



**SOMAIYA**  
**V I D Y A V I H A R**

K. J. Somaiya College of Science & Commerce



Date: 11-03-2022

To:  
Dr. Hemantkumar Akolkar,  
Assistant Professor,  
Department of Chemistry  
Abasaheb Marathe Arts and Commerce, Science  
College, Rajapur

Respected Sir,

Somaiya Vidyavihar is committed to the cause of Education, Community Service, Indian Culture and Research in Science and Technology. The K. J. Somaiya College of Science and Commerce was awarded "A" Grade by NAAC. The College was adjudged the Best College of the University of Mumbai in 2010 in the Urban category. The College has been conferred Autonomous Status from 2013-2014. The College was awarded FIST "O" level grant by DST, Star College Scheme by DBT and has recently awarded 'College with Potential for Excellence' by UGC.

It gives me a great pleasure in inviting you as a resource person for the "Stereochemistry - A Problem solving approach" organised by Department of Chemistry K J Somaiya college of Science and Commerce Vidyavihar on 16<sup>th</sup> March, 2022 for our, under graduate and post graduate students .

I am sure your expertise in the subject will enrich and enhance the competency of our students.

Thanking you,

Yours Sincerely

Principal





**SOMAIYA**  
**VIDYAVIHAR**

K J Somaiya College of Science & Commerce



Date: 17-03-2022

To:  
Dr. Hemantkumar Akolkar,  
Assistant Professor,  
Department of Chemistry  
Abasaheb Marathe Arts and Commerce, Science  
College, Rajapur

Respected Sir,

Thank you very much for accepting our invitation as a resource person for the “Stereochemistry - A Problem solving approach” organised by Department of Chemistry of K J Somaiya college of Science and Commerce Vidyavihar Mumbai on 16<sup>th</sup> March, 2022 for our under graduate and post graduate students

I really appreciate your gesture in sparing your valuable time and sharing your expertise with the students.

With warm regards,

Yours Sincerely

Principal





Rayat Shikshan Sanstha's

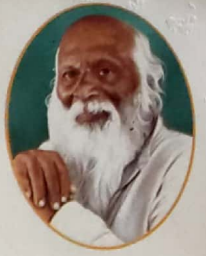
# ABASAHEB MARATHE ARTS & NEW COMMERCE, SCIENCE COLLEGE, RAJAPUR

Estd. June 1994

(Vikhare Gothane) Dist. Ratnagiri - 416702. ● NAAC Reaccredited with 'B' grade

Ph.: No. (02353) 221002 Fax : (02353) 221003

E-mail : abasahebmarathecollege@gmail.com



Founder - **Dr. Karmaveer Bhaurao Patil** (D.Lit.)

Prin. **Dr. Pralhad G. Pawar**, M.Com., M.Phil., Ph.D.

Outward No. *By mail / 2020-21*

Date : *25/03/2021*

To,

Mr. Jaidip B. Wable,

Assistant Professor,

K. J. Somaiya College of Science and Commerce, Vidyavihar,

Mumbai, 400077.

**Subject: Invitation as a guest lecturer for Drugs and Dyes course to T.Y.B.Sc. class.**

Respected sir,

We are very much pleased to invite you as a guest lecturer for Drugs and Dyes course to our T.Y.B.Sc. Chemistry class. Your guidance will inspire them to achieve excellence. You are requested to accept the invitation.



Topic: Chemistry of Drugs

Date: 1<sup>st</sup> April to 3<sup>rd</sup> April 2021

Thanking you.



*P. Pawar*  
Principal  
A.M.A. & N.C.S. College  
Rajapur, (V. Gothane) Dist. Ratnagiri.

<b>Estd : June 1963</b>  <b>Principal :</b> <b>Dr. R. S. More</b> <b>M.A.,M.Phil., Ph.D.</b>	<b>"Education through self-help is our motto"- Karmaveer</b> <b>Rayat Shikshan Sanstha's</b> <b>BALWANT COLLEGE, VITA</b> Tal-Khanapur, Dist-Sangli (Maharashtra) Pin- 415311	<b>Jr.College No.J 22.05.001</b> <b>Z.P.Sangli C-11</b>  <b>STD Code 02347</b> <b>Office : 272096</b> <b>Resi. : 272628</b> <b>Fax : 272096</b>
	<b>Founder : Padmabhushan Dr.Karmaveer</b> <b>Bhaurao Patil, D.Litt.</b> <b>Reaccredited By NAAC "A"</b>	<b>E-Mail : <a href="mailto:balwantcollege7207@yahoo.com">balwantcollege7207@yahoo.com</a></b> <b>Website : <a href="http://www.balwantcollege.edu.in">www.balwantcollege.edu.in</a></b>

Ref.No. 229 / 2022-23

Date- 19/05/2022

To  
 Mr. Ganesh Pawar  
 Department of Botany,  
 Abasaheb Marathe College,  
 Rajapur

**Subject:-** Appreciation letter

Dear Sir,

Our college is one of the leading colleges in the field of research. To enhance the student's participation and development in the research we have organized "**Balwant Research Festival- 2021-22**" on 19<sup>th</sup> May, 2022 at 11.30 am in our college. We are grateful to you for receiving our invitation to work as an examiner in the aforesaid convention. You have examined and evaluate our students for the betterment and your insights and views will be helpful to enhance their research aptitude.

We are once again thankful to you for kind cooperation which we are expecting in the future also.

Thanking you

Yours faithfully



  
**PRINCIPAL**  
**Balwant College, VITA**  
**Dist. Sangli**





"Education through self-help is our motto" - Karmaveer

RAYAT SHIKSHAN SANSTHA'S

**BALWANT COLLEGE, VITA**

**बळवंत कॉलेज, विटा**

A/p- VITA -Tal.Khanapur, Dist. Sangli (M.S.) PIN- 415311

(Affiliated to SHIVAJI UNIVERSITY, KOLHAPUR)

☎ : (02347) Office : 299303  
Resi. : 272096

Website : www.balwantcollege.edu.in  
E-mail : balwantcollege\_7207@yahoo.com

**FOUNDER : Padmabhushan Dr. Karmaveer Bhaurao Patil, D.Litt.**

■ **PRINCIPAL :**  
**Dr. More R.S.**  
M.A., M.Phil., Ph.D.

