Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 9, pp. 20074-20079, September, 2017

ISSN: 0976-3031

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

IMPACT OF CLIMATIC FACTORS ON FLOWERING OF THREE EXCLUSIVELY ENDEMIC IMPATIENS SPECIES (FAMILY BALSAMINACEAE) IN WESTERN GHATS OF INDIA

Prasad G[1]* and Antony VT[2]

[1]R&D Centre, Bharathiar University, Coimbatore, India
[2]Department, Botany, Kuriakose Elias College, Mannanam, Kottayam Phone

DOI: http://dx.doi.org/10.24327/ijrsr.2017.0809.0820

ARTICLE INFO

Article History:

Received 17th June, 2017
Received in revised form 21st July, 2017
Accepted 05th August, 2017
Published online 28th September, 2017

Key Words:

Rainfall, relativehumidity, temperature, Impatiens, flowering, endemic.

ABSTRACT

Study discusses climatic factor's impact on flowering of exclusively endemic *Impatiens johnii* Barnes, *I. coelotropis* C. E. C. Fischer and *I. platyadena* C. E. C. Fischer. Mean noon temperature ranged from 19^0 C - 19.5^0 C revealing no influence on flowering. But survival is only in temperature range around 19^0C.

Peak Relative Humidity from July to September persuades *I. johnii* to initiate flowering. At higher RH flowering plants were more except in *I johnii* which flowers from September to December. Vegetative resurrection happened in all species by onset of monsoon. In *I johnii,* a facultative lithophyte vegetative enlargement took 3 months for flowering. Rainfall triggers spontaneous and staggered flowering in other two as and when it rains.

Even at lower rainfall higher RH favors optimum flowering ascribed to stored biomass of previous year's growth. There is direct relationship of luxurious flowering and high rainfalls. Low rains reduce seed production and number of new individuals for coming year.

INTRODUCTION

According to Went (1963) climate is the most important environmental factor affecting plant growth and development. However the various elements that create climate does not operate singly. Variation in one of these climatic factors affects others and modifies the various physiological processes in plants. Climate can be attributed as one of the reasons for differential distribution of plant species throughout the world or in any geographical region (Bareja, 2011)

Climate is an overall effect of atmospheric condition of a place produced over a long period of time. Eagleman (1985) reported that climate is more than just average weather and that a realistic description should include the extremes as well as the average weather as to temperature and other atmospheric elements. Aspects to be considered include temperature, humidity, rainfall, solar radiation, cloud, wind and atmospheric pressure. Poincelot (1980) clarified that climatic data are obtained with the use of instruments that are 2 or more meters above the ground. To distinguish, the term macroclimate is used to refer to the atmospheric climate while microclimate refers to the climate below this level, which is restricted to a locality.

Microclimate is likely to change depending upon conditions of surface profile, wind, precipitation, vegetation type and density, edaphic features, slope, anthropogenic alterations like constructions, pavements and other surface conditions both natural and artificial. Thus microclimate of an area is a key determinant of the distribution of RET species.

The genus *Impatiens* (Family Balsaminaceae) is represented by above 1000 species distributed in tropical and north temperate regions of world, chiefly India, China and Africa, with a few representatives in America and Europe. India has 210 species distributed mainly in Himalayas and Western Ghats (Pusalkar and Singh, 2010).

Impatiens is highly habitat and climate specific. Hence this study was undertaken. It discusses the impact of Climatic factors on the flowering of 3 exclusively endemic *Impatiens* species in Western Ghats, India. They are *Impatiens johnii* Barnes, *I. coelotropis* C. E. C. Fischer and *I. platyadena* C. E. C. Fischer. Their only known common habitat is in Munnar Landscape adjacent to Eravikulam National Park. The above 3 species are rare and endemic to Sothern Western Ghats and are confined to Shola habitat of Munnar landscape. These species have a very narrow geographic range and detailed information is unavailable. *I. coelotropis* is reported to be present in Idukki and Palakkad districts of Kerala state, whereas other 2 species

