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IMPACT OF ECOLOGICAL FACTORS IN THE SEEDLINGS PERIOD OF PADDY

S.R. SINGH, P. RUKAMANI DEVI, N.B. DEVI, W.K. DEVI and N.S. DEVI*
Post-Graduate Studies Centre, HRDRI, Canchipur – 795003, Imphal, India.
* Botany Department, Imphal College, Imphal, Manipur, India.

Agro-ecosystem, an important key in environment as its changing would be consequent to changes in vast cereal ecosystem, the components and their functions of paddy fields has been formulated with selection of two varieties *viz.* Leimaphou (CV_1) and Phoudongba (CV_2) for facilitating and understanding of the components of eco-system of seedling period and impact of meteorological factors. The RGR on height, biomass (RGRd, RGRw) canopy, LA, LAI, growth of radicle, growth of plumule and radicle/plumule ratio of test cultivars have close corelationship with meteorological parameters. It explore the prime task the releasing crop varieties to the suitable agro-climatic zone with a view to conserve environment with more production for betterment of humankind in the wetland of Imphal valley.

Keywords : Agro-ecosystem; Biomass; Canopy; Leaf Area (LA); Leaf Area Index (LAI); Regulatory Growth Rate (RGR); Wetland.

Introduction

Mathematically plant consists of an assembly of discrete units each of which has measurable attributes such as number, size, weight and length. If the development of a rice crop defined as the outcome of processes of differentiation and growth[1], the rate of differentiation can be expressed by an increase in primordial numbers, whereas the growth of an organ is expressed and measured by an increase in its size or weight, cell division and expansion provide a basic example of the distinction between number and size. It is applicable to any higher level of organization and weather indeed, environmental factors generally to determine the time at which a specific developmental process begins, the subsequent rate of development and the time when the process stops. Various crop ecologist have been more concerned with measuring rates, particularly changes of weight per unit time related to transpiration and photosynthesis for about past 30 years[2], the changes in size per unit time have usually been measured over periods which are too long to reveal the sensitivity of rates of expansion to temperature changes. Mean temperatures recorded from day to day fluctuate around the monthly mean in response to changes in the synoptic pattern of weather. In terms of plant growth, the diurnal temperature cycle is more important than either the regular seasonal cycle of the random effects of weather. Whatever the cause, extremes of temperature occurring for a period of several days or even few hours, may severely reduce the growth of annual crops or even destroy perennial species.

This present work investigate some basic concept that help in establishing a clear understanding of the adaptability of high yielding variety of rice cultivars CV_1 (Leimaphou) and CV_2 (Phoudongba) to the environment at Imphal valley, Manipur, which include –

—To analyze consequence of ecological factors to radicle and radicle/plumule.

—To determine the regulatory growth rate (RGR) and plant growth to test crop varieties CV_1 and CV_2.

—To analyze the ecological impacts on LA, LAI, and canopy.

Materials and Methods

Investigation on the agro-ecological studies on paddy field was conducted in farmer's field during two kharif crop seasons *viz.* 2001 and 2002 at "Kitna Panung Loukon" situated in the Imphal East District of Manipur (24°5′ to 25°16′) Latitude and 93°37′ to 94°15′ E Longitude). The corresponding meteorological parameters during the course of study were recorded from the Tulihal Airport, Imphal and ICAR, Lamphel, Imphal, the nearest and in the area of same agro climatic zone. The investigation is mainly concerned for vegetative phases by determination of growth of radicle, growth of plumule and ratio of radicle/plumule, Regulatory Growth Rate (RGR), Leaf Area (LA), Leaf Area Index (LAI) and Canopy. For growth of radicle, growth of plumule and ratio of radicle/plumule were measured at an interval of 24 hours and RGR, the plant height was measured at an interval of four days right from emergence of seedlings and calculated as per the following formula[3].

$RGR = (\text{Log } W_2 - \text{Log } W_1)/(T_2 - T_1)$

where, W_2 =Final dry weight, W_1 =Initial dry weight, T_1 and T_2 are respective time intervals

For plant growth, observation was measured as per treatment at four days intervals following Blackman's formula adopted by Mishra[3].