Ref. No. 1112/2021-22

Date : 01-01-2022

■ NAAC : GRADE - "A", CGPA -3-11

To,  
**Mr. Ganesh B. Pawar**  
Head & Assistant Professor  
Department of Botany,  
Abasaheb Marathe College, Rajapur

■ DST-FIST Funded College

**Subject: Invitation for Guest lecture.**

Dear Sir,

■ RUSA Funded College

Greetings of the day!! With reference to above subject, Department of Botany of our college is going to organize a Guest lecture entitled "Scope and Opportunities in Botany after graduation" on 1<sup>st</sup> January, 2022 at 11.30 am under Green College Activity. We kindly request you to spare your valuable time for guest lecture.

■ ISO. 9001:2015 Certified

Thanking you

■ Govt. Approval No.-

Sr.- UKF.1563,  
Dt.11-09-1963

  
**Head**  
Department of Botany  
Balwant College, Vita

Yours sincerely,


  
**PRINCIPAL**  
Balwant College, Vita  
Dist-Sangli.

■ ZP Sangli C-11

H.S.C. Code No. : J 22.05.001

■ Govt. Approval No.

Jr.- HSC/1077/64250/XX.XXI,  
Dt.15-04-1977

<b>Estd : June 1963</b>  <b>Principal :</b> <b>Dr. R. S. More</b> <b>M.A., M.Phil., Ph.D.</b>	<b>"Education through self-help is our motto" - Karmaveer</b> <b>Rayat Shikshan Sanstha's</b> <b>BALWANT COLLEGE, VITA</b> Tal-Khanapur, Dist-Sangli (Maharashtra) Pin- 415311	<b>Jr.College No.J 22.05.001</b> <b>Z.P.Sangli C-11</b>
	<b>Founder : Padmabhushan Dr.Karmaveer</b> <b>Bhaurao Patil, D.Litt.</b>	<b>STD Code 02347</b> <b>Office : 272096</b> <b>Resl. : 272628</b> <b>Fax : 272096</b>
<b>Reaccredited By NAAC "A"</b>	<b>E-Mail : <a href="mailto:balwantcollege7207@yahoo.com">balwantcollege7207@yahoo.com</a></b> <b>Website : <a href="http://www.balwantcollege.edu.in">www.balwantcollege.edu.in</a></b>	

Ref.No. 298 / 2022-23

Date- 17/05/2022

To  
 Mr. Ganesh Pawar  
 Department of Botany,  
 Abasaheb Marathe College,  
 Rajapur

**Subject:- Invitation to work as Resource Person**

Dear Sir,

We are running successfully UG, PG and Ph.D. courses in our college. Environmental awareness is key factor for surviving the living world. We pleased to invite you as Resource Person to awareness talk on, **"Role of Teachers and Students in Biodiversity Conservation"** on 19<sup>th</sup> May, 2022 at 2.00 pm.

Kindly convey your acceptance and do the needful.

Thanking you

Yours faithfully



**PRINCIPAL**  
**Balwant College, VITA**  
**Dist. Sangli**





"Education through self-help is our motto" - Karmaveer  
RAYAT SHIKSHAN SANSTHA'S

# BALWANT COLLEGE, VITA

## बळवंत कॉलेज, विटा

A/p- VITA -Tal.Khanapur, Dist. Sangli (M.S.) PIN- 415311  
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☎ : (02347) Office : 299303  
Resl. : 272096

Website : www.balwantcollege.edu.in  
E-mail : balwantcollege\_7207@yahoo.com

**FOUNDER : Padmabhushan Dr. Karmaveer Bhaurao Patil, D.Litt.**

■ **PRINCIPAL :**  
Dr. More R.S.  
M.A., M.Phil., Ph.D.

Ref. No. 53A/2022-23

Date : 12/04/2022

To,

Mr. Ganesh B. Pawar  
Head & Assistant Professor  
Department of Botany,  
Abasaheb Marathe College, Rajapur

Subject: Thanking letter.....

Dear Sir,

We are very much thankful to you for giving guest lecture in our Balwant College, Vita on 13<sup>th</sup> April 2022. Your talk was very informative and thoughtful on "Plant tissue Culture-current status and Future perspectives". Your cooperation in future is highly appreciated.

Thanking you,

Yours faithfully



*ddy*  
PRINCIPAL,  
Balwant College, Vita  
Dist-Sangli.

■ **NAAC : GRADE - A**  
CGPA -3-11

■ **DST-FIST Funded**  
College

■ **RUSA Funded**  
College

■ **ISO. 9001:2015**  
Certified

■ **Govt. Approval No.-**  
Sr.- UKF.1563,  
Dt.11-09-1963

■ **ZP Sangli C-11**  
H.S.C. Code No. :  
J 22.05.001

■ **Govt. Approval No.**  
Jr.- HSC/1077/  
64250/XX.XXI,  
DL.15-04-1977



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RAYAT SHIKSHAN SANSTHA'S

# BALWANT COLLEGE, VITA

## बळवंत कॉलेज, विटा

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☎ : (02347) Office : 299303  
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E-mail : balwantcollege\_7207@yahoo.com

FOUNDER : Padmabhushan Dr. Karmaveer Bhaurao Patil, D.Litt.

■ **PRINCIPAL :**  
Dr. More R.S.  
M.A., M.Phil., Ph.D.

Ref. No. 1061/2021-22

Date : 24.12.2021

■ **NAAC : GRADE - "A" CGPA-3.11**

To,  
Dr. B. A. Sonar  
Department of Botany,  
Abasaheb Marathe College,  
Rajapur.

■ **DST-FIST Funded College**

Sub. Thanking Letter for 3<sup>rd</sup> International Multidisciplinary Conference  
(IMCET-2021).

■ **RUSA Funded College**

Respected Sir,

Thank you for responding to our invitation positively and sparing your valuable time as an examiner on the occasion of 3<sup>rd</sup> International Multidisciplinary Conference on Emerging Trends in Humanities, Commerce, Management, Science and Technology 2021 (IMCET-2021) on 23<sup>rd</sup> and 24<sup>th</sup> December, 2021.

■ **ISO. 9001:2015 Certified**

Your presence as a Examiner of the oral session was resourceful. We missed your presence in the campus in person due to the conduct of the program on ZOOM MEET. However, we would love to remain in touch with you in future as well and foresee your being with us in the campus on some occasion.


■ **Govt. Approval No.-**

Sr.- UKF.1563,  
Dt.11-09-1963

Thank you once again.

■ **ZP Sangli C-11**

H.S.C. Code No. : J 22.05.001

  
PRINCIPAL  
Balwant College, Vita  
Dist-Sangli.