Corresponding author:* **Prasad G
R&D Centre, Bharathiar University, Coimbatore, India

are reported only from Idukki District (Sashidharan, 2013). The only known habitat of *I. johnii* is Pettimudy - Kallarvalley area of Munnar. *I. coelotropis* is having a better distribution outside the study area, but *I.platyadena* is another species having limited distribution in the study area and in very few countable localities in the fringes of Eravikulam National Park. As per literature available, (Vivekananthan *et al*, 1997; Rao *et al*, 2003; Sasidharan 2013) the three balsams studied are Endemic and Endangered/Critically Endangered. According to Vivekananthan *et al*., *I. platyadena* was probably an 'Extinct' species (1997) and 'Critically Endangered' as per Nair (1991). Present IUCN Status of *I. platyadena* is "CR B1(Critically Endangered & Geographical range /extend of occurrence is <100km2)". Barnes had described *I johnii* from Kallar Valley near Eravikulam National Park in 1931 and after a lapse of 67 years Biju *et al*. (1999) rediscovered the species from same locality. This species was categorized as 'rare' or 'threatened' by Vajravelu and Daniel (1983) and 'endangered' as Nair (1991).

MATERIALS AND METHODS

Location and duration of study

The work pertains mainly to the immediate surroundings of Eravikulam National Park in Idukki Revenue District in Kerala State, covering Forest areas of Munnar Territorial Division. Pettimudi, where the maximum population of all 3 species was recorded is a cup shaped valley facing to west, sharing boundary with Hamilton plateau (present Eravikulam National Park) in the upper northern end. The elevation varies from 1400 m- 1900 m MSL. This unique area subtends a wet evergreen forest with few small perennial streams flowing towards the Edamalayar dam. Since the global distribution of all the 3 species are confined to this common locality, and they are not seen outside, the micro climate of the common occurrence area is to be studied.

The study area lies between North 10°18'53.12"N, 77° 5'27.39"E to South 10° 8'28.90"N, 77° 2'23.74"E and West 10° 9'41.64"N, 76°58'33.11"E to East 10°13'51.58"N, 77° 7'58.96"E. The National Park and the adjoining forest lands are inevitable in maintaining the micro-climate and providing drinking water to the surrounding estates and for irrigation in parts of the *Anchunad* Valley. The area gives rise to tributaries of west flowing Periyar and Chalakudy rivers and is important as their catchment. South-West monsoon dominates annual weather cycle and temperature varies from 17^{O} C to 22^{O}C. Average humidity ranges from 62 %to 98 %. Duration was from 2013 to 2016.

Materials and methods

Observations were made in the natural habitat at Pettimudy for various phenological events of the plants from January 2013 to December 2016. Populations of all the 3 species were identified through field survey in the study area and individuals were counted in various months to know the number of new seedlings, mature plants and those with flowers to analyze any correlation with changing climate parameters. The number of plants, and those with flowers in each month were collected. The elements of climate including Rainfall, Relative Humidity and temperature were also recorded during the same period. Temperature was recorded at 2pm noon throughout the study period. The climate data was entered in MS Excel worksheet and analyzed graphically and compared with number of flowering individuals.

RESULTS

The diagrammatic representation of monthly climate data from 2013 to 2016 *viz* Rainfall, Relative Humidity and Temperature in natural habitats of the study species are given in Graph 1 to Graph 3. The number of plants of each species and those with flowers in each month is given as Table 1.

Rainfall

Rainfall is the most common form of precipitation in the study area. In 2013, summer showers were present from February (1.09 cm) to April (2.61 cm). We recorded the least quantity of summer showers of March (1.29 cm) than in the coming 3 consecutive years of study. In May it moved up to 18.16 cm. Rainfall recorded during June - July showed a maximum rainfall of 256 cm- 258 cm, followed by months of August - September (142 cm and 126 cm) of that year. There was no considerable rainfall after October.

In 2014, summer showers were present from February (1.65 cm) followed by March (3.22 cm), April (4.80 cm) and moved up in May (22.58 cm). Only 124 cm of rainfall was recorded in June 2014 and it was lower than that in 2013June. But it increased to the highest rainfall recorded during the whole 4 year study in July 2014 (314 cm). Then rainfall decreased to 224 cm in August and then to 77 cm in September and to 31 cm in October after which there were scanty rains due to cyclonic depressions in the Arabian Sea.