$W_1 = W_0 e^{rt}$

where, W_1 = final dry length, e= base of natural logarithm, r =rate of increase in dry weight per unit time, t=time interval

Investigation on leaf area (LA), canopy and leaf Area Index (LAI) were calculated by measurement of area of leaf, radius of stem, coverage area of canopy etc. at four days during the seedling period (vegetative phase) of test crop varieties CV_1 and CV_2 following Mishra[3].

LA (Leaf Area) = k × length × width

where, k = the adjustment factor (0.670)

LAI (Leaf Area Index) = {Sum of leaf area/hill of six hills (m^2)}/ {Area of land covered by six hills (m^2)}

Canopy = πr^2

where, r is the radius of the test crop.

Results and Discussion

The ecology of agricultural production systems and the natural resources being required to sustain the main components, crops and yield components thereof. The growth of radicle, plumule and their increment values and the ratio of radicle and plumule for test varieties CV_1 and CV_2 were recorded and shown in Table 1. The maximum rate of increment of radicle i.e. 22.8 mm for CV_1, 21 mm for CV_2 have attained on 9th and 7th June in 2001. The maximum increment of plumule length 20.4 mm, 19.3 mm attained on 7th and 5th June 2001 and 2002 in CV_1.

The height of the plant, biomass in wet and dry values of CV_1 and CV_2 during the crop season 2001 and 2002 was displayed in Table 2. Lea Area (LA), Canopy, Leaf Area Index (LAI) and increment values during vegetative phase in CV_1 and CV_2 for crop season 2001 and 2002 were shown in Table 3. The highest rate of increment value of LA (cm^2) i.e. 4.811 on 24th June and 5.36 cm on 28th June in CV_1 and CV_2 were recorded in 2001. In 2002, the highest 5.9697 cm on 24th June and 9.112 cm on 28th June in CV_1 and CV_2 were recorded. The highest LAI 2.4729 and 0.5803 was observed on 28th June on CV_1 and CV_2 during 2001. During 2002, the highest 2.0299 and 0.4021 on CV_1 and CV_2 were accorded on 28th June 2002.

The influential impact on RGR by meteorological factors to varieties CV_1 and CV_2 for crop seasons 2001 and 2002 were computed and recorded (Table 2). Highest RGR values 0.0405 on 12th June and 0.1256 on 8th June in CV_1 and CV_2 during 2001 and 0.9158 on 4th June and 0.0816 on 8th June in CV_1 and CV_2 during 2002 was accorded (Table 2). The RGR values in biomass (wet) attained height i.e. 0.2465 mg and 0.2214 mg were attained on 8th June 2001. In 2002 the highest 0.2371 mg and 0.2361 mg on 8th and 4th June 2002 was observed in CV_1 and CV_2 respectively. The maximum RGR values in biomass (dry) i.e. 0.229 and 0.229 for CV_1 and CV_2 on 4th June 2001. Similarly the highest value 0.229 mg of biomass in CV_1 and CV_2 was observed on 4th June 2002.

Table 1 accords different values of radicle, plumule, increment value and ratio of radicle/plumule during 2001 and 2002 for both CV_1 and CV_2 with different meteorological factors. On 2nd day CV_1 accorded as 12.3 mm radical in 2001 and 20.3 mm in 2002. On last day growth of radicle for CV_1 accorded as 123.2 mm in 2001 and 110.5 mm in 2002 respectively. For CV_2 the growth of radicle on second day was observed as 18.2 mm in 2001 and 25.0 mm in 2001. On last day, growth of radicle for CV_2 was accorded as 110 mm in 2001 and 105.3 mm in 2002 respectively. The maximum rate attainment of increment of radicle for CV_1 was recorded as 22.8 mm on 9th June and minimum as 8.3 mm on 5th June during 2001. In 2002, the maximum rate attainment of increment of radicle for CV_1 was recorded as 21 mm on 7th June and minimum as 4.3 mm on 4th June for CV_2, the maximum rate attainment of increment of radicle was observed as 21.8 mm on 6th June and minimum as 9 mm on 8th June 2001. The maximum rate attainment of increment of radicle for CV_2 was accorded as 16.2 mm on 8th June and minimum as 7.2 mm on 6th June 2002.

