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Vireyas



Rhododendrons



Azaleas

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From the Editor

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“Rhododendrons International” (RI) is an online journal distributed free to all the world’s known rhododendron associations for their internal distribution. It can also be accessed on the American Rhododendron Society website at <https://www.rhododendron.org/ri-index.htm>. This fourth issue of RI includes five articles, some modified slightly from those printed initially, that I have extracted from various rhododendron publications that I feel are worthy of wider world-wide distribution. Articles in this volume are from Rhododendron Species 2018, the journal of the Rhododendron Species Botanical Garden in Federal Way, WA; Rhododendrons, Camellias & Magnolias 2018, Royal Horticultural Society Group; and the Journal American Rhododendron Society. I regularly search botanical publications for worthwhile rhododendron articles I deem to be of international significance for wider distribution through RI issues. I also welcome submissions from authors of such material that I might not be aware of, so please feel free to bring such material to my attention

Examining the Significance of the *Rhododendron* Collection at the *Rhododendron* Species Botanical Garden (Federal Way, WA, USA)

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M. MacKay



S. Hootman

(Modified from “Rhododendron Species 2018,” the publication from the Rhododendron Species Botanical Garden: 25-39).

Executive Summary

Premise: A 2012 study by Botanic Gardens Conservation International (BGCI) identified the *Rhododendron* collection at Royal Botanic Garden Edinburgh (henceforth referred to as Edinburgh) as the largest globally of 304 collections that were surveyed (BGCI 2012); however the *Rhododendron* Species Botanical Garden (RSBG) was not a participant in the 2012 study. Comparison between the Edinburgh collection and the collection at RSBG will establish the significance of the RSBG collection.

Method: The comparison between the two collections used the data-set developed for previous studies on *Rhododendron* (MacKay and Gardiner 2016; MacKay *et al.* 2016; MacKay *et al.* 2017), combined with an inventory of the RSBG collection (Hootman, unpublished), a 2017 update of the Edinburgh data (RBGE 2017), a 2017 update of the BGCI data (BGCI 2017) and the addition of data describing taxa ‘in cultivation’ from the German Genebank database (<http://www.bundessortenamt.de/internet30/index.php?id=3>. Searched 06 January 2017), and the online inventory of Wespelaar Arboretum, Belgium (<http://www.arboretumwespelaar.be/EN/>. Searched 05 January 2017), the latter being identified by BGCI (2012) as the third largest collection worldwide at that time. Royal Botanic Garden Kew was identified as the second largest

collection world-wide; that collection is already in the MacKay *et al.* (2017) data-set. The comparison between RSBG and Edinburgh that is reported here was primarily based on the group of 1215 taxa that were Red List assessed by Gibbs *et al.* (2011) and Argent (2015). Comparisons include:

- Numbers of 'all taxa' in each subgenus in each collection,
- Numbers of Red List taxa in each subgenus in each collection,
- Numbers of 'all taxa' from each country of origin in each collection,
- Numbers of Red List taxa from each country of origin in each collection,
- Numbers of taxa represented by wild-collected material in each collection,
- A 'collection score' method used by BGCI (2012) which was applied to the RSBG collection,
- Numbers of named taxa at RSBG that additional to those considered by Gibbs *et al.* (2011) and Argent (2015),
- A summary of un-named taxa additional to those considered by Gibbs *et al.* (2011) and Argent (2015).

Key results: RSBG contains a substantial collection which, according to the BGCI (2012) method, is more significant than that at Edinburgh; however the two collections have a range of contrasting characteristics. Particularly:

- RSBG (650 taxa) contains more taxa than Edinburgh (616), and RSBG holds more Red List taxa (291 taxa) than Edinburgh (241). It should be noted that the BGCI study (BGCI 2012) recorded 734 taxa at Edinburgh; however, despite several searches of the Edinburgh database between 2013 and 2017 the MacKay studies have not recorded more than 616. There are about 80 additional taxa at Edinburgh that were not assessed by either Gibbs *et al.* (2011) or Argent (2015), which may explain the difference, although BGCI (2012) appears to state that non-assessed taxa were not included. Other explanations for the difference are that there may have been differences in data that were on the database in 2012, or the 2012 study may have had a different level of access to the Edinburgh data.
- RSBG has a greater number of 'all taxa' and Red List taxa than Edinburgh for subgenera *Hymenanthes* and *Rhododendron*, whereas Edinburgh has a larger collection than RSBG of 'all taxa' and Red List taxa for section *Schistanthe*.
- RSBG has more taxa from China, Myanmar, India, Nepal, eastern Russia, Japan, Vietnam, and USA than does Edinburgh, whereas Edinburgh holds

more taxa from Indonesia, Malaysia, Philippines and Papua New Guinea than does RSBG.