2015 was the year which got maximum rainy days and maximum quantity of rainfall spread all over the year even though there was decrease in some months (especially July and August). A higher quantity of summer showers were present in 2015 March (6.35 cm) followed by a little higher quantity in April (28 cm) accompanied by a reduction to 13 cm in May. But in June the rainfall quantity increased to 268 cm (second highest RF value during the 4 year period). It was higher than last year data of June. Then it decreased in July to 123 cm, and to 88 cm in August and 64 cm in September, 23 cm in October, 20 cm in November and 17cm in December. Except in January 2015, there was rainfall round the year 2015 and it continued to rain in January 2016 also.

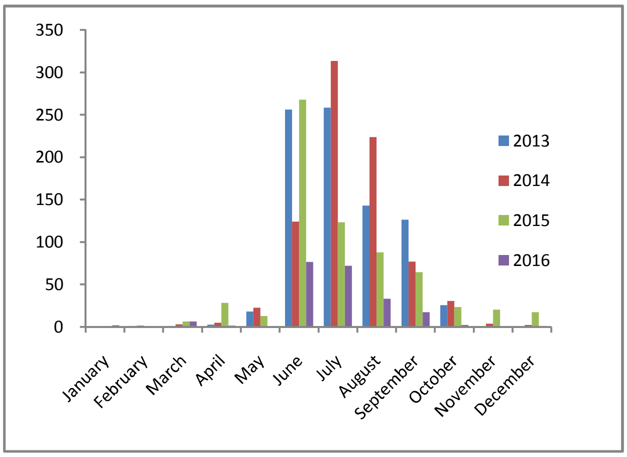
The rainy days of December 2015 extended to January 2016 (1.78 cm). But overall, rainfall in rainy season reduced drastically in 2016. Summer showers were present in March (6.21 cm) followed by a reduction in April (1.46 cm) accompanied by a reduction to 0.20 cm in May. Thereafter quantity of rains were lower in all months from June (77 cm), July (72 cm), August (33 cm) in September (17 cm), October (2.15 cm), November (no rains)and December (0.95 cm). There was an evident reduction of rainfall quantity from May to December when compared to the same months in last 3 years of the study period.