In CV_1 the highest attainment of rate of radicle length increment was observed on 9th June 2001, with 22.9 mm from the previous day (i.e. 100.3 mm to 123.2 mm) which corresponds with meteorological factors 30.4°C maximum, 20.2°C minimum temperatures, relative humidity 98% - 81% and rainfall 38.7 mm (Table 1). In case of CV_2, highest attainment of radicle length was recorded on 6th June as 78.0 mm with an increment rate of 21.8 mm from the previous observation i.e. 56 mm to 78.0 mm which coincides with temperature of 24.5°C maximum and 19.9°C minimum, relative humidity 98% - 91% and rainfall 56.5 mm. Minimum increment rate of radicle was recorded on 8th June, its increment from the previous observation period is only 9.0 mm (i.e. 88.0 mm – 97.0 mm) which coincides with temperature 27.5°C maximum, 21.1°C minimum, relative humidity 94% - 75% and rainfall 18.4 mm (Table 1). From the present investigation it shows that maximum attainment of radicle length for CV_1 was recorded as 123.2 mm during 2001. On second day (i.e. 2nd June) growth of plumule for CV_1 was recorded as 20.3 mm and 18.0 mm in 2001 and 2002 respectively. On last day, 9th June growth of plumule was accorded as 95.5 mm and 98.5 mm in CV_1 during 2001 and 2002. For CV_2 on 2nd days growth of plumule was observed as 15.3 mm and 16.9 mm on 2001 and 2002. On the last day, 9th June growth of plumule for CV_2 was accorded as 92.3 mm and 75.9 mm in 2001 and 2002. The maximum rate

Table 1. Analysis of characteristics of radicle and plumule of CV_1 and CV_2 with their meterological parameters.

Y_1 (2001)

1	2		3		4		5		6		7	8	9	10	11	12	13
	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2							
1/6/01	-	-	-	-	-	-	-	-	-	-	31.0	19.2	25.1	72	83	77.5	17.9
2/6/01	12.3	18.2	-	-	20.3	15.3	-	-	0.6:1	1.18:1	29.5	20.4	24.9	83	63	73.0	4.2
3/6/01	24.0	35.0	11.7	11.7	35.2	28.4	14.9	9.2	0.68:1	1.23:1	31.0	20.6	25.8	79	64	71.5	14.0
4/6/01	40.0	45.0	16.0	16.0	38.1	30.7	2.9	2.3	1.04:1	1.46:1	26.9	22.6	23.7	91	90	90.5	8.4
5/6/01	48.3	56.2	8.3	8.3	42.6	48.1	4.5	17.4	1.1:1	1.16:1	22.6	20.0	21.3	98	94	96.0	65.1
6/6/01	59.5	78.0	11.2	11.2	49.8	63.4	7.2	15.3	1.19:1	1.23:1	24.5	19.9	22.2	98	91	94.5	56.1
7/6/01	78.8	88.0	19.3	19.3	70.2	73.1	20.4	9.7	1.13:1	1.20:1	29.1	20.4	24.7	91	75	83.0	14.0
8/6/01	100.3	97.0	21.5	21.5	90.1	80.6	19.9	7.5	1.11:1	1.20:1	27.5	21.1	24.3	75	94	84.5	18.4
9/6/01	123.2	110.0	22.9	22.9	95.5	92.3	5.4	11.7	1.29:1	1.19:1	30.4	20.2	25.3	98	81	89.5	38.7
	Y_2 (2002)																
1/6/02	-	-	-	-	-	-	-	-	-	-	30.5	19.1	24.8	90	72	81	0.0
2/6/02	20.3	25.0	-	-	18.0	16.9	-	-	1.21:1	1.47:1	29.3	20.4	24.8	75	68	71.5	0.5
3/6/02	35.2	40.0	14.9	15.0	21.6	22.0	3.6	5.1	1.62:1	1.8:1	31.1	20.5	25.8	65	64	64.5	0.0
4/6/02	30.9	50.2	4.3	10.2	30.9	30.8	9.3	8.8	1:1	1.62:1	30.6	19.9	25.2	66	70	68	0.0
5/6/02	50.2	58.0	15.0	7.8	50.2	42.8	19.3	12.0	1:1	1.35:1	61.3	19.7	25.5	68	63	65.5	0.0
6/6/02	71.2	65.2	19.3	7.2	63.5	51.3	13.3	8.5	1.12:1	1.27:1	31.0	20.4	25.7	69	64	66.5	0.0
7/6/02	88.0	73.8	21.0	8.6	87.0	63.0	14.5	11.4	1.12:1	1.17:1	31.0	20.6	25.8	79	65	72	0.0
8/6/02	95.6	90.0	16.8	16.2	91.2	70.3	3.2	7.3	1.17:1	1.28:1	30.6	19.5	25.0	66	68	67	0.0
9/6/02	110.5	105.3	7.6	15.3	98.5	75.9	17.3	5.6	1.12:1	1.38:1	28.3	21.5	24.9	75	76	75.5	0.0