■ **Govt. Approval No.**

Jr.- HSC/1077/64250/XX.XXI,  
Dt.15-04-1977



Estd : June 1963



Principal :  
Dr. R. S. More  
M.A., M.Phil., Ph.D.

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Rayat Shikshan Sanstha's

**BALWANT COLLEGE, VITA**

Lal-Khanapur, Dist-Sangli (Maharashtra) Pin- 415311

Founder : Padmabhushan Dr.Karmaveer  
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Reaccredited By NAAC "A"

Jr.College No.J 22.05.001

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E-Mail : [balwantcollege7207@yahoo.com](mailto:balwantcollege7207@yahoo.com)

Website : [www.balwantcollege.edu.in](http://www.balwantcollege.edu.in)

Ref.No 1400 / 2021 - 22

Date- 31/01/2022

Dr. B. A. Sonar

Department of Botany,

Abasaheb Marathe Mahavidyalaya,

Rajapur, Dist. Ratnagiri

**Subject:- Appreciation Letter .....**

Dear Sir,

We are very grateful to you to accept our invitation to work as **Resource Person** in our college. You have guided our students regarding the **Inauguration function of Science association and Nature Club** on 31<sup>st</sup> January, 2022. Your guidance and insights motivated our students and their feedback is excellent.

Thanking You,

Yours Sincerely



  
PRINCIPAL  
Balwant College, VITA  
Dist. Sangli



Estd. 1965

Prin. Dr. Salunkhe S.T.  
[M.S. (B.D.M.D.A.)]

**"Education through self-help is our motto" KARMVEER**

**Rayat Shiksan Sanstha's**

**Dahiwadi College Dahiwadi**

**Tal. Man, Dist. Satara & 415508**

**(Arts, Science, Commerce & H.S.C. Vocational)**

**(Affiliated to Shivaji University, Kolhapur)**

**Founder : Padmabhushan Dr. Karmaveer Bhaurao Patil**

**D Litt.**

**NAAC Re-Accredited at 'A' grade (CGPA 3.25<sup>1/2</sup>)**

**Office**

02165&220231

**Residence**

02165&220328

**Fax**

02165&220231

E-mail : [dedprincipal@gmail.com](mailto:dedprincipal@gmail.com)

Web : [www.dahiwadicollege.in](http://www.dahiwadicollege.in)

J 21 06.001

HSC Voc. 21.06.901

Ref. In presence

Date: 06.05.2022

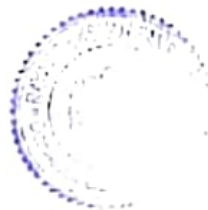
## **Letter of Appreciation**

It gives me an immense pleasure to put on record my hearty thanks to **Dr. S. K. Kamble** from Department of Botany, A. M. A. & N. C. S. College, Rajapur, District- Ratnagiri for delivering lecture to B.Sc.II and B.Sc.III Students regarding **Scope of Biotechnology** under Lead College Activity held on 06/05/2022.

Thanking you

Place: Dahiwadi

Date : 06/05/2022



Principal

Dahiwadi College Dahiwadi



**Principal**  
Prof. V V Killedar  
M.Sc., D C A, Ph.D.

"Education through self-help is our motto" Karmaveer



Estd.: 1961

Rayat Shikshan Sanstha's  
**RAJARSHI CHHATRAPATI SHAHU  
COLLEGE, KOLHAPUR**

Kadamwadi Road, Kolhapur - 416 003, Maharashtra

NAAC Reaccredited 'A' (with CGP 3.07)

Phone No. 0231-2654658

E-mail: [klpshahuacol@gmail.com](mailto:klpshahuacol@gmail.com) Website: [www.rcshahucollege.in](http://www.rcshahucollege.in)



Ref. No. 204/2022

Date: 18 / 05 / 2022

To,  
Dr. Suhas Kundlik Kamble  
Assistant Professor,  
Department of Botany,  
Abasaheb Marathe Arts and New Commerce, Science College Rajapur  
Dist-Ratnagiri.

**Subject:** Letter of Thanks.

Respected Sir,

We are very much thankful to you Sir for sparing your valuable time with us and delivering nice lectures on " **Plant Disease and its Management**" for B. Sc. students on 18<sup>th</sup> May 2022 at 12:30 pm. Sir, we assure you that your valuable guidance to students will definitely help them to focus to appear the examination, making their career and apply same knowledge to Control Plant Disease. Thank you for delivering brainstorming lecture in Dept of Botany, Rajarshi Chhatrapati Shahu College, Kolhapur.

Thanking you,

Yours Faithfully,



  
I/C PRINCIPAL  
R.C. SHAHU COLLEGE  
KOLHAPUR

# Impact of Foliar Spray of Plant Extract Formulation on Rust Disease of Bean and Their Photosynthetic Pigments

Kamble SK<sup>1\*</sup>, Kengar YD<sup>2</sup>, Sonar BA<sup>3</sup>, Chopade AU<sup>4</sup>

<sup>1,3</sup>Department of Botany, Abasaheb Marathe Arts and New Commerce, Science College Rajapur, Dist. Ratnagiri 416702, Maharashtra India

<sup>2</sup>Department of Botany, Smt. Kusumtai Rajarambapu Patil Kanya Mahavidyalaya, Islampur, Dist. Sangli 415409, Maharashtra, India

<sup>4</sup>Department of Chemistry, Karmaveer Bhaurao Patil College, Pandharpur, Dist. Solapur 413304, Maharashtra, India

\*Corresponding author E-mail: [suhaskamble272@gmail.com](mailto:suhaskamble272@gmail.com)

\*\*\*\*\*

## ABSTRACT

Rust of bean caused by *Uromyces appendiculatus* F. Strauss results in to the severe loss of yield all over the world. The extensive use of fungicides for controlling fungal diseases has adverse effects on environment and human beings too. Moreover, rust pustules reduce the rate of photosynthesis in leaves which ultimately contribute to the yield of bean crops. The disadvantages of chemical fungicides are familiar. Therefore, this research work deals with the control of bean rust disease by spraying plant extract formulation, "Panchparni Extract" for the management of rust disease. The positive influence of formulation on photosynthetic pigments also recorded.

**Keywords-** Bean rust disease, Plant extract formulation, Photosynthetic pigments.

## INTRODUCTION

*Lablab purpureus* (L.) Sweet., commonly called lablab bean is an annual plant belongs to Fabaceae distributed world-wide. It is primarily grows for its green pod, feed and soil improvement (Biju et al., 2001). There is frequent occurrence of rust disease in the bean fields. Rust of bean caused by *Uromyces appendiculatus* F. Strauss usually reaches epidemic scale in most regions of the world where a relative humidity of 95 % or more is maintained for a period of eight hours or more (Harter et al., 1935). Jacques (2002) stated that, severe rust infection results in defoliation, stunted growth, consequently reduced the yield of bean crop.