Table 1 Monthly Number of plants with flowers from 2013-2016

Date	*I. platyadena*			*I. Coelotropis*			*I. johnii*		
	Seedlings	Big plants	*Plants with Fl	Seedlings	Big plants	*Plants with Fl	Seedlings	Big plants	*Plants with Fl
06.01.2013	0	39	9	0	18	1	0	84	0
13.01.2013	0	38	8	0	18	1	0	84	0
06.02.2013	0	37	10	0	18	2	0	84	0
22.02.2013	0	37	10	0	18	5	0	84	0
14.03.2013	0	37	12	0	18	1	0	84	0
20.03.2013	0	37	11	0	18	0	0	84	0
09.04.2013	0	33	14	0	18	5	0	84	0
21.04.2013	0	33	14	0	18	4	0	84	0
06.05.2013	0	32	17	0	18	9	0	84	0
23.05.2013	14	39	20	0	18	11	0	84	0
09.06.2013	19	41	29	9	18	18	11	84	0
25.06.2013	22	48	48	12	18	18	23	85	0
04.07.2013	14	49	49	14	21	21	16	85	0
12.07.2013	17	49	49	07	21	21	8	85	0
07.08.2013	12	50	50	06	21	21	11	88	33
23.08.2013	8	50	50	08	21	21	8	88	34
06.09.2013	11	51	51	4	21	21	10	88	55
26.09.2013	9	51	51	9	19	14	11	92	57
09.10.2013	0	50	44	0	20	13	7	92	88
20.10.2013	0	48	40	0	20	9	5	92	88
06.11.2013	0	48	33	0	20	11	0	92	76
19.11.2013	0	48	30	0	20	10	0	90	40
07.12.2013	0	48	23	0	20	08	0	97	7
26.12.2013	0	48	20	0	20	7	0	97	0
11.01.2014	0	48	10	0	20	9	0	97	0
23.01.2014	0	48	8	0	20	4	0	97	0
13.02.2014	0	44	9	0	20	5	0	97	0
22.02.2014	0	43	10	0	20	4	0	97	0
12.03.2014	0	43	11	0	20	11	0	97	0
24.03.2014	0	42	12	0	20	12	0	97	0
01.04.2014	0	42	12	0	20	12	0	97	0
29.04.2014	0	42	14	0	20	14	0	97	0
10.05.2014	0	42	17	09	20	17	0	97	0
26.05.2014	0	42	33	11	26	23	7	97	0
13.06.2014	5	42	32	5	42	32	9	97	0
29.06.2014	9	42	30	9	42	39	11	97	0
05.07.2014	12	42	30	12	42	40	11	97	0
24.07.2014	15	43	43	15	43	43	4	98	0
04.08.2014	9	44	34	9	44	44	5	98	28
23.08.2014	11	45	35	11	45	45	0	99	46
29.09.2014	27	45	35	45	46	44	17	99	78
09.10.2014	21	45	35	8	45	34	11	100	90
19.10.2014	19	46	33	8	45	34	4	103	88
04.11.2014	6	46	30	5	45	45	3	103	81
24.11.2014	0	46	23	3	45	34	0	103	78
11.12.2014	0	46	11	0	45	28	0	103	44
26.12.2014	0	46	9	0	45	20	0	103	23
05.01.2015	0	45	11	0	45	4	0	103	05
22.01.2015	0	45	7	0	45	5	0	103	0
09.02.2015	0	45	11	0	43	4	0	103	0
11.03.2015	0	45	19	0	40	7	0	102	0
21.03.2015	0	45	21	0	40	12	0	100	0
10.04.2015	0	45	28	0	41	33	0	100	0
22.04.2015	0	45	33	16	52	34	0	100	0
05.05.2015	0	45	44	29	54	39	0	100	0
22.05.2015	22	45	45	11	54	42	7	100	0
11.06.2015	24	106	101	05	55	51	18	100	0
02.07.2015	19	151	141	19	55	55	23	100	0
23.07.2015	34	155	150	12	57	57	24	104	0
04.08.2015	55	198	188	15	58	58	26	123	0
22.08.2015	22	206	192	19	64	58	15	133	88
10.09.2015	29	233	208	22	67	59	29	142	94
22.09.2015	34	252	221	10	67	66	2	142	100
11.10.2015	78	284	277	6	67	60	0	149	110
23.10.2015	55	296	280	11	68	61	8	151	104
13.11.2015	39	399	304	04	69	65	0	168	106
17.11.2015	47	428	364	76	72	59	0	244	103
25.12.2015	3	411	204	4	72	55	0	244	98
07.01.2016	0	411	198	0	68	34	0	244	88
09.02.2016	0	411	111	0	68	5	0	244	04
14.03.2016	11	401	188	0	65	4	0	244	0

29.03.2016	16	398	178	0	65	7	0	244	0
22.04.2016	3	311	123	0	65	2	0	244	0
05.05.2016	0	305	99	0	65	9	0	498	0
22.06.2016	27	311	198	26	67	58	46	512	0
10.07.2016	33	334	286	22	67	60	51	560	0
22.07.2016	22	341	298	13	68	67	48	563	0
19.08.2016	24	356	198	22	18	6	39	600	69
01.10.2016	16	325	121	11	17	9	36	607	78
21.10.2016	27	116	96	24	19	5	23	608	84
15.11.2016	0	98	23	5	8	1	0	608	89
02.12.2016	0	98	18	0	8	1	0	610	78
22.12.2016	0	88	12	0	8	1	0	610	75

*Plants with Fl = Plants with flowers; and included in number of big plants in previous column.