1 = Date of observation
2 = Growth of radicle (mm)
3 = Increment value of radicle (mm)
4 = Growth of plumule (mm)
5 = Rate of increment value of plumule (mm)
6 = Ratio of radicle/plumble (mm)
7 = Maximum temperature (°C)
8 = Minimum temperature (°C)
9 = Mean temperature (°C)
10 = RH value in Morning (%)
11 = RH value in Afternoon (%)
12 = RH Mean (%)
13 = Rainfall (mm)
CV_1 = Leimaphou
CV_2 = Phoudongba

Table 2. Analysis of RGR with reference to plant height and biomass during vegetative phase (2011-2002).

1	2		3		4		5	6	7	8	9	10	11
	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2							
Y_1 (2001)													
4/6/01	0.8888	0.5802	0.2290A	0.2290A	0.1732	0.1884	26.9	20.6	23.75	91	90	90.5	8.4
8/6/01	0.2388	0.2513	0.1732	0.1175	0.4930D	0.4429D	27.5	21.1	24.3	75	94	84.5	18.4
12/6/01	0.1215	0.1209	0.1175	0.1399	0.0664C	0.1013	30.3	20.1	25.2	84	75	79.5	10.4
16/6/01	0.0637B	0.1038	0.0679C	0.1129	0.0719	0.1068	27.4	21.3	24.35	82	82	82	24.3
20/6/01	0.0409	0.0349B	0.0333	1.0217	0.0507	0.0306C	28.7	21.0	24.85	80	62	71.5	3.4
24/6/01	0.0564	0.0419	0.5956	0.5858	0.4113	0.3984	30.1	22.4	26.25	72	70	71.0	1.2
28/6/01	0.0292	0.0513	0.0745	0.0980	0.0189	0.0188	31.6	21.8	26.7	73	65	69.0	1.2
Y_2 (2002)													
4/6/02	0.9158	0.9093	0.2290A	0.2290A	0.1809	0.2361	30.6	19.9	25.25	70	66	68	-
8/6/02	0.1857	0.1632	0.1732	0.0841C	0.1809	0.2360	30.6	19.5	25.05	68	66	67	-
12/6/02	0.1301	0.2083	0.1013	0.0628	0.0602C	0.0584C	28.3	20.7	24.5	95	82	88.5	41.5
16/6/02	0.0927B	0.0186B	0.0900C	0.1104	0.0989	0.0719	30.7	21.6	26.15	90	86	88	4.8
20/6/02	0.0360	0.0756	0.02275	0.1347	0.0459	0.1308	31.5	21.5	26.5	80	65	72.5	5.3
24/6/02	0.0507	0.0404	0.5956	0.6050	0.4063D	0.3929	28.6	21.5	25.05	83	81	82	10.8
28/6/02	0.0414	0.0508	0.1108	0.0854	0.0243	0.0185	30.1	22.4	26.25	79	63	71	0.1

I = Date of observation
2 = RGR valeue in height (cm)
3 = RGR value in wet (mg)
4 = RGR value in dry (mg)
5 = Maximum temperature (°C)
6 = Minimum temperature (°C)
7 = Mean temperature (°C)
8 = RH in Morning
9 = RH in Afternoon (%)
10 = RH Mean (%)
11 = Rainfall (mm)
A = Weight with seeds
B = Less growth
C = Low biomass
D = High biomass

Table 3. Analysis of LA, Canopy, and LAI during vegetative phase of CV_1 and CV_2 (2001-2002).