### Bean Rust



Fig. 1. a. Rust infected plant, b. Rust pustules on leaves and c. Enlarged rust pustules





Murugan (2006) reported the use of chemical insecticides against the insect pests has increased harms of pollution, contamination, the development of insecticide resistance by pests and the appearance of secondary pests. Varma and Dubey (1999) have been demonstrated that several higher plants extract for their antibacterial, antifungal and insecticidal. Plant metabolites and plant based pesticides emerged to be one of the better alternatives because of their minimal environmental impact and danger to consumers as compared to synthetic pesticides. The impact of a pathogen beyond actual pustules of bean rust was mainly studied through measurement of disease effects on net photosynthesis as shown by Lopes & Berger (2001). Yield of a plant is basically the integral of photosynthesis in leaves, although respiration, a few grams of nutrients from the soil and to some extent photosynthesis in organs other than leaves contribute to actual yield (Waggoner & Berger, 1987).

Thus, the present research work deals with the management of bean rust by foliar spraying of plant extract formulation, “Panchparni Extract” and their impact in recovery of photosynthetic pigments in leaves.

## MATERIALS AND METHODS

### Preparation of plant extracts:

An aqueous ‘Panchparni extract’ was prepared by using an equivalent quantity of leaves of *Eupatorium odoratum*, *Eucalyptus globulus*, *Azadirachta indica*, *Vitex nigundo* and *Datura metel* (1:1:1:1:1). The mixed leaves extract was filtered through four layered muslin cloth. This filtrate was then centrifuged at 1600 RPM for 5 minutes to avoid debris. The supernatant from centrifugation was considered as a stock solution. The 10% concentration of ‘Panchparni extract’ was prepared by adding distilled water in to the stock solution. The formulation is then supplied to farmer for spraying.

### Field experiment:

For the management of bean rust, experiment was conducted in the farm of Mr. Dilip Ghare of Gharewadi village in Karad tehsil during September of 2015. A widely used local variety- ‘Divashi’ has been sown in the farm. One row of bed sown with bean crop kept as it is without spraying. The remaining beds were sprayed with ‘Panchparni extract’ at certain interval of time. The sum totals of three sprayings were carried out on naturally originated rust infection. The first spray was employed at the time of beginning of disease *i.e.* 90 after sowing. The second and third sprayings were taken place after the interval of fifteen days *i.e.* 105 and 120 days after sowing.

### Evaluation of disease intensity:

The efficacy of ‘Panchparni extract’ was compared to plot without application of spray. The intensity of disease was recorded by selecting five plants at random from each of the plot was selected for recording observations. From each plant, five leaflets from top, middle and bottom portions were chosen for recording observation. The percent disease intensity was examined by using 0-9 scale (Mayee and Datar, 1986). It has been described here under:

#### Scale

- 0 = No pustules;
- 1 = 1-10% leaf area covered with rust pustules,
- 3 = 11-25% leaf area covered with rust pustules,
- 5 = 26-50% leaf area covered with rust pustules,
- 7 = 51-75% leaf area covered with rust pustules and
  
- 9 = > 75% leaflet area covered with rust pustules

**Application of ‘Panchparni Extract’ Spray**



**Supply of Panchparni Extract to Farmer**



**Bean field**

**Spraying on bean crop**



**Non- sprayed Bean plants**

**Sprayed on bean plants**

The percent disease index (PDI) and percent disease control (PDC) of the rust developed from natural inoculums were measured at fifteen days interval after the appearance of the first symptoms and calculated by Wheeler’s (1969) formula.

$$PDI = \frac{\text{Sum of numerical values grades}}{\text{Number of plants observed}} \times \frac{100}{\text{Maximum disease rating}}$$

Where,

PDI= Percent Disease Index,

$$PDC = \frac{\text{PDI in control} - \text{PDI in treatment}}{\text{PDI in control}} \times 100$$

Where,

PDC= Percent Disease Control,

PDI= Percent Disease Index

**Estimation of Photosynthetic pigments:**

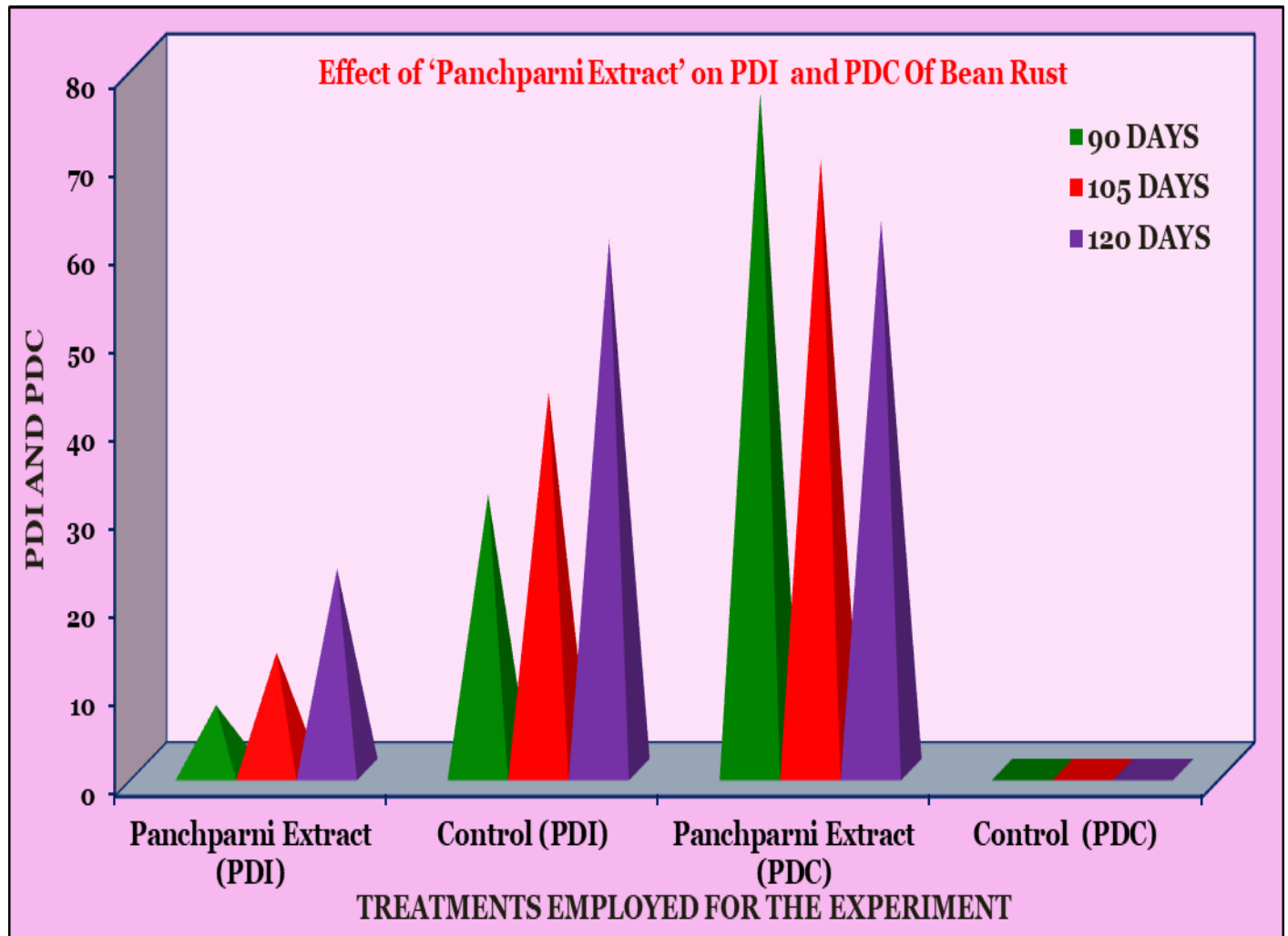
Chlorophylls were estimated by following method of Arnon (1949). The carotenoids were estimated from the same acetone extract of chlorophylls as per the methods described by Kirk and Allen (1965).

