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Cover: *Geodorum laxiflorum* Griff.—inflorescence (Orchidaceae) © Ashish Ravindra Bhoyar.

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COMMUNICATION

New host plant records of Fig Wax Scale *Ceroplastes rusci* (Linnaeus, 1758) (Hemiptera: Coccomorpha: Coccidae) from India

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Abstract: A survey for the host plants of Fig Wax Scale *Ceroplastes rusci* (Linnaeus, 1758) was conducted in the Uttarakhand province, India. Among the six new host plants recorded during the study, four are new host records of *C. rusci*. A global check list of host plants of *C. rusci* was also prepared.

Keywords: Biological stages, checklist, infestation, morphological characters, scale insect.

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Author contributions: AK has surveyed the region and collected the host plants in the Garhwal region, identified the insect species, photography, and prepared this manuscript. RP has collected the host pants from Kumaun region of Uttarakhand and contributed to prepare this manuscript.

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INTRODUCTION

Members of the genus *Ceroplastes* Gray, 1828 (Hemiptera: Coccomorpha: Coccidae), known as wax scale insects are pest of numerous fruit and other plants of economic importance (Pellizzari & Camporese, 1994). The genus has a worldwide distribution including India (Kumar 2013). Among the species belonging to this genus, *Ceroplastes rusci* (Linnaeus, 1758), Fig Wax Scale, is of immense economic importance with a wide range of host species across the world (Morales et al. 2016). *Ceroplastes rusci* is one of the earliest species reported from the Mediterranean region and has been known since Theophrastus' era, i.e., 370–285 BCE (Silvestri & Martelli 1908). Primarily it is native to the Afrotropical region (Qin et al. 1994, 1998) and has also been reported from Palearctic, Neotropical, Oriental, Ethiopian, and Australian regions (Ben-Dov 1993; Waterhouse & Sands 2001). *Ceroplastes rusci* was first reported in Britain from *Ficus carica* fruits imported from Italy (Green 1917). It has a wide range of host plants in Algeria, Cyprus, Egypt, Greece, Israel, Italy, Lebanon, Morocco, Spain, Tunisia, Turkey, and India (Talhouk 1975; Kumar 2013). Apart from fig, *Nerium oleander*, *Pistacia lentiscus*, and *P. terebinthus* are its common host plants (Balachowsky & Mesnil 1935). About 100 per cent plant infestation by *C. rusci* in *Annona muricata* was recorded with 100 per cent of its shoot infestation (Vu et al. 2006). *Ceroplastes rusci* infestation in fig was recorded with about 500 nymphs per twig (Bodkin 1927; Balachowsky & Mesnil 1935; Khasawinah & Talhouk 1964; Talhouk 1969; Argyriou & Santorini 1980; Mustafa-Al-Antary & Al-Momany 1990; Mustafa-Al-Antary & Sharaf 1994). In India *C. rusci* has been reported infesting *Mangifera indica*, *Dalbergia sissoo, Syzygium* sp., *Ziziphus mauritiana*, *Citrus* sp., *Ficus benghalensis, F. religiosa*, *F. rubiginosa, F. acrocarpa*, *F. retusa*, and *F. carica* (Del Guercio 1906; Balachowsky & Mesnil 1935; Talhouk 1975; Morsi & Mousa 2003; Vu et al. 2006; Mifsud et al. 2012; Kumar 2013). *Ceroplastes rusci* is also reported as a vector of plant viruses (La Notte et al. 1997). Ben-Dov (1993) reported 39 plant species hosting *C. rusci* and subsequently, Morales et al. (2016) listed 137 host plant species belonging to 48 families of the world. The finding of the workers proves that *C. rusci* has wide range of host plants worldwide. The present survey was carried out to find out the host-plant species and infestation intensity in Uttarakhand, India and subsequently check list of host plant of the world was also prepared.

MATERIAL AND METHODS

The present study was carried out in foothill regions of Uttarakhand province, India at an elevation range of 200–1,200 m. The plant species infested with *C. rusci* were observed from Dehradun (30.349N, 79.002E), Haridwar (29.934N, 77.938E), Udham Singh Nagar (29.022N, 79.484E), Nainital (29.150N, 79.582E), and Champawat (29.078N, 80.101E) districts during the years 2018 and 2019. The infestation intensity of *C. rusci* on each host plant species was recorded and plant samples were collected and identified by taxonomists at the Systematic Botany Discipline. Digital photo of morphological characters and biological stages of *C. rusci* (Figure 2) were taken under Leica M-205 microscope fitted with a photographic camera MC190 HD at the Insect Systematic Laboratory, Forest Research Institute, Dehradun. Subsequently, identification of *C. rusci* also referred to the reports of Gimpel et al. (1974), Williams & Watson (1990), and Hodgson & Peronti (2012). Infestation data was statistically analysed for their mean and standard deviation using Microsoft Excel.

