

## OBSERVATIONS ON *PUCCINIA THWAITESII* Berk.

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On the 16th of September 1928 one of the authors (S. L. A.) collected at Andheri (about 25 miles from Bombay) some leaves of *Justicia Gendarussa* affected by a rust fungus. This was subsequently identified with *Puccinia Thwaitesii* Berk. in consultation with the Imperial Mycologist, Pusa. The same authority kindly supplied a list of references to this fungus available in the Library of the Agricultural Research Institute, Pusa, on perusal of which it was learnt that beyond the naming and description of the fungus and some observations on the germination of its spores, no work had been previously done on it. The following account of some observations made by the writers on the life-history of this Uredine while it was still unidentified may not, therefore, be without interest.

*Justicia Gendarussa* is commonly grown in Bombay and elsewhere as a border plant for flower-beds and it was found that the rust occurs very abundantly on it during the rains. Subsequently to its collection at Andheri it was noticed to occur in many other gardens in and round about Bombay. Also from the literature consulted it appears that the fungus is very widely distributed, having been previously reported from Ceylon, Java, Celebes, Singapore, Mysore, Malabar and N. Guinea.

### Observations.

Owing to the presence of this fungus the leaves at first show definite, roundish, pale yellow spots on the upper surface which, later, may extend and run together and ultimately cover the whole leaf. These spots, after a time, turn deep yellow and then brown and finally dry off. Badly attacked leaves then fall off, leaving the stem and its branches bare. On the lower side of the leaf corresponding to these yellowish spots pustules of brown sori appear in concentric circles, the oldest being at the centre and the youngest at the periphery (Pl. I, Figs. 1, 2). The diameter of each spot is from 3 to 7 mm. The colour of the open pustules is dark brown owing to the exposure of the spores. Solitary pustules are also seen to occur on the petiole and the part of the stem near it in severely attacked plants. Free hand sections through some of these dark brown spots occurring on the lower side of the leaf were observed under the microscope and they showed that the sori consisted of two-celled, thick-walled, long-stalked teleutospores of a species of *Puccinia* (Pl. I, Figs. 3, 4, 5).

Fresh material of the fungus was collected on the 5th of October 1928 and healthy and diseased plants were brought from the same locality and replanted in pots in the garden of the Royal Institute of Science, Bombay. The spores were placed in two watch glasses containing distilled water and 4 per cent cane sugar solution respectively, at 7-15 p.m. on the same day. At 8-30 a.m. on the following day some of the spores were seen to have germinated and by 2 p.m. most of them had put out long germ tubes and sterigmata and sporidia also in a few cases. A sporidium germinating while still attached to the sterigma was also seen (Pl. I, Fig. 6). No appreciable difference was seen between the behaviour of the spores kept in the two different media (distilled water and cane sugar solution). As regards the germ tubes, it was observed that single spores lying free on the surface of the water had put out very long promycelia with thin walls and little protoplasm. Very few of these promycelia were divided into four chambers, the majority showing only two or three (Pl. II, Figs. 1, 2). But spores which occurred in groups produced short promycelia projecting in the air above the surface of the water (Pl. II, Figs. 3, 4, 5). With the naked eye these germ tubes or promycelia could be seen as a greyish felt appearing on the surface of the water. The germ-pore of the upper cell of the teleutospore is terminal while that of the lower cell is lateral and near the septum (Pl. II, Fig. 6).

As a result of twelve germination trials made with the teleutospores it was seen that a period of eighteen hours was necessary to complete the process of germination and also that in this species there was no resting period for the mature teleutospores. This is similar to what has been found by Barclay (2) in the case of *Puccinia Geranii sylviticii* Karst. and by Ajrekar and Tonapy (1) in the case of *Uromyces Aloes* and is different from what is found in the majority of rust fungi where the teleutospores undergo a period of rest before they begin to germinate. In the case of the present fungus, the spores can germinate as soon as they become exposed to the atmosphere on the leaf surface.

Spores collected on the 5th of October, 1928 did not germinate on the 19th of January, 1929. This points to a loss of germinating power with age.