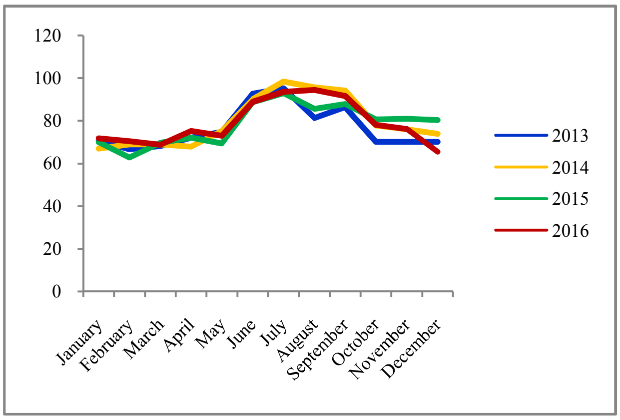


Graph 1 Monthly rainfall fluctuations during 2013-2016 in study area.

Relative Humidity

The amount of water vapor in air expressed as the percent of maximum amount of water vapor it can hold at a certain temperature is called Relative Humidity (Miller 2001). Relative Humidity (RH) in 2013 started rising up from April middle to September with values ranging from 72 % to 86 % with a peak in July (95%). From October to December, it receded to a steady stable state (70 %).

Relative Humidity (RH) data of 2014 started rising up from May to September with values ranging from 75 % to 94 % with a peak in July (98%). From October to December, it receded to comparatively stable state (77% to 73%). RH never went down below 74 % in this year from June to December.



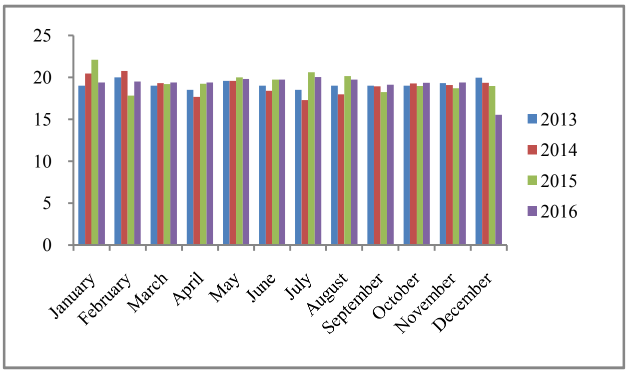
Graph 2 Monthly relative humidity fluctuations during 2013-2016 in study area.

Relative Humidity in 2015 started rising up from April to September with values ranging from 72 % to 88 % with a peak in July (93%). From October to December, it receded to a stable state (80%).

Relative Humidity in 2016 started rising up from April to September with values ranging from 75 % to 92% with a peak in July (94 %). From October to December, it receded to a lower range owing to decline of rains (78% to 66 %).

Temperature

The noon temperature pattern did not show much fluctuations in 2013 and was almost around 19.2 ^{0} C. There was a mild temperature fluctuation between 17.3^{0} C to 20.8^{0}C in 2014 but average noon temperature was 19 ^{0} C. Minor temperature fluctuations were noted in 2015 also with an average of 19.5^{0} C and in 2016 also with an average of 19.2^{0} C. The December winter temperature in 2016 went low to 15.5^{0} C. The overall noon temperature during the 4 years remained almost steady around 19^{0} C to 19.5^{0} C.



Graph 3 Monthly noon temperature fluctuations during 2013-2016 in study area.

DISCUSSION

Lithophytes (epipetric or epilithic plants) are plants that grow in or on rocks. They feed on nutrients from rain water and nearby decaying plants, including their own dead tissue. As nutrients tend to be rarely available to lithophytes, they are pre-adapted to life on rocks. (Wikipedia, 2017). *I. johnii* is a facultative lithophyte. Rainfall quantity and frequency vary with location and climate types and determines the vegetation type ((Bareja, 2011).

A high Relative Humidity (RH) means that air is moist whereas air with minimal content of moisture is described as dry air. RH affects opening and closing of stomata which regulates transpiration and there by photosynthesis. Flowering of plants started at the age of second year only in all the species. There was a vigorous vegetative growth preceding flowering, which was catalyzed by the rains. In case of *I johnii* the resurrection from dormancy after rains was visible in June annually and vegetative enlargement took 2 to 3 months in that plant to produce flowers. The vegetative resurrection was of a short duration in other two species and it happened in June and they maintained their size and form more or less round the year. *I. johnii* had a period of leaflessness and lean period from February to June annually, which was seen in March to June in other two species.