RESULTS AND DISCUSSION

In the present survey of host plants of *C. rusci* in Uttarakhand, India, *Chrysanthemum* sp., *Ocimum gratissimum* L., *Ficus benjamina* L., *Ficus natalensis* Hochst., *Grevillea robusta* A.Cunn. ex R.Br. and *Geijera parviflora* Lindl. were found to be infested with *C. rusci* (Table 1 & Figure 1). These host plants were also recorded as new hosts in India. Kumar (2013) has reported eight host plants of *C. rusci*, viz., *Citrus* sp., *D. sissoo*, *F. benghalensis*, *F. religiosa*, *F. carica*, *M. indica, Psydium* sp., *Syzygium* sp., and *Z. mauritiana* from India. *Ficus benjamina* (Balachowsky, 1927) and *Grevillea robusta* (Ben-Dov, 1970) were also reported from Israel. The

Table 1. New host plants of *Ceroplastes rusci* and its population intensity in Uttarakhand, India.

Botanical name	Family	Population (mean ±SD) m^{-2}
*Chrysanthemum sp.**	Asteraceae	24.60±3.91
Ocimum gratissimum L.*	Lamiaceae	3.67±1.47
Ficus benjamina L.	Moraceae	27.34±4.53
Ficus natalensis Hochst.*	Moraceae	32.10±3.89
Grevillea robusta A.Cunn. ex R.Br.	Proteaceae	3.34±1.39
Geijera parviflora Lindl.*	Rutaceae	2.70±1.02
*New records for the world		

Image 1. New host species (a–f) with *Ceroplastes rusci* infestation: a— *Chrysanthemum* sp. | b—*Ocimum gratissimum* L. | c—*Ficus benjamina* L. | d—*Ficus natalensis* Hochst. | e—*Grevillea robusta* A.Cunn. ex R.Br. | f—*Geijera parviflora* Lindl.

Image 2. Growth stages of *Ceroplastes rusci* (a–d): a—Nymphal stages | b—Dorsal view of nymph | c—Ventral view of female adult | d—Dorsal view of female adult.

Table 2. Check list of host plant species of *Ceroplastes rusci* of the world.

	Family	Botanical name	References
1	Anacardiaceae	*Mangifera indica* #	Carnero Hernandez & Perez Guerra (1986), Malumphy (2010), Kumar (2013)
2		*Pistacia lentiscus*	Bodenheimer (1928)
3		*Pistacia terebinthus*	Balachowsky & Mesnil (1935)
4		*Pistacia vera*	Ülgentürk & Dokuyucu (2019)
5		*Rhus coriaria*	Marott (1987)
6		*Schinus terebinthifolius*	Ben-Dov (1970)
7		*Schinus molle*	Bodenheimer (1928)
8		*Searsia gerrardii*	Brain (1920)
9		*Spondias purpurea*	Lincango et al. (2010)
10	Annonaceae	*Annona cherimoya*	Nakahara (1983)
11		*Annona muricata*	Ben-Dov (1993)
12		*Annona reticulata*	Malumphy & Anderson (2011)
13		*Annona squamosa*	Nakahara (1983)
14	Apocynaceae	*Alstonia scholaris*	Wu and Wang (2019)
15		*Cascabela thevetia*	Ben-Dov (1970)
16		*Nerium oleander*	Balachowsky & Mesnil (1935)
17		*Thevetia peruviana*	Malumpy & Anderson (2011)
18	Aquifoliaceae	*Ilex aquifolium*	Ben-Dov (1993)
19	Araliaceae	*Hedera helix*	Ben-Dov (1993)
20	Arecaceae	*Brahea armata*	Malumphy (2010)
21		*Chamaerops humilis*	Marotta (1987)
22		*Cocos nucifera*	Chua (1997)
23		*Dictyosperma album*	Malumphy (2010)
24		*Dypsis lutescens*	Wu & Wang (2019)
25		*Mascarena* sp.	Malumphy (2010)
26		*Phoenix canariensis*	Malumpy & Anderson (2011)
27		*Phoenix roebelenii*	Malumphy (2010)
28		*Trachycarpus fortunei*	Wu & Wang (2019)
29	Asparagaceae	*Ruscus aculeatus*	Marotta (1987)
30	Asteraceae	*Argyranthemum frutescens*	Crnero & Perez (1986)
31		*Chrysanthemum* sp. #	New Record
32	Balsaminaceae	*Impatiens sultani*	Ben-Dov (1993)
33	Boraginaceae	*Cordia lutea*	Lincango et al. (2010)
34		*Cordia myxa*	Ben-Dov (1970)
35	Buxaceae	*Buxus balearica*	Balachowsky (1939)
36	Cannaceae	*Canna* sp.	Ben-Dov (2012)
37	Clusiaceae	*Psorospermum* sp.	Malumpy & Anderson (2011)
38	Compositae	*Artemisia* sp.	Crnero & Perez (1986)
39		*Artemisia monosperma*	Ben-Dov (2012)
40	Convolvulaceae	*Convolvulus* sp.	Ben-Dov (1993)
41		*Ipomoea sp.*	Borg (1932)
42		*Ipomoea batatus*	Nakahara (1983)
43	Cyperaceae	*Cyperus* sp.	Hall (1922)