- With respect to Red List taxa, RSBG has more Red List taxa from China, India, Myanmar, Japan, Vietnam Taiwan, and USA than does Edinburgh, while Edinburgh has larger holdings of Red List taxa from Indonesia, Malaysia, Philippines and Papua New Guinea.
- Both collections have similar numbers of wild-collected Red List taxa (Edinburgh 208, RSBG 210); however, Edinburgh has a greater number of wild-collected 'all taxa' (555) than RSBG (480). The larger number at Edinburgh is largely due to their wild-collected holdings of section *Schistanthe*. When considered as percentages, the collection at Edinburgh has better representation of wild-source material for 'all taxa' (90%) and Red List taxa (86%) than RSBG which has 74% for 'all taxa' and 72% for Red List taxa.
- RSBG holds 14 taxa, that were considered in the Red List assessments, that are not 'in cultivation' in any other collection recorded thus far. These are *R. blumei* (LC), *R. brevicaudatum* (DD), *R. dachengense* (DD), *R. guihainianum* (DD), *R. hyugaense* (LC), *R. mianningense* (CR), *R. oblancifolium* (DD) *R. pachycarpon* (LC), *R. roxeioides* (EN), *R. shanii* (DD), *R. subulatum* (LC), *R. taibaiense* (DD), *R. wattii* (Vu), *R. zekoense* (DD).
- Both collections contain a range of named taxa that were not Red List assessed and RSBG holds seven taxa that have not previously been recorded "in cultivation." These are *R. baihuaense*, *R. bainaense*, *R. breviperulatum*, *R. x chamaezelum*, *R. lilacinum*, *R. pseudomaddenii*, *R. x verruculosum*.
- Both collections contain substantial numbers of un-named taxa, many of them wild-collected. RSBG has some 37 aff. taxa, 30 or more *species nova*, and about 27 taxa that are identified only to section level. Edinburgh has around 40 wild-collected aff. taxa, and some 26 wild-collected natural hybrids (<http://elmer.rbge.org.uk/bgbase/livcol/bgbaselivcol.php>. Searched 11 January 2017).
- *Ex situ* conservation requires a minimum number of different accessions of each taxon (although the literature is unclear on what that number is). Numbers of accessions of each taxon has not been investigated in this study.

Assumptions and limitations: A number of assumptions and limitations to the dataset and the analysis should be noted. Particularly:

- Analyses are largely restricted to the 1215 taxa that were considered in the Red

List assessments by Gibbs *et al.* (2011) and Argent (2015). Taxa additional to that set are described in Tables 5-7.

- Base subspecies have been 'lumped' in this analysis, e.g., *R. aureum* is considered to be synonymous with *R. aureum* subsp. *aureum*.
- A taxon is defined as 'in cultivation' if it is present in any of the collections or listed in any of the databases investigated thus far in the MacKay studies, including this investigation.
- In this report the term 'collection' refers to an assemblage of living plants held at a particular botanic garden or similar site.
- The comparison conducted here is between the collections at Edinburgh and RSBG; it does not compare RSBG to the somewhat wider range of taxa that has been recorded 'in cultivation' overall (844 taxa, MacKay *et al.* (2017)). The aforementioned comparison will be investigated in a subsequent publication.
- Of the 304 gardens examined by BGCI (2012), only about eight were from Asia. It may transpire that there are large *Rhododendron* collections in Asian locations that hold species of interest. At the same time, it should also be noted that the BGCI data, which was used as an indicator of taxa 'in cultivation', covers some 1147 sites world-wide. That database has 1,363,723 entries of 496,775 taxa, including *Rhododendron* (bgci.org, accessed 02 May 2016).

