application of soil physics*. Academic Press, New York. 385 p.

Raghunath, H.M. 1985. *Hydrology: Principles, analysis and design*. John Wiley & Sons, New York. 482 p.

Slatyer, R.O. 1967. *Plant-water relationships*. Academic Press, New York. 366 p.

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PROGRAM PEMULIAAN KONVENSIONAL TANAMAN SALAK DI FAKULTAS PERTANIAN UGM

SALAK CONVENTIONAL BREEDING PROGRAM IN FACULTY OF AGRICULTURE GMU

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ABSTRACT

Salak as an original crop from Indonesia has a high potential to develop as one of the main fruit product to export to international market. However in fulfilling international standard quality of fruit production, the salak cultivars in Indonesia should be improved through an integrated breeding program.

The paper told about salak breeding program conducted in Faculty of Agriculture, Gadjah Mada University. The model was developed based on materials have it, i.e. bulk population of local varieties. As many aspects of the crop have not been investigated yet, the paper also suggests that research on fisiological genetics and biotechnology should be stressed in the future to support the breeding program of this crop.

INTISARI

Salak merupakan tanaman asli Indonesia yang berpotensi tinggi untuk dikembangkan sebagai salah satu produk ekspor utama ke pasar internasional. Akan tetapi untuk memenuhi standar kualitas produksi buah, kultivar salak di Indonesia seharusnya diperbaiki melalui program pemuliaan yang menyeluruh.

Program pemuliaan tanaman salak dilaksanakan di Fakultas Pertanian Universitas Gadjah Mada. Model dikembangkan berdasarkan materi utama yang dimiliki, antara lain: populasi *bulk* varietas lokal. Banyak aspek tanaman salak yang belum diteliti sebelumnya, ditegaskan lagi bahwa penelitian genetik-fisiologi dan bioteknologi harus lebih mendukung program pemuliaan tanaman salak.

PENDAHULUAN

Usaha peningkatan ekspor produk hortikultura akhir-akhir ini mendapat perhatian utama pemerintah, sebagai salah satu komoditas andalan dalam penanggulangan krisis moneter melalui sektor pertanian. Salak (*Salacca zalacca* (Gaertner) Voss.) merupakan tanaman asli Indonesia (LBN-LIPI, 1980). Daerah penghasil salak di Jawa yang terkenal antara lain Condet (Jakarta), Manonjaya (Jawa Barat), Kedungparuk (Purwokerto, Jawa Tengah) Sleman (Daerah Istimewa Yogyakarta/DIY), Bangkalan (Madura), Suwaru (Malang-Jawa Timur), dan sebagainya. Di luar Jawa, antara lain Karangasem (Bali), Tahulandang (Sulawesi Utara) dan Padangsidempuan (Sumatra). Species ataupun varietas yang berkembang di setiap daerah sangat berlainan, yang kesemuanya ini merupakan sumber keragaman genetik yang sangat penting bagi usaha pemuliaan tanaman salak.

Salak pondoh belakangan ini dipromosikan sebagai produk hortikultura andalan dari DIY, khususnya Kabupaten Sleman (Sungkono, 1997). Komoditas ini sudah dikenal pada skala nasional tetapi sampai sekarang produk ini belum mampu menembus pasaran ekpor secara rutin. Dikarenakan mutunya menurun sampai di negara tujuan, penyebab utamanya adalah penyimpanan yang belum memenuhi standar. Disamping sifat unggulnya, salak pondoh juga memiliki beberapa kelemahan seperti daging buah yang relatif tipis, biji relatif besar dan penampilan buah yang kurang menarik (kusam).

Usaha pemuliaan tanaman salak yang dilakukan secara terprogram dan sistematis, hingga saat ini belum pernah dilakukan.

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