	Family	Botanical name	References
44		*Cyperus diffusus*	Malumpy & Anderson (2011)
45		*Cyperus involucratus*	Ben-Dov (1970)
46	Ebenaceae	*Diospyros austro-africana*	Hodgson & Peronti (2012)
47		*Diospyros glabra*	Hodgson & Peronti (2012)
48		*Euclea* sp.	Hodgson (1969)
49		*Euclea schimperi*	Hodgson & Peronti (2012)
50	Ericaceae	*Arbutus unedo*	Balachowsky (1931)
51	Euphorbiaceae	*Codiaeum variegatum*	Malumpy & Anderson (2011)
52		*Euphorbia longan*	Ben-Dov (1993)
53	Fabaceae	*Albizia* sp.	Malumpy & Anderson (2011)
54		*Dalbergia sissoo #*	Kumar (2013)
55		*Phaseolus caracalla*	Malumpy & Anderson (2011)
56		*Tamarindus* sp.	Gomez (1958)
57		*Vigna caracalla*	Borg (1932)
58	Heliconiaceae	*Heliconia* sp.	Malumphy (2010)
59	Hypericaceae	*Psorospermum* sp.	Hodgson (1994)
60		*Psorospermum febrifugum*	Hall (1931)
61	Juncaceae	*Juncus acutus*	Carnero & Perez (1986)
62	Lauraceae	*Laurus nobilis*	Ben-Dov (1993)
63		*Persea americana*	Ben-Dov (1970)
64	Lamiaceae	*Ocimum gratissimum*	New Record
65	Loranthaceae	*Plicosepalus acaciae*	Ben-Dov (2012)
66	Lythraceae	*Lawsonia inermis*	Hall (1923)
67	Malvaceae	*Gossypium* sp.	Carnero & Perez (1986)
68		*Hibiscus rosa-sinensis*	Lincango et al. (2010)
69	Moraceae	*Ficus amplissima*	Marotta (1987)
70		*Ficus benghalensis #*	Hodgson & Peronti (2012) Kumar (2013)
71		*Ficus benjamina #*	Balachowsky (1927) New record
72		*Ficus carica #*	Green (1917) Balachowsky (1939) Kumar (2013)
73		*Ficus concinna*	Wu & Wang (2019)
74		*Ficus elastica*	Marotta (1987)
75		*Ficus infectoria*	Hodgson & Peronti (2012)
76		*Ficus macrophylla*	Balachowsky (1927)
77		*Ficus microcarpa*	Wu & Wang (2019)
78		*Ficus natalensis*	New Record
79		*Ficus obliqua*	Ben-Dov (1970)
80		*Ficus pseudosycomorus*	Hall (1922)
81		*Ficus religiosa #*	Kumar (2013)
82		*Ficus retusa*	Ben-Dov (1970)
83		*Ficus rubiginosa*	Ben-Dov (1970)
84		*Ficus sycomorus*	Ben-Dov (1970)
85		*Ficus thonningii*	Hodgson (1994)
86		*Ficus virens*	Bodenheimer (1924)