1	2		3		4		5		6	
	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2
Y_1 (2001)										
4/6/01	0.067	0.067	-	-	0.1257	0.1257	-	-	0.5330	0.5330
8/6/01	0.1507	0.1507	0.0837	0.0837	0.7857	0.7857	0.66	0.66	0.1918	0.1918
12/6/01	1.2194	0.217	1.068	0.0663	1.1314	1.52	0.3457	0.7343	1.0777	0.1427
16/6/01	1.742	0.5025	0.523	0.2855	5.3114	8.0457	4.18	6.5237	0.3280	1.0624
20/6/01	1.8894	1.1256	0.147	0.6231	8.0457	10.1828	2.7343	2.1371	0.2348	0.1105
24/6/01	6.7	4.288	4.811	3.1624	11.3457	15.2114	3.3007	5.0286	0.5905	0.2818
28/6/01	11.256	9.648	4.556	5.36	13.86	16.6257	2.5143	1.4143	0.8121	0.5803
Y_2 (2002)										
4/6/02	0.067	0.067	-	-	0.1257	0.1257	-	-	0.5330	0.5330
8/6/02	0.1715	0.1715	0.4985	0.4985	1.1314	0.5028	1.0057	0.3771	0.1515	0.3410
12/6/02	1.34	0.4321	1.685	0.2606	1.54	1.54	0.4086	1.0372	0.8701	0.2805
16/6/02	1.876	0.8375	0.536	0.4054	7.0714	6.16	5.0714	4.62	0.2652	0.1359
20/6/02	2.8743	1.407	0.9983	0.5695	9.02828	8.0457	2.0114	1.8857	0.3183	0.2579
24/6/02	8.844	4.288	5.9697	2.881	13.56	16.6257	4.4772	8.58	0.6522	0.2579
28/6/02	14.07	13.4	5.226	9.112	16.6257	18.1028	3.0657	1.4771	0.8462	0.7402

1 = Date of observation; 2 = Leaf area (cm^2); 3 = Rate of increment value of LA (cm^2); 4 = Canopy (cm^2); 5 = Rate of increment value of canopy (cm^2); 6 = Leaf Area Index.

attainment of increment of plumule for CV_1 was observed as 20.4 mm on 7th June and minimum on 4th June with 29.0 mm in 2001. In 2002, the maximum rate attainment of increment of plumule for CV_1 was recorded as 19.3 mm on 5th June and minimum as 3.2 mm on 8th June. In CV_2, the maximum rate attainment of increment of plumule during 2001 was observed as 17.4 mm on 5th June and 2.3 mm on 4th June. During 2002, the maximum rate attainment of increment of plumule for CV_2 was recorded as 12 mm on 5th June and minimum as 5.1 mm on 3rd June (Table 1). Maximum attainment of plumule length in CV_1 was observed on 7th June with 70.2 mm, it is 20.4 mm increase from the previous observation (i.e. 49.8 mm to 70.2 mm) and corresponding meteorological factors were temperatures 29.1°C in maximum, 20.4°C in minimum, relative humidity 91%- 75% and rainfall 14 mm. Lowest rate attainment of increment of length of plumule was accorded on 9th June, with its value of 95.5 mm which coincides with temperature 30.4°C maximum, 20.2°C minimum, relative humidity 98% - 81% and rainfall 38.7 mm. From the present analysis it shows that maximum attainment of plumule during 2001 for CV_1 was 95.5 mm.