### **Inoculation Experiments.**

In order to study the further life-history of this rust fungus, a healthy plant of *Justicia Gendarussa* was inoculated on the 5th of November, 1928 by placing on young leaves a few drops of water containing germinating teleutospores and covering the plant with a bell jar. Following Plowright (7) such experiments were always done in the evening, water being poured over the plant before transferring the inoculum and over the bell jar after the inoculation to keep the temperature cool. A healthy plant was also kept as control under a

bell jar and treated in the same way except that no spores were placed on it. It was on the ninth day after the inoculation that the inoculated plant showed obvious signs of infection. A number of distorted, pale yellow and round areas had appeared on the leaves inoculated. No spores were, however, seen at this time; these appeared first on the 24th November 1928. Later on, the whole leaf, petiole and the stem near it were covered with the sori of teleutospores (Pl. II, Fig. 8). No other kind of spores were observed in this and five other experiments and it appears that in this rust all the other spore forms are omitted. A teleutospore on germination gives rise to sporidia which produce a mycelium, which, in turn, produces teleutospores.

The controls remained healthy in every case (Pl. II, Fig. 7).

The details of the inoculation experiments are given in the following table :—

Expt. No.	Date of Inoculation	Inoculum	No. of plants inoculated	Results.
1	5-11-28	Germinated teleutospores.	1 (1 control)	Signs of infection on 14-11-28; spores appeared on 24-11-28; control healthy.
2	15-11-28	"	2 (2 controls)	Signs of infection on 28-11-28; spores appeared on 6-12-28; control healthy.
3	22-11-28	Fresh teleutospores.	1 (1 control)	Spores seen on 10-12-28 on the inoculated plant; control healthy.
4	23-11-28	Germinated teleutospores.	"	Signs of infection on 1-12-28; spores seen on 10-12-28; control healthy.
5	13-12-28	"	"	Signs of infection on 24-12-28; spores seen on 3-1-29; control healthy.
6	4-1-29	"	"	Signs of infection on 21-1-29; spores seen on 29-1-29; control healthy.

Except the first one all the experiments were done on plants obtained from fresh and healthy cuttings and it was invariably observed that the teleutospores when placed on young leaf buds gave rise to a fresh crop of teleutospores and to no other spore form.

This *Puccinia* is, therefore, a *Lepto-Puccinia* and a *Micro-Puccinia* form, to use the terminology suggested by Harshburger and others (3, 4, 5, 6).

Although this fungus can cause very considerable damage to *Justicia Gendarussa* plants and may, in severe cases, spoil a whole border in a garden in a few days, the fact that the host plant is so easily propagated by cuttings makes the question of remedial measures an unimportant one. It would seem to be practically sufficient to remove and destroy the affected plants as soon as the pale yellow spots are noticed and before the spores are exposed. In any case spraying with the common fungicide, Bordeaux mixture, which was given a trial was not effective in checking the spread of the disease.

Before concluding, the writers would like to express their gratitude to the Imperial Mycologist, Pusa, for identifying the fungus under study and for supplying the relevant literature.