The degree of hotness or coldness influence all plant growth process such as photosynthesis, respiration, transpiration, breaking of seed dormancy, seed germination protein synthesis and trans location. At higher temperature, translocation of photosynthates is faster and so plants tend to mature faster. The favorable or optimal day and night temperature range for plant growth varies among species (Poincelot 1980). Mean noon temperature of the study area during the 4 year study ranged from 19^0 C to 19.5^0 C. This shows that there is no considerable change in temperature of the Pettimudy area over these years. From the comparison of temperature data over 4 years, influence of temperature on flowering cannot be seen in these species. But these 3 high altitude balsams survive only in this range of temperature and their general physiology is well oriented at around 19^0 C. There were no freezing temperatures or warmer temperatures above 20.5^0 C. The lower temperatures possibly due to frost or snowfall etc and higher temperatures due to habitat destruction can endanger them. Excessively low temperature can be limiting plant growth and development (Delvin 1975). Opening up of the tree canopy of the forest can expose the plants to frost bites in winter, as adjoining landscape is peaking up to 2600 m height. Exposing the tree cover and habitat destruction can raise the temperature above the present limits, which can be fatal to the species. During this study, there were no such instances noted. Hence any relations with the temperature and flowering could not be arrived. However it is established that suitable temperature required by the three species for their healthy survival co existence, flowering and establishment is around 19^0 C.

Peak values of RH from July to September seem to persuade *I. johnii* to initiate flowering. The average RH from October to December during the 4 years never went below 70%, which was helpful in retention of the flowers of *I johnii*. During periods of higher RH, number of flowering plants were more in all the species, except *I johnii* which restricts flowering in September to December after a prolonged escalation of RH.

RH went down to 70 % in 2013 with scanty rains from October to December resulting in reduced flower longevity in all the 3 species mainly *I. johnii.* But a higher RH with low rainfall during the same months in 2016 supported more flowering of all the 3 species. RH never went down below 74 % in 2014 from May to December. The retention of flower is seen to have a positive relation with higher RH. Above 80% RH in 2015 during October to December and rainfall in 2016 January resulted in more flowering and flower retention of *I. johnii.* This was same for other two species also.

Even if rainfall is low in a year with a higher RH, the plants flower to an optimum level. None of the study species are annuals and they all have more than 3 years of life span, in natural conditions as seen from field observations. Thus flowering at a low rainfall condition with better RH may be due to the accumulated and stored biomass of previous luxurious year's growth. There is a direct relationship with luxurious flowering and high rainfall. Reduction in rainfall reduced number of flowering plants which will certainly reduce the seed production and thus the number of new individuals next year. There was Rainfall round the year 2015, except in January 2015 and it continued to rain in January 2016. The flowers of *I. johni* lasted till January 26^{th} 2016. Even though, it starts flowering in September only, the reduction of rains after September to October seems to favor *I. johnii* in retention of flowers as they have enough water in their body and growing media in all years of study.

Rainfall invariably triggers spontaneous and staggered flowering in mature *I. platyadena* and *I. coelotropis* as Staggered flowering is seen all round the year in them as and when there is little rainfall and dampness. But *I. johnii* needs continuous prolonged rainfall months from June to September to grow up from dormancy and to produce leaves and finally flower buds in September only. This may be because the plant is a facultative lithophyte; meaning that rainfall can only supply and promote much of the nutrients needed for its growth and development. Micro climate of the area has been the reason for the survival and flowering of the three endemic plants in the locality.

Along with a decrease in rainfall during 2016, the unscientific forest road construction through Pettimudy in 2016 has destroyed many surviving *I. platydena* and *I. coelotropis* and their dispersed seeds have been churned by the movements of earth raking and digging up using JCB. The area Pettimudy with unique population of these three endangered endemic *Impatiens* along with recently identified and Critically Endangered *I pandurangani* is proposed to be a buffer area outside the Eravikulam National Park having rich biodiversity values with high degree of endemism for conservation and management as Gene Pool Conservation Area.