### RESULTS AND DISCUSSION

#### Effect of Panchparni Extract on Bean rust:

The Percent Disease Index (PDI) Percent Disease Control (PDC) of the bean rust on sprayed and no-sprayed crop beds at certain time intervals of period depicted in figure 2.

**Fig. 2. Effect of Panchparni Extract on Percent Disease Index (PDI) and Percent Disease Control (PDC) Of Bean Rust**



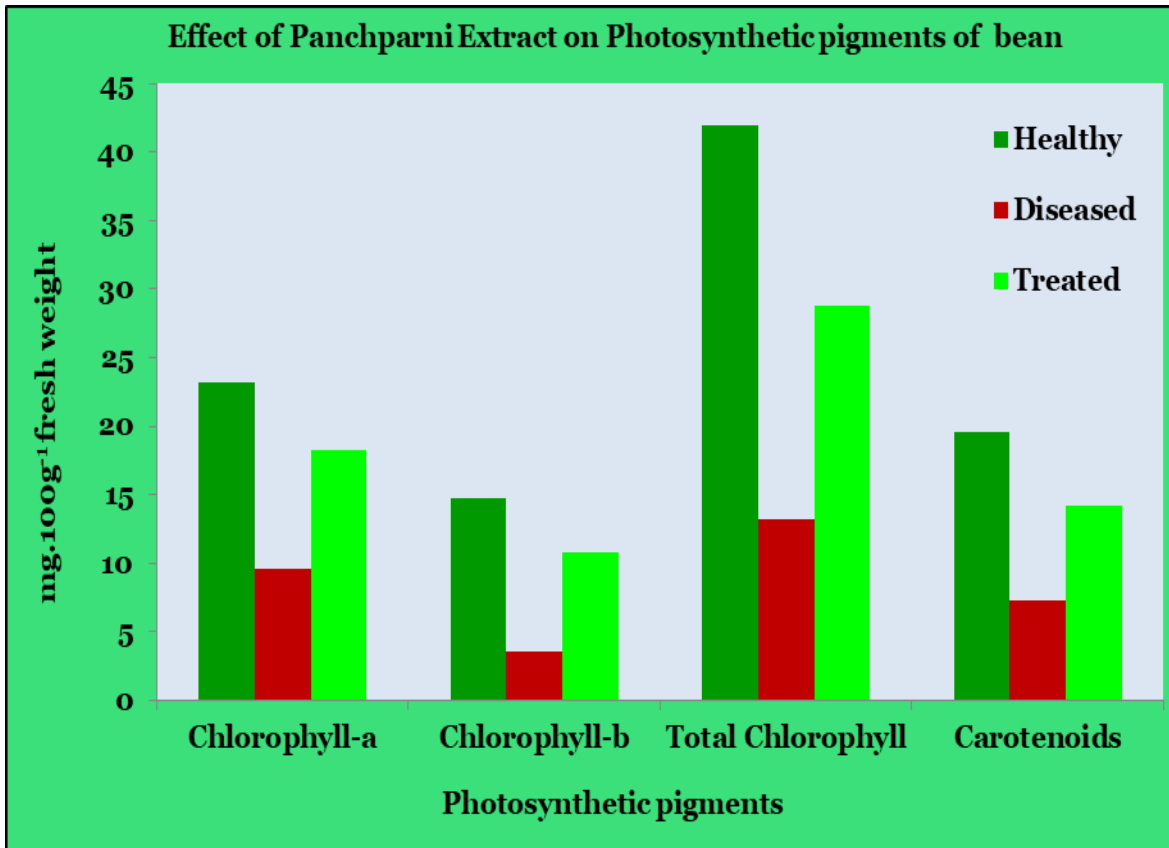
Percent Disease Index was found increased with increase in sowing period. The reduction in percent disease index was observed after the succeeding time intervals *i.e.* 90, 105 and 120 days after sowing respectively. The minimum disease incidence (07.30%) was observed after first spray of Panchparni Extract while that of maximum (59.76%) after third spray in control (Without Spray). An average Percent Disease Index (PDI) on bean after foliar spray application of Panchparni Extract is 14.41% and that of without spray is 44.46 %.

Monda *et al.* (2009) studied inhibitory effects *Azadirachta indica* A. Juss., *Carica papaya* L, *Urtica massaica* L. and *Nicotiana tabacum* L. against bean rust in field. The plant extract of *Artemisia vulgaris* showed significant property in reducing rust development in the bean fields (Chhetry and Mangang, 2012). In the same way, 'Panchparni' extract spray was detected significantly superior in controlling bean rust disease.