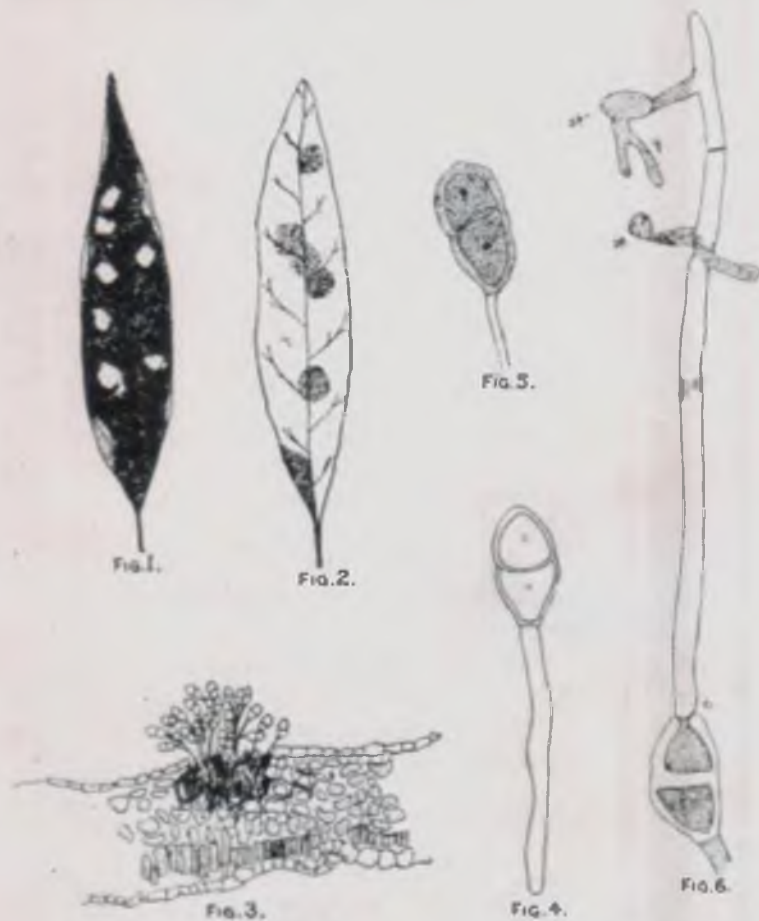
### Summary and Conclusions.

Germination studies and inoculation experiments with the teleutospores of *Puccinia Thwaitesii* Berk. on *Justicia Gendarussa* are reported. These show that this fungus is both a *Lepto* and *Micro* form i.e. the teleutospores require no resting period to germinate and the other spore forms are omitted from its life-history.

### Literature Cited.

1. AJREKAR AND TONAPY: On the Life-history of *Uromyces Aloes* Journ. Ind. Bot. Soc. Vol. III, Nos. 9 & 10, 1923.
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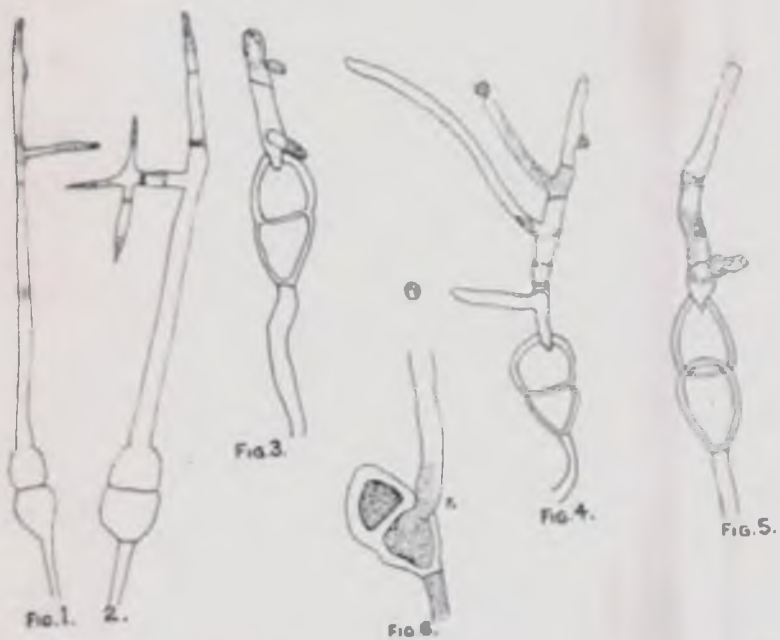


FIG. 7



FIG. 8

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### Explanation of Figures.

#### PLATE I.

- Fig. 1. Upper side of leaf of *Justicia Gendarussa* with pale yellow spots. (Natural size).  
Fig. 2. Lower side of the same showing the sori in concentric rings.  
Fig. 3. Vertical section through a sorus of *Puccinia Thwaitesii*.  
Figs. 4. and 5. Free teleutospores.  
Fig. 6. A germinating teleutospore.

#### PLATE II.

- Figs. 1 and 2. Free teleutospores germinating. (Diagrammatic).  
" 3, 4, 5. Groups of teleutospores germinating.  
Fig. 6. Free teleutospore germinating.  
" 7. Photograph of control plant.  
" 8. " " diseased plant.