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Research Note

A report on the natural incidence of *Puccinia noccae* on the exotic weed *Lagascea mollis* in India

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ABSTRACT: *Lagascea mollis* (=*Nocca mollis* (Cav.) Jacq. commonly known as Velvet weed or Silk leaf weed) is native of Tropical Central America and is an invasive annual herb belonging to the family Asteraceae. It is found to occur in most parts of the country, grows on cultivated land and in pastures along field bunds, roadsides and channels. It grows throughout the year but appears severe in the late Kharif (monsoon) and early Rabi (winter) seasons (July to November) natural infection by the rust pathogen, identified as *Puccinia noccae* was found to occur on the weed in and around the fields of Jabalpur district. The pathogen survives as dormant teliospores and on favorable climatic conditions produces the uredospores, which are the pathogenic stage of its life cycle. The disease appears as scattered dull brown individual spots on the underside of the leaves, which later develops into rusty brown raised spots containing the urediniospores. The pathogen affects the green leaves and the bracts. General observations and host range studies indicated that *P. noccae* is highly specific on *L. mollis* and hence may be used as a biocontrol agent against *L. mollis*.

KEY WORDS: *Lagascea mollis, Puccinia noccae,* silk leaf weed, velvet weed, weed biocontrol

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Lagascea mollis Cav. (commonly known as Velvet weed or Silk leaf weed) is an annual herb native to Central America and has been introduced in India, found to occur in most parts of the country (Khuspe *et al.,* 1982). *L. mollis* occurs throughout the year but becomes a threat in the late Kharif (July onwards) and early Rabi seasons (November till) aided by warm humid climate and grows on cultivated land and in pastures along field bunds, roadsides and channels (Krishna, 2010). It is a serious weed in fields where cotton, maize, mustard, millets and vegetables are grown, because of its rapid growth and high spreading characters (Pulliah *et al.,* 2000). *L. mollis* is an important weed which harbors the American bollworm, *Heliothis armigera* Hubner that proliferates and survive for offseason multiplications in *L. mollis*. Thus, management of *H. armigera* would require an integrated approach by managing *L. mollis* for an effective control of the pest populations (Ahrekar *et al.,* 1999). It may be mentioned that the single most important reason for the dominance of a particular weed in a locality is the absence of its natural enemies.

The biological control of weeds is the deliberate use of such enemies to the disadvantage of the weed, so that the population of the target weed always remains under the critical level without causing any economic damage to the main crop. A successful biocontrol agent should be host specific, adapt to the new environment and spread effectively (Charudattan and Dinoor, 2000). During 2009, in the central farm of the Directorate, a natural infestation of the rust pathogen, *Puccinia noccae.* Arthur (1905) (syn. *Puccinia lagascae* Speg.) was observed on *L. mollis*. *P. noccae* is known to occur in Mexico, Central America and Argentina on *Lagasca nocca* (Parmelle, 1967). The *P. noccae* infects mainly the leaves and bracts. This is the first such report of the incidence of *P. noccae* on *L. mollis* in India and the paper deals with the study in detail on the different aspects of the pathogen, their host range and the extent of their damage on *L. mollis*.

The pathogen was collected from the leaves of *L. mollis* in and around the fields of Jabalpur and in the central farm of this Directorate. The disease regularly appears in the month of August (temperature about 30±3°C in the day and 29±3°C in the night with moderate rainfall) and continues till the month of February (temperature about 26±2°C in the day time and 16±2°C in the night without rainfall). Disease incidence on *L. mollis* is about 90% in the farm and it has also been observed in and around Jabalpur.

Disease symptoms and severity in *L. mollis*

The disease appears as scattered dull brown individual spots in the underside of the leaves, which later develops into rusty brown raised spots containing the urediniospores. Under warm humid conditions when the temperature is about 30± 2°C and humidity above 70%, individual raised rust spots develop rapidly, merge together and the whole leaves become dark black and rotten (Fig. 1). Incidence of the disease on the weed host was restricted to certain pockets of the farm, however when the spore suspension is sprayed on the healthy plants, the disease spreads quickly among the populations. The pathogen affects the green leaves and the bracts. The stem, roots and the flowers are not affected. However, because of the rapid loss in the green photosynthetic parts of the plant, the disease results in the quick death of the whole plant. The plants when affected at the young stages do not produce flowers and numbers of tillers are also reduced from an average five to eight tiller per plant to less than three tillers. This may result in the lesser number of seed bank for the next season.