#### Effect of Panchparni Extract on photosynthetic pigments of bean

The amounts of photosynthetic pigments in healthy, diseased, treated bean plants were studied and represented in figure 3.

**Fig. 3. Effect of Panchparni Extract on Photosynthetic pigments of bean**



The maximum amount of photosynthetic pigments was observed in healthy bean plants and that of minimum in diseased ones.

The amount of photosynthetic pigments in healthy bean plant studied and recorded as chlorophyll-a (23.21 mg.100g<sup>-1</sup>), chlorophyll-b (14.73 mg.100g<sup>-1</sup>), total chlorophyll (41.94 mg.100g<sup>-1</sup>) and carotenoids (19.51 mg.100g<sup>-1</sup>). Whereas, diseased plant were showed amount of chlorophyll-a (9.58 mg.100g<sup>-1</sup>), chlorophyll-b (3.51 mg.100g<sup>-1</sup>), total chlorophyll (13.23 mg.100g<sup>-1</sup>) and carotenoids (7.31 mg.100g<sup>-1</sup>) after infection. Similarly, the amount of photosynthetic pigments observed in treated bean plants i.e. after foliar spray application of ‘Panchparni Extract’ as chlorophyll-a (18.23 mg.100g<sup>-1</sup>), chlorophyll-b (10.75 mg.100g<sup>-1</sup>), total chlorophyll (28.73 mg.100g<sup>-1</sup>) and carotenoids (14.23 mg.100g<sup>-1</sup>).

The fungal infection has inhibitory effect on chlorophylls and carotenoids (Hashem and Hamada, 2002). Several studies have reported the effect of bean rust on photosynthetic activity. According to Livne (1964) the photosynthetic activity was found to be decreased when bean was inoculated with rust. Bojtor *et al.* (2019) recorded significant reduction in the relative chlorophyll content due to rust disease on bean. The observations of photosynthetic pigments from healthy plants were used for comparison among diseased and treated plants after application of ‘Panchparni Extract’. It was detected that diseased plants showed reduction in amount of photosynthetic pigments as compared to healthy plants. On the other hand, spraying of Panchparni Extract formulation on diseased plants resulted in the enhancement of photosynthetic pigments. The reduction in chlorophyll content in diseased leaves of bean was observed during present investigation which was recovered after the spraying of ‘Panchparni Extract’.

### CONCLUSION

The crop diseases are generally controlled by using chemical fungicides which proved to be harmful to soil, water, environment and animals including humans. An eco-friendly approach of controlling bean rust disease by means of plant extract formulation is adopted in the present research work. It is found that ‘Panchparni extract’ was efficiently reduced the disease incidence accompanied by increase in the photosynthetic pigments.





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## Additional distribution records of *Ceropegia anjanerica*, an endemic and 'Endangered' lantern flower of the northern Western Ghats, India

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Genus *Ceropegia* L. (s.s.) (Ceropegiae: Apocynaceae) is represented by more than 260 taxa worldwide (The Plant List 2013) and distributed in the Canary Islands, India, Madagascar, New Guinea, northern Australia, southeastern Asia, tropical Arabica, and Africa except the Mediterranean region (Meve 2002). It is represented by 62 taxa in India and 26 taxa in Maharashtra (Kambale & Yadav 2019; Murugesan et al. 2019). Nashik district represents six species and two varieties of *Ceropegia*, viz., *Ceropegia anjanerica* Malpure, M.Y.Kamble & S.R.Yadav, *C. bulbosa* Roxb. var. *bulbosa*, *C. bulbosa* Roxb. var. *lushii* (Graham) Hook.f., *C. hirsuta* Wight & Arn., *C. lawii* Hook.f., *C. mahabalei* Hemadri & Ansari, *C. media* (H.Huber) Ansari, and *C. vincifolia* Hook (List modified based on personal observations, after

Lakshminarasimhan & Sharma 1991).

*Ceropegia anjanerica* is an 'Endangered' (Pethe & Watve 2021) and endemic flytrap flower and has recently been reported from adjacent area called Navardev, Kushegaon, Igatpuri tehsil of Nashik district (Auti et al. 2019).

As a part of floristic studies on Tryambakeshwar and surrounding areas, various places have been surveyed by the authors. A recent survey made of the Bhaskargad, Bramha Hill, Bramhagiri Hill, Harihar Fort, Vatvad Hill, (Nashik District) resulted in the collection of *Ceropegia anjanerica* (Malpure et al. 2006).

*Ceropegia anjanerica* Malpure, M.Y.Kamble & S.R. Yadav Curr. Sci. 91(9): 1141. 2006; Karthik. et al. Fl. Pl.