In case of CV_2 maximum increment rate of plumule was recorded on 5th June with 17.4 mm (i.e. 30.7 mm to 48.1 mm) the corresponding meteorological factors are temperature 22.6°C maximum, 20°C minimum, 98%- 94% relative humidity and 65.1 mm rainfall. The lowest increment rate of plumule was observed on 4th June with 2.3 mm only from the present value (i.e. 28.4 mm to 30.7 mm), the corresponding meteorological factors were temperatures 26.9°C in maximum, 22.6°C in minimum, relative humidity 91% - 90% and 8.4 mm rainfall (Table 1). From the above analysis it shows that maximum attainment of plumule for CV_2 during 2001 as 92.3 mm. The highest increment of plumule rate was recorded on 5th June with 12.0 mm (i.e. 30.8 mm to 42.8 mm). The lowest increment rate was observed on 9th June with its increment value of 5.6 mm from the previous period (i.e. 70.3 mm to 75.9 mm). From the present analysis it shows that maximum attainment of plumule length during 2002 for CV_2 as 75.9 mm (Table 1).

Ratio of radicle and plumule for CV_1 was observed as 0.6:1, 0.6:1, 1.04:1, 1.1:1, 1.19:1, 1.12:1, 1.11:1, 1.29:1, 1.12:1, 1.62:1, 1:1, 1:1, 1.12:1, 1.12:1, 1.17:1, 1.12:1, and 1.18:1, 1.23:1, 1.46:1, 1.16:1, 1.23:1, 1.20:1, 1.20:1, 1.19:1, 1.47:1, 1.8:1, 1.62;1, 1.35:1, 1.27:1, 1.17:1, 1.28:1, 1.38:1, for CV_2 during 2001 and 2002 respectively (Table 1).

Table 2 depicted the RGR on plant height and biomass values for CV_1 and CV_2 for 2001 and 2002 with their corresponding meteorological parameters. On second day (i.e. 4th June) RGR on plant height for CV_1 was recorded as 0.8888 cm and on last day (i.e. 28th June) the value was accorded as 0.0292 cm during 2001. In 2002, on 4th June RGR on plant height for CV_1 was observed as 0.9158 cm and 0.0414 cm on 28th June. RGR on plant height for CV_2 was recorded as 0.8502cm and 0.9093 cm on 4th June and 0.0513 cm and 0.0508 cm on 28th June during 2001 and 2002 respectively. RGR on wet biomass for CV_1 was recorded as 0.1732 mg and 0.1809 mg on 4th June and 0.0189 mg and 0.0243 mg on 28th June during 2001 and 2002 respectively. For CV_2 it accorded as 0.1884 mg and 0.2361 mg on 4th June and 0.0188 mg and 0.0185 mg on 2001 and 2002 respectively. RGR on dry biomass for CV_1 was observed as 0.299 mg and 0.229 mg on 4th June and 0.0743 mg and 0.1108 mg on 28th June in 2001 and 2002 respectively. RGR on dry biomass for CV_2 was accorded as 0.299 mg and 0.229 mg on 4th June and 0.0980 mg and 0.0854 mg on 28th June during 2001 and 2002 respectively.

Table 3 displayed the analysis results of Leaf Area (LA), Canopy, Leaf Area Index (LAI) and increment values during vegetative phase in rice CV_1 and CV_2. The maximum rate attainment of increment of leaf area for CV_1 was observed as 4.811 cm^2 and 5.9697 cm^2 on 24th June 2001 and 2002 respectively. The highest growth of the plant in terms of leaf area was recorded as 11.25 cm^2 on 28th June in CV_1 in 2001. The period coincides with meteorological parameters of temperature 21.8°C in minimum and 31.6°C in maximum, relative humidity 73%- 65% and rainfall 1.2 mm. But in case of 2002 the highest leaf area record on 28th June with a value of 14.07 cm^2 and the period coincides with the 22.4°C in minimum and 30.1°C in maximum, relative humidity 79%- 63% and rainfall 0.1 mm (Table 3).

In CV_2 the highest leaf area was accorded as 9.64 cm^2 in vegetative phase of crop growth in 2001. The period coincides with meteorological parameters of temperature 21.8°C in minimum, 31.6°C in maximum, relative humidity 73% 65% and rainfall 1.2 mm (Table 3). In 2001, the highest leaf area was accorded as 13.4 cm^2 in CV_2 the corresponding meteorological parameters of temperature 22.4°C in minimum, 30.1°C in maximum, relative humidity 79%- 63% and rainfall 0.1mm. From the present investigations of rice cultivars CV_1 and CV_2 it is clear that leaf area was affected by temperature. The finding was in agreement with that of Hung *et al.*[4] and IRRI[5].