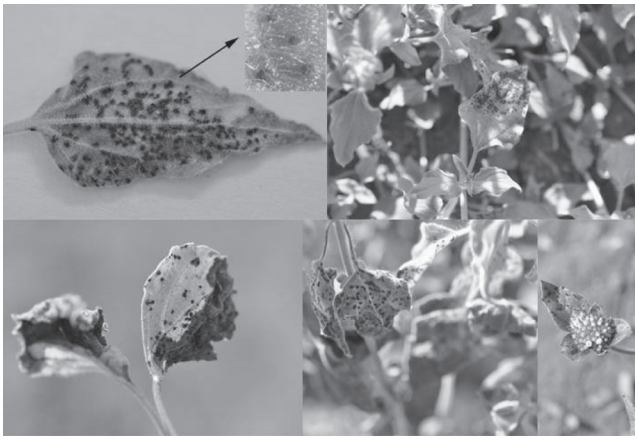

Fig. 1. Different stages of severity of *Puccinia noccae* infection on leaf and bract of *Lagascea mollis*

Pathogen description

The rust pathogen was identified as *Puccinia* sp. based on the morphological characters as described by Parmelle (1967). The pathogen spores were later sent to CABI for further identification and accordingly the pathogen was identified as *P. noccae* (IMI Number 398189). The pathogen has also been submitted to the HCIO (Herbarium Cryptogamae Indiae Orientalis, HCIO No. 50090) at Indian Agricultural Research Institute (IARI), New Delhi, India. *P. noccae* is an autoecious rust, with uredosori mostly present in the abaxial surface of the leaf as shown in the cross section of the leaf, are amphigenous, scattered, pulverulent, brown colored, and during the early stages of colony establishment commonly fuse with each other (Fig. 2). Teliospores are one or two celled, oblong or elliptical have a long colourless pedicel firmly attached to it and generally seen at the end of the season when the whole leaf has become dark black and rotten. *P. noccae* belongs to the Phylum Basidiomycota, Class Urediniomycetes, Order Uredinales, and Family Pucciniaceae, which contains 17 genera and approximately 4000 species, majority belonging to the genus *Puccinia* (Kirk *et al.,* 2001). A similar rust infection caused by *P. jabalpuriensis* was reported to occur in *L. mollis* in the fields of the Directorate (Chandrabhanu, 2009). It is proposed that there may be a possibility of admixture in the populations of this *Puccinia* species in the fields. However it is very interesting to note that *P. noccae,* which has co-evolved with its natural host *L. mollis* in Central America (Joe *et al.,* 1972), must have been introduced with its host into India and naturalized here. This would have been one of the reasons why *L. mollis* has not reached alarming levels as that of other exotic weeds like *Parthenium, Lantana*, etc.

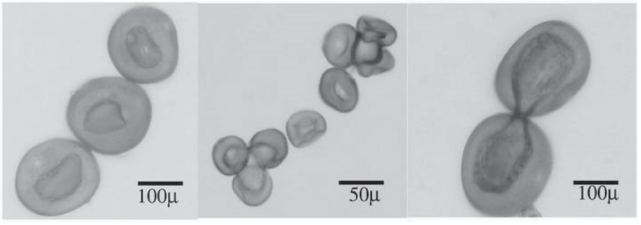

Fig. 2. Different stages of uredospores of *Puccinia noccae* on *Lagascea mollis*

Host range studies and prospects of use of *P. noccae* as biocontrol agent

P. noccae is a host specific pathogen infecting *L. mollis* and for its use as a biocontrol agent, the major criterion is its host specificity. To Host range studies were conducted in the field with the crops in which *L. mollis* is a serious weed or likely to occur in future, including the cereals like wheat, oats, barley, weeds like wild oats (*Avena fatua*), little seed canary grass (*Phlaris minor),* pulses like chickpea (*Cicer arietinum*), lentil (*Lens culinaris*), rajma bean (*Phaseolus vulgaris*), field pea (*Pisum sativum*) and the oil seed crop mustard (*Brassica nigra*). Three rows of the test plants were planted, with one row of *L. mollis* in between each row of the test plants. This was done to ensure that the test plants get sufficient load of pathogen inoculum from both the sides. The rust spores were collected from fully diseased 50 leaves of *L. mollis* and suspended in 1000 ml of distilled water and sprayed on the plants. The pathogen was sprayed two times at 20 and 40 DAS so that to ascertain the non-host nature of the crops

during different stages of their growth. The plants were observed periodically for disease symptoms if any. While the centre rows of *L. mollis* plants were fully diseased upon spraying with *P. noccae*, the main crops in the adjacent rows were not affected by the pathogen spray. The results indicated that *P. noccae* was host specific and did not affect any of the other crops tested. However testing with other host plants and the members in the family Asteraceae may be done to ascertain the effect of the pathogen on the non-target crops. *P. noccae* as a biocontrol agent on *L. mollis* may be effective because of the fact that *L. mollis* is completely killed, the number of tillers is reduced and infection at young stages inhibits flower production leading to a reduced seed bank for the next season. However the problems of seasonal occurrence of *P. noccae* and its heavy dependence on climatic conditions to proliferate, may hinder the use of *P. noccae* as an effective biocontrol agent against *L. mollis*. Further in spite of several attempts to culture *Puccinia* in artificial media (Bushnell and Bosacker, 1982; Kuhl *et al.,* 1971), there has been little success in culturing fully viable spores capable of infecting the hosts. Thus development of efficient races of the pathogen which can survive in all seasons and those which can be cultured artificially may enable the use of *P. noccae* as a biocontrol agent against *L. mollis*.

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