	Family	Botanical name	References
87		*Morus alba*	Ben-Dov (1970)
88		*Morus nigra*	Marotta (1987)
89	Musaceae	*Musa* sp.	Hall (1924)
90		*Musa acuminata*	Marotta (1987)
91		*Musa cavendishi*	Ben-Dov (1993)
92		*Musa paradisiaca*	Hall (1922)
93		*Musa sapientum*	Ben-Dov (1993)
94	Myrtaceae	*Myrtus* sp.	Bodenheimer (1928)
95		*Myrtus communis*	Aziz (1977)
96		*Psydium* sp. #	Kumar (2013)
97		*Psydium guajava*	Hodges et al. (2005)
98		*Syzygium cumini* #	Ben-Dov (1993) Kumar (2013)
99	Ochnaceae	*Ochna* sp.	Malumpy & Anderson(2011)
100		*Ochna ciliata*	Williams & Matile (2009)
101	Oleaceae	*Olea europaea*	Ulgenturk & Dokuyucu (2019)
102	Phyllanthaceae	*Bischofia javanica*	Wu & Wang (2019)
103	Pinaceae	*Cedrus deodora*	Malumpy & Anderson (2011)
104	Piperaceae	*Piper* sp.	Hall (1924)
105		*Piper nigrum*	Gomez (1958)
106	Pittosporaceae	*Pittosporum tobira*	Marotta (1987)
107	Platanaceae	*Platanus orientalis*	Ben-Dov (1993)
108	Proteaceae	*Grevillea robusta* #	Ben-Dov (1970) New Record
109	Punicaceae	*Punica granatum*	Bodenheimer (1926)
110	Ranunculaceae	*Clematis cirrhosa*	Ben-Dov (2012)
111	Rhamnaceae	*Ziziphus mauritiana* #	Kumar (2013)
112	Rosaceae	*Amygdalus communis*	Malumpy & Anderson (2011)
113		*Crataegus azarolus*	Ben-Dov (1970)
114		*Crataegus vulgaris*	Hodgson & Peronti (2012)
115		*Cydonia* sp.	DeLotto (1978)
116		*Cydonia oblonga*	Ben-Dov (1970)
117		*Mespilus germanica*	Marotta (1987)
118		*Mespilus monogyna*	Pierce (1917)
119		*Mespilus oryneantha*	Pierce (1917)
120		*Mespilus cocinea*	Pierce (1917)
121		*Pyrus communis*	Ben-Dov (1970)
122		*Prunus dulcis*	Carnero & Perez (1986)
123		*Prunus domestica*	Hodgson & Peronti (2012)
124	Rubiaceae	*Pavetta* sp.	DeLotto (1978)
125		*Ixora* sp.	Hamon & Mason (2017)
126	Rutaceae	*Citrus aurantium*	Ben-Dov (1970)
127		*Citrus limon*	Nakahara (1983) Talhouk (1975)
128		*Citrus maxima*	Ben-Dov (2012)
129		*Citrus paradisi*	Ben-Dov (1993)
130		*Citrus reticulata*	Argyriou & Mourikis (1981)

	Family	Botanical name	References
131		*Citrus sinensis*	Argyriou & Mourikis 1981)
132		*Geijera parviflora*#	New Record
133	Salicaceae	*Populus alba*	Marotta (1987)
134		*Populus deltoides*	Ben-Dov (1970)
135		*Populus nigra*	Pierce (1917)
136		*Populus tremula*	Pierce (1917)
137		*Salix* sp.	Ben-Dov (2012)
138		*Salix babylonica*	Hall (1923)
139	Santalaceae	*Osyris alba*	Kozar et al. (1991)
140	Sapindaceae	*Dimocarpus longan*	Carnero & Perez (1986)
141		*Dodonaea viscosa*	Hodgson (1994)
142		*Litchi chinensis*	Carnero & Perez (1986)
143		*Nephelium lappaceum*	Ben-Dov (1970)
144		*Sapindus saponaria*	Marotta (1987)
145	Sapotaceae	*Sideroxylon oxyacanthurm*	Hodgson (1994)
146		*Mimusops roxburghiana*	Hamon & Mason (2017)
147	Smilacaceae	*Smilax aspera*	Kozar& Franco (1995)
148	Strelitziaceae	*Strelitzia reginae*	Carnero & Perez (1986)
149		*Strelitzia nicolai*	Malumpy & Anderson (2011)
150	Umbelliferae	*Bupleurum* sp.	Gomez (1946)
151		*Bupleurum subfructicosum*	Malumpy & Anderson (2011)
152	Vitaceae	*Vitis vinifera*	Balachowsky (1927)
153	Thymelaeaceae	*Synaptolepis alternifolia*	Hodgson (1969)

Host records of *Ceroplastes rusci* in India.

population intensity (Table 1) of *C. rusci* was recorded to be maximum in *F. natalensis* (132.10 insects m^{-2}) followed by *F. benjamina* (27.34 insects m^{-2}), *Chrysanthemum* sp. (24.60 insects m^{-2}), *O. gratissimum* (3.67 insects m^{-2}), *G. robusta* (3.34 insects m^{-2}), and *G. parviflora* (2.70 insects m^{-2}). *Ceroplastes rusci* was recorded to be infesting to *D. sissoo* tree with an intensity of about 23.33 insects per twig and up to 10.00 insect per leaf (Kumar 2013). The present study also revealed that plants of Moraceae family were preferred hosts of *C. rusci* in the study area. Six new host plant species of *C. rusci* recorded from India, indicated that *C. rusci* is a polyphagous species and there are additional host plants yet to be detected.

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