Table 3 revealed the canopy of CV_1 and CV_2 in 2001. On 4th June, canopy was observed as 0.1257 cm^2; 0.125 cm^2 and 13.86 cm^2; 16.62 cm^2 on 28th June for CV_1 and CV_2 respectively during 2001. During 2002, canopy on 4th June for both CV_1 and CV_2 was accorded as 0.125 cm^2 and 0.125 cm^2 respectively and on 28th June 16.62 cm^2 and 18.102 cm^2 for CV_1 and CV_2 respectively. Highest rate of increment of canopy for CV_1 was accorded as 4.18 cm^2 on 16th June with corresponding meteorological parameters of temperatures 27.4°C in maximum, 21.3°C in minimum, relative humidity 82% and 24.3 mm in rainfall and lowest as 0.3457 cm^2 on 12th June in 2001 with meteorological parameters of temperatures 30.3°C in maximum, 20.1°C in minimum, relative humidity 84%-75% and 10.4 mm in rainfall. In CV_2 highest rate of increment of canopy was observed as 6.52 cm^2 on 16th June with corresponding meteorological parameters of temperatures of 27.4°C in maximum, 21.3°C in minimum, relative humidity 82% and rainfall 24.3 mm and lowest on 12th June with a value of 0.3457 cm^2 during 2001 with meteorological parameters of temperature 30.3°C in maximum, 20.1°C in minimum, relative humidity 84%- 75% and 10.4 mm in rainfall. The area cover or canopy for CV_1 was accorded as 13.86 cm^2 and 16.6 cm^2 on 2001 and 2002 respectively. In case of CV_2 it was recorded as 16.62 cm^2 and 18.1 cm^2 during 2001 and 2002. From the above analysis it shows that crop variety CV_2 (Phoudongba) covered more canopy than that of CV_1. It is evident from the present analysis that canopy of paddy varieties have influenced impact by meteorological factors consequently to yield and yield parameters as in trapping radiation energy and getting high of biological efficiency [6,7].

The attainment of leaf area index was recorded on 4th June with a value of 0.5330 in CV_1 and 0.5330 in CV_2 and on last day i.e. 28th June the value was accorded as 0.8121 and 0.5803 in CV_1 and CV_2 during 2001. In 2002, on 4th June leaf area index (LAI) for CV_1 and CV_2 accorded with a value of 0.5329 and 0.5329 respectively. On last day i.e. 28th June leaf area index (LAI) for CV_1 and CV_2 were observed as 0.8462 and 0.7402 (2002).

The finding indicates the impact of varieties to LAI, the key characteristics of exponent to the yield and yield factors with their micro and macro environment. King and Evans[8] reported the LAI values as high as 10 in wheat. Similar reports supports the present finding in various crops and from different parts of the country [9-11].

The highest growth in terms of leaf area index (LAI) was observed as 1.077 sq.cm. in the vegetative phase of the crop growth in CV_1 (2001). The period coincides with the meteorological parameters of temperature 20.1°C in minimum and 30.3°C in maximum, relative humidity 84%- 75% and rainfall 10.4 mm. In 2002, the leaf area index (LAI) for CV_1 was accorded as 0.8701 sq.cm, the corresponding meteorological parameters of 20.7°C in minimum temperature

and 28.3°C in maximum, relative humidity 95%- 82% and rainfall 41.5mm. In CV_2 the leaf area index accorded as 0.58 sq.cm, in 2001 with the meteorological parameters of temperatures 21.8°C in minimum and 31.6°C in maximum, relative humidity 73%- 69% and rainfall 1.2 mm. In 2002 in CV_2 the leaf area index was recorded as 0.7402 sq.cm, with 22.4°C in minimum and 30.1°C in maximum temperature, relative humidity 79%-63% and rainfall 0.1 mm. The present finding vividly showed that LAI of the present test crop varieties CV_1 and CV_2 have close correlation with meteorological factors i.e. high temperature, moderate relative humidity and low rainfall. Further this entity reflects to yield and yield parameter of the crop as the greatest net photosynthesis is achieved at high leaf area index. The finding is corroborative with that of the other workers[11].