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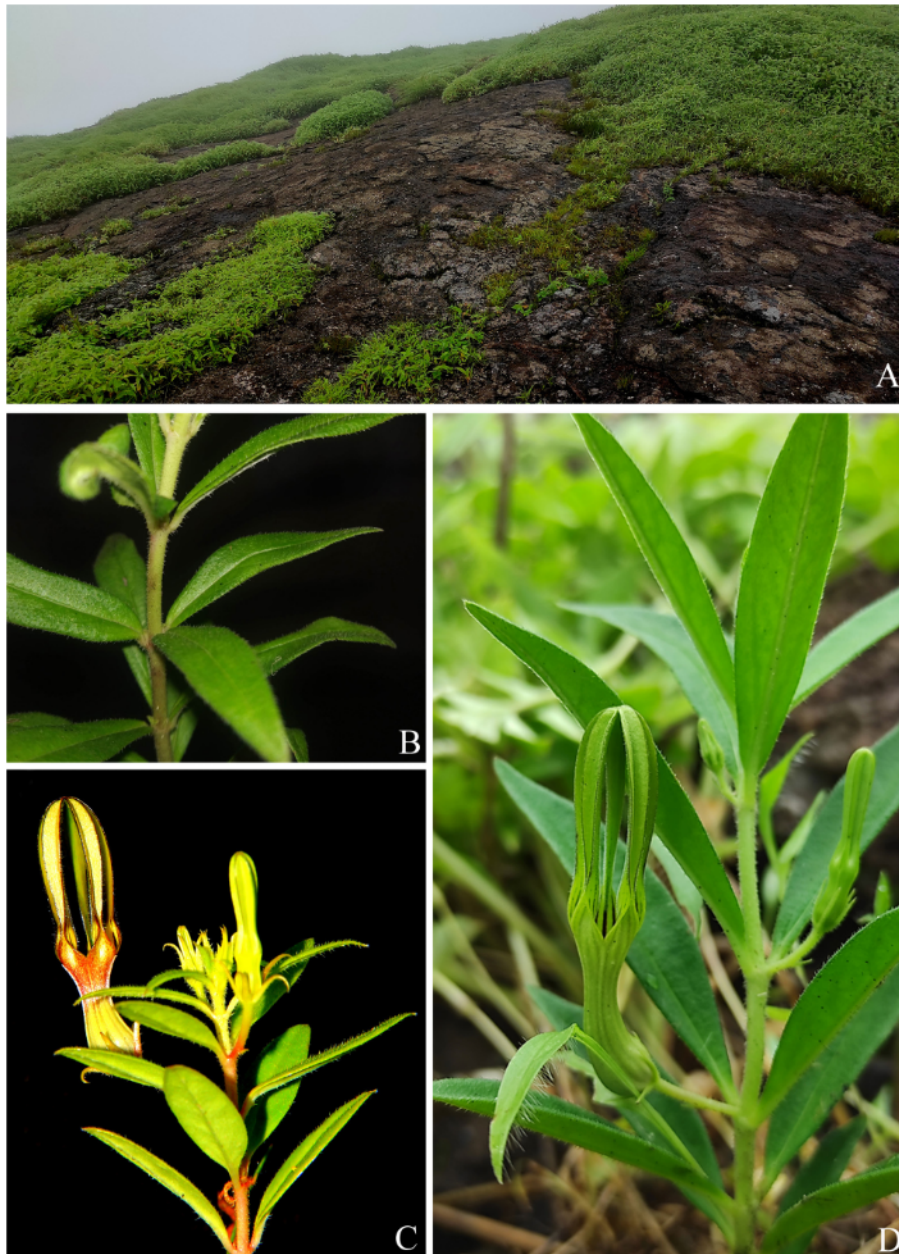
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**Image 1.** *Ceropegia anjanerica* Malpure, M.Y. Kamble & S.R. Yadav: A—Habitat (Bhaskargad) | B—Whorled leaves (Bramhagiri) | C—Kushegaon Population | D—Vatvad population. © S.S. Maity.

India 1: 160. 2009; Kambale & S.R.Yadav, *Asklepios* 115: 29. 2013; Kambale & S.R.Yadav, *Rheedea* 29(1): 93; Auti et al. *J. Bombay Nat. Hist. Soc.* 116. 181. 2019. (Fig. 1, Table 1).

Perennial, erect, tuberous herbs. Stems rarely two per tuber. Leaves scabrous above, along midrib, and margin, lamina lamina elliptic-narrowly elliptic, 1.3–3.7 × 0.3–1.1 cm, glabrous otherwise. Inflorescence an extra-axillary solitary flower; corolla tube up to 1.9 cm long, gradually dilated at base, funnel-shaped towards throat, slightly curved, greenish-grey, striated with deep

purple lines within, white otherwise, glabrous within; corolla lobes 1.4–1.9 cm long, greenish-yellow, obovate, attenuate, finely pubescent throughout, connate at the tip, lobes reflexed. Corona biseriate, stipitate; outer corona of five bifid lobes, 2×2 mm, yellow, ciliate within and along margin; inner corona of five erect linear lobes, c. 2 mm long, alternating with outer corona. Follicles usually in pairs, straight, tapering to a fine point, erect. Seeds ovoid, oblong, comose; coma white, silky.

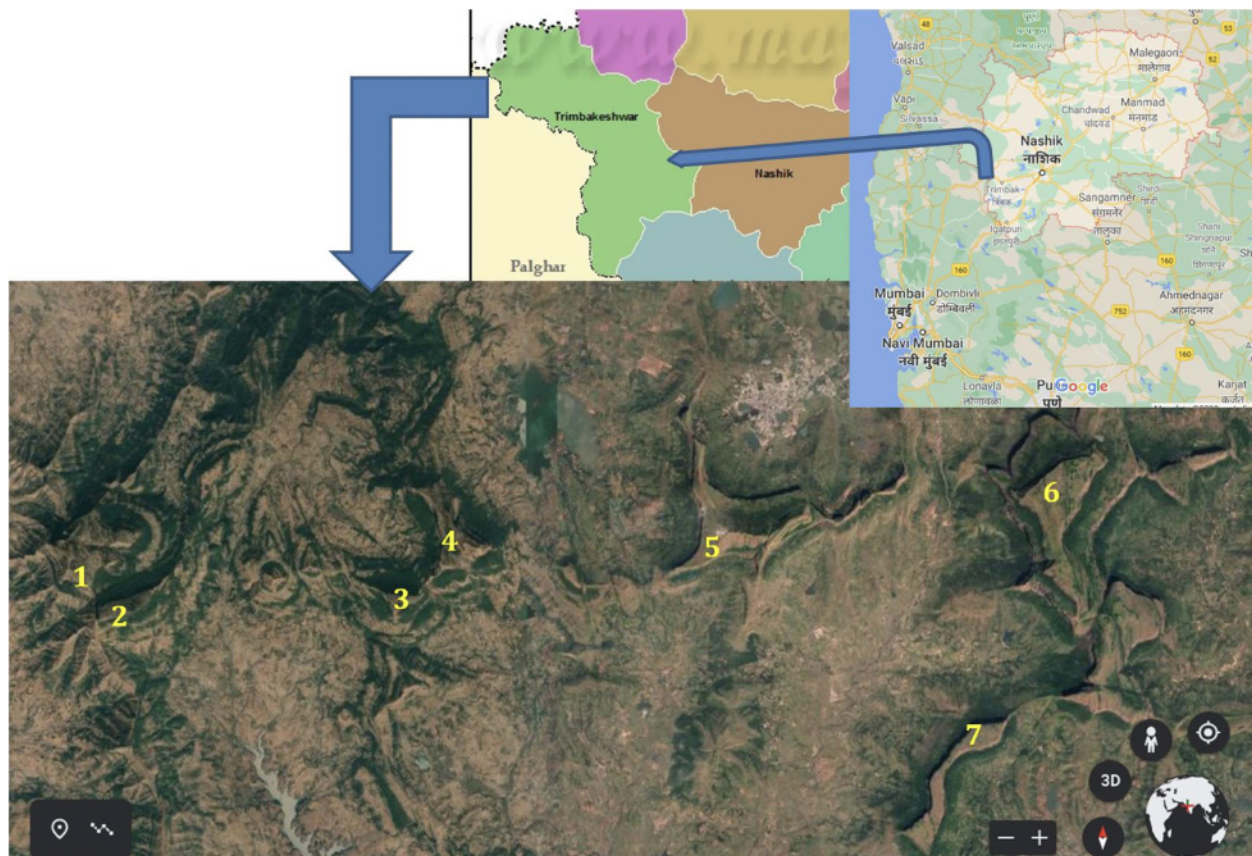
Flowering & Fruiting: July–November.