CONCLUSION

The study does not reveal relation of temperature or influence on flowering. But survival of these plants is in temperature range ranged from 19^0 C - 19.5^0 C. Peak Relative Humidity from July to September is required for *I. johnii* to initiate flowering. Peak values of RH from July to September seem to persuade *I. johnii* to initiate flowering. During periods of higher RH, number of flowering plants were more in all the species, except *I johnii* which restricts flowering in September to December after a prolonged escalation of RH. Vegetative resurrection happened in all the species by onset of rains in June, and in case of *I johnii* vegetative enlargement took 2 to 3 months to end in flowering. Rainfall invariably triggers spontaneous flowering in *I. platyadena* and *I. coelotropis.* Flowers are seen all round the year in them as and when there is little rainfall. *I. johnii* needs continuous prolonged rainfall months from June to September to grow up from dormancy to produce leaves and finally flower buds in September only. This species is a facultative lithophyte.

Even at lower rainfall higher RH favors optimum flowering ascribed to stored biomass of previous year's growth. There is direct relationship of luxurious flowering and high rainfalls. Low rains reduce seed production and number of new individuals for coming year. The area Pettimudy with unique population of these three endangered endemic *Impatiens* along with recently identified and Critically Endangered *I pandurangani* is proposed to be a buffer area outside the Eravikulam National Park having rich biodiversity values with high degree of endemism for conservation and management as Gene Pool Conservation Area.

References

Bareja, B. G. (2011) Climate factors can promote or inhibit please growth and development. *Crops Review.Com.*

Biju S.D & Manoj Kumar V (1999) Rediscovery of *Impatiens johnii* Barnes (Balsaminaceae), a balsm endemic to Eravikulam national park, Kerala, India, *Indian Journal of Forestry,* 22(2): 174-176.

Delvin R.1975, Plant Physiology. New York, NY: D, Van Nostrand Company. 600 p.

Eagleman J.R.1985, Meteorology: The Atmosphere in Action, Wadsworth Publishing Company. 394 p.

Mader S.S.1993, Biology Part 1: The Cell. 4th ed. Duburque, IA, USA: Wm. C. Brown Communications, Inc. 152 p.

Miller G.T. 2001, Environmental Science: Working with the Earth. 8th ed. Pacific Grove, CA, USA: Brooks/Cole. p. 135-167.

Nair, N.C (1991) Endemism on the western ghats with special reference to *Impatiens* L. Proceedings of the symposium on rare, endangered and endemic plants of the Western Ghats Kerala Forest Dept,. Spl Publ. No III P 93-102.

Poincelot R.P.1980, Horticulture: Principles and Practical Applications. Englewood Cliffs, NJ: Prentice-Hall, Inc. 652 p.

Pusalkar, P.K. & D.K.Singh (2010). Three New species of Impatiens (Balsaminaceae) from Western Himalaya, India. Taiwania 55: 13-23.

Rao, C.K., *et al* 2003, Red List of Threatened Vascular Plant Species in India, Compiled From the 1997 IUCN Red list Threatened Plants. *Botanical Survey of India*, pp 19-20.

Sasidharan, N, Flowering plants of Kerala: Ver 2.0. Kerala Forest Research Institute, Peechi. [CD-ROM]. (2013).

Vajravelu E & Daniel P,. Jain S. K & Sastry A.R.K. Ed. Enumeration of threatened plants of Peninsular India. Materials for a catalogue of Threatened Plants of India, Botanical Survey of India, Culcutta. (1983)

Vivekananthan, K.N, *et al* 1997, Balsaminaceae, 4. In:: Hajra, P.K., V.J. Nair & P. Daniel (eds.). *Flora of India.* Botanical Survey of India, Howrah. pp. 95-229

Went F.W. 1963, The Editors of Life. The Plants. Time Incorporated ,New York. pp. 139-158.

Wikipedia (2017) Lithophytes; Free online encyclopaedia.

How to cite this article:

Prasad G and Antony VT.2017, Impact of Climatic Factors on Flowering of Three Exclusively Endemic Impatiens Species (Family Balsaminaceae) In Western Ghats of India. *Int J Recent Sci Res.* 8(9), pp. 20074-20079.
DOI: http://dx.doi.org/10.24327/ijrsr.2017.0809.0820

****