Initial as well as maximum increment of RGR value with relation to plant height for CV_1 was recorded as 0.8888 and 0.8502 cm for CV_2 in 2001. The period considered with meteorological parameters of temperatures 26.9°C in maximum and 20.6°C in minimum, relative humidity 91% - 90% and rainfall 8.4 mm. But in case of 2002 it was accorded as 0.9158 cm for CV_1 and 0.2290 cm for CV_2 the corresponding with meteorological parameters of temperature 30.6°C in maximum and 19.9°C in minimum, relative humidity 70% - 66% and rainfall nil. During the observation period, lowest increment of RGR for CV_1 was recorded as 0.0292. The period coincides with meteorological parameters of temperature 31.6°C in maximum and 21.8°C in minimum, relative humidity 73% - 65% and rainfall 1.2 mm in 2001. For CV_2 it was recorded as 0.0349 cm with corresponding meteorological parameters of temperature 28.7°C in maximum, 21°C in minimum, relative humidity 80% - 62% and rainfall 3.4 mm. In case of 2002, lowest increment of RGR for CV_1 was accorded as 0.0360. The period coincides with the meteorological parameters of temperatures 31.5°C in maximum and 21.5°C in minimum, relative humidity 80% - 65% and rainfall 5.3 mm. For CV_2 it was accorded as 0.0186 cm with meteorological parameters of temperatures 30.7°C in maximum, 21.6°C in minimum, relative humidity 90% - 86% and rainfall 4.8 mm.

With relation to biomass in wet, initial attainment of RGRw was recorded as 0.1732 in CV_1 and 0.1884 in CV_2 on 4th June. The period coincides with the meteorological parameters of temperature 26.9°C in maximum and 20.6°C in minimum, relative humidity 91%-90% and rainfall 8.4 mm. On 8th June RGRw for both CV_1 and CV_2 were recorded as 0.4930 mg and 0.4429 mg respectively with corresponding meteorological parameters of temperatures 27.5°C in maximum and 21.1°C in minimum, relative humidity 75% - 94% and rainfall 18.4 mm during 2001. During 2002, on 4th June the initial attainment rate of RGR base on wet biomass (RGRw) was recorded as 0.1809 mg in CV_1 and 0.2361 in CV_2. The period coincide with meteorological parameters of temperature 30.6°C in maximum and 19.9°C in minimum, relative humidity 68%- 66% and rainfall nil (Table 2).

With relation to biomass in dry for both CV_1 and CV_2 during 2001 the initial attainment rate of RGR was recorded as 0.229 mg. The period coincides with meteorological parameters of temperatures 26.9°C in maximum and 20.6°C in minimum, relative humidity 91%-90% and rainfall 8.4 mm. Maximum increment rate of RGRd for CV_1 was accorded as 0.5956 mg and 0.5858 mg for CV_2. The period coincides with meteorological parameters of temperature 30.1°C in maximum and 22.4°C in minimum, relative humidity 73% - 65% and rainfall 1.2 mm. During the period of 2002, on 4th June, the initial attainment rate of RGR based on biomass in dry (RGRd) was recorded as 0.229 mg in both CV_1 and CV_2. The period coincides with meteorological parameters of temperature 30.6°C in maximum and 19.9°C in minimum, relative humidity 70% -66% and rainfall nil. The maximum increment of RGRd for CV_1 was recorded as 0.5956 mg and 0.6050 mg for CV_2, the corresponding meteorological parameters were temperature 28.6°C in maximum and 21.5°C in minimum, relative humidity 83%- 81% and rainfall nil. The present analysis showed that meteorological parameters affects the Regulatory Growth Rate (RGR), the basic of vital physiological kinematics of rice in test cultivars CV_1 and CV_2. The present finding was in agreement with that of previous workers[12-16].

The present investigation clearly showed that there exist an ecological relationship among RGR, canopy, LA, LAI, growth of radicle, growth of plumule and ratio of radicle/plumule in the environment of agro-ecosystems and here lies the crucial needs to find out the best type of crop species which is fittest to the environmental condition of Imphal valley before releasing the varieties so that it can conserve environment with more production for betterment of human kind.

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