Distribution: Endemic to the northern Western Ghats



**Table 1. Comparison of characters at different populations.**

Character	Anjaneri	Bramhagiri	Harihar fort	Kushegaon
Arrangement of leaves	opposite-decussate	whorled (Image 1B)	opposite-decussate	opposite-decussate
Lamina shape	elliptic-narrowly elliptic	elliptic-narrowly elliptic	linear to lanceolate	elliptic-narrowly elliptic
Corolla tube	green	green	green	red at the upper half (Image 1C)
Corolla lobes	Yellowish-green	Yellowish-green	Yellowish-green	yellow with reddish tinge (Image 1C)



**Image 2. Distribution of *Ceropegia anjanerica* Malpure, M.Y. Kambale & S.R. Yadav: 1—Vatvad Hill | 2—Bhaskargad | 3—Harihar fort | 4—Bramha Hill | 5—Bramhagiri Hill | 6—Anjaneri Hill (Type locality) | 7—Kushegaon.**

of Maharashtra (Nashik district).

Habitat: Grows at an altitude of about 1,300 m in well-drained soil, in association with *Cyanotis fasciculata* (B. Heyne ex Roth) Schult.f., *Justicia procumbens* L., *Senecio bombayensis* N.P. Balakr. and *Swertia minor* Knobl.

Specimens examined: SSK-5420, 19.vii.2020, India, Maharashtra, Nashik District, Tryambakeshwar, Umbhrande, Vatvad Hill, coll. S.S. Kambale (Image 3); SSK-5421, 28.vii.2020, Bhaskargad, coll. A.N. Gangurde & S.S. Maity; SSK-5422, 3.viii.2020, Harshvadi, Harihar Fort, coll. S.S. Maity & A.N. Gangurde; SSK-5423, 4.viii.2020, Tryambakeshwar, Bramhagiri Hill, coll. S.S. Maity & A.N. Gangurde; SSK-5427, 6.ix.2020, Bramha

Hill, Harshvadi-Talegaon, coll. A.N. Gangurde, S.S. Maity, A.A. Adsul & S.S. Kambale (All specimens are in the Herbarium of Department of Botany, Arts, Commerce & Science College, Tryambakeshwar).

Notes: These peculiar flytrap flowers remained unnoticed despite the localities of their occurrence were frequently visited by both botanists and amateur plant photographers. Vatvad Hill, Bhaskargad, Harihar Fort, and Brahmagiri are the places of the public interest and visited for adventurous treks during and after monsoon. Authors have visited Bramhagiri Hill several times, however, never encountered with *Ceropegia anjanerica*. This year when we visited Vatvad Hill during



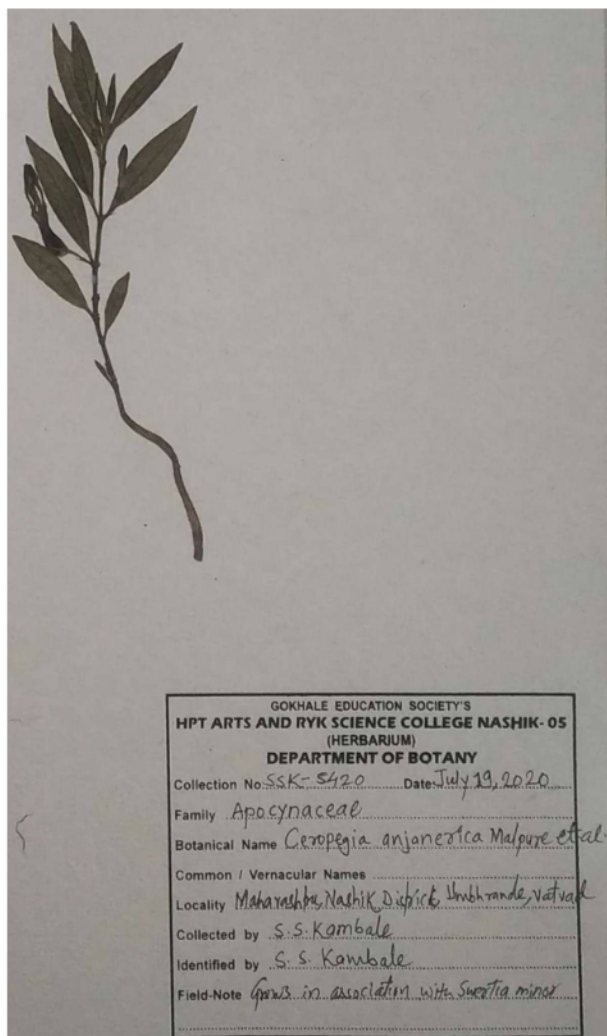


Image 3. Herbarium sheet of *Ceropegia anjanerica* (# SSK-5420).

monsoon (July 2020) we observed healthy population of *Ceropegia anjanerica*. Then, we thought that the species may occur wherever similar habitats are available. Such similar habitats are available on the very next rock outcrops which are Bhaskargad, Harihar fort, Bramha Hill and Bramhagiri Hill. Surveys undertaken to these places resulted in the collection of *Ceropegia anjanerica*. This collection highlights the need of designated surveys to locate such endemic species which are reported from their type localities only. This will help in prioritizing the conservation of threatened species.

Conservation status: *Ceropegia anjanerica* was assessed as Critically Endangered [CR B1ab (iii,v) + B2 ab (iii)] by Pethe et al. (2015) and as 'Endangered' by Pethe & Watve (2021) based on additional four locations on the IUCN Red List. Though the type locality, i.e., Anjaneri Hills, Nashik, is declared as an 'Anjaneri Conservation Reserve' and due care has been taken by Maharashtra Forest Department for its conservation, other localities are under constant anthropogenic pressure. Other than Anjaneri Conservation Reserve, all the localities are tourist places and therefore, frequent trampling by tourists will certainly destroy the habitats. Grazing is not a severe threat at the above mentioned localities. Controlled tourism and awareness amongst tourists will help in reducing the threat to some extent. Unnecessary uprooting of the tuber just for the sake of growing this endemic species in captivity should be avoided as it will not survive outside its habitat more than a year or so if appropriate care is not taken.

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