Conclusion and Recommendations: This examination reveals that the *Rhododendron* collection at RSBG is a significant resource for conservation. Particularly:

- RSBG contains a globally significant collection of *Rhododendron* species, with a majority of species represented by wild-collected material.
- RSBG has significant collections of subgenera *Hymenanthes* and *Rhododendron*.
- RSBG has a large collection of section *Schistanthe*, and some useful wild-collected material; however, Edinburgh is still the primary global collection for section *Schistanthe*.
- With respect to taxa, Red List taxa, and wild-collected material, both the RSBG and Edinburgh collections are significant resources for *ex situ* conservation.
- Both the Edinburgh and RSBG collections contain a range of un-named taxa which may eventually be described as new species.
- Cooperation among the two collections, particularly to exchange plant material and ensure there are duplicate collections (on different sites) of as many taxa as possible, is desirable.

- Should it transpire that the RSBG site is dis-established every effort should be made to transfer the collection to other locations and retain the resource of plant material presently held at the RSBG.

Results

Numbers of taxa in each subgenus in each collection

RSBG has more taxa (650) than Edinburgh (616). RSBG has more taxa than Edinburgh in all of the larger subgenera except section *Schistanthe* where Edinburgh holdings are almost twice the number of taxa of RSBG.

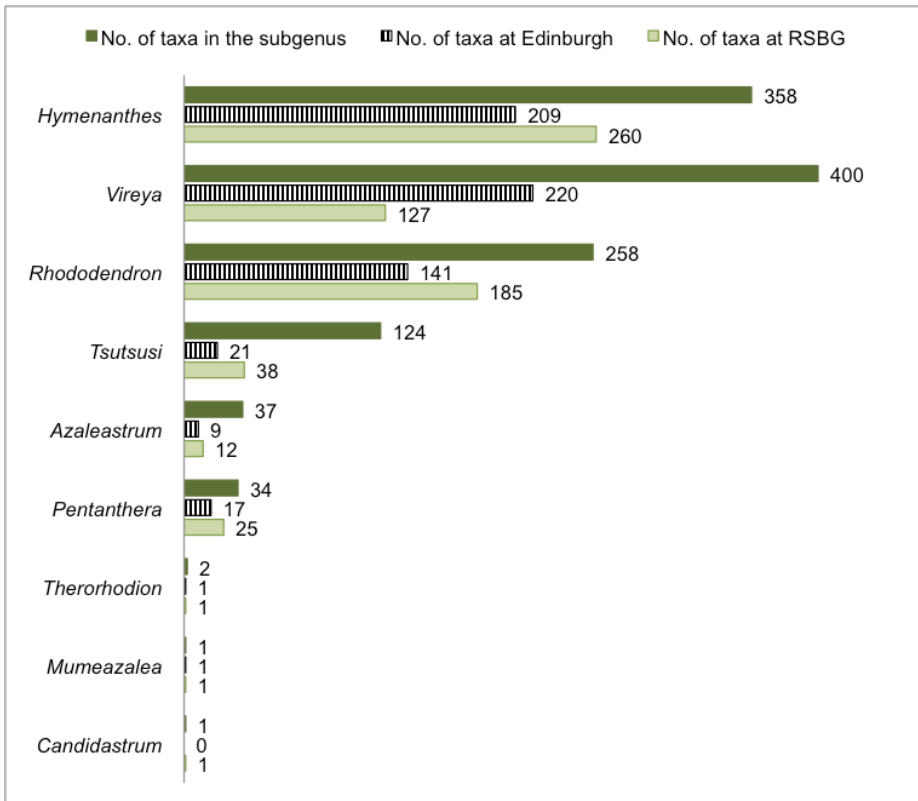


Fig. 1. *Rhododendron* subgenera (Chamberlain *et al.* 1996; Gibbs *et al.* 2011; Argent 2015) considering the 1215 taxa that were red list assessed (Gibbs *et al.* 2011; Argent 2015): number of taxa in each subgenus, number of taxa in each subgenus at Edinburgh in 2017, and number of taxa in each subgenus at RSBG in 2017. [Note: subgenus *Vireya* is not recognised now as a subgenus, with vireyas now incorporated into section *Schistanthe* in subgenus *Rhododendron* (Craven *et al.* 2011).]

Numbers of Red List taxa in each subgenus in each collection

RSBG has more Red List taxa (291) than does Edinburgh (241). RSBG has more Red List taxa than Edinburgh in subgenera *Hymenanthes*, *Rhododendron*, *Tsutsusi*, *Azaleastrum* and *Pentanthera*. Edinburgh holds more than twice the number of Red List vireya taxa than is held at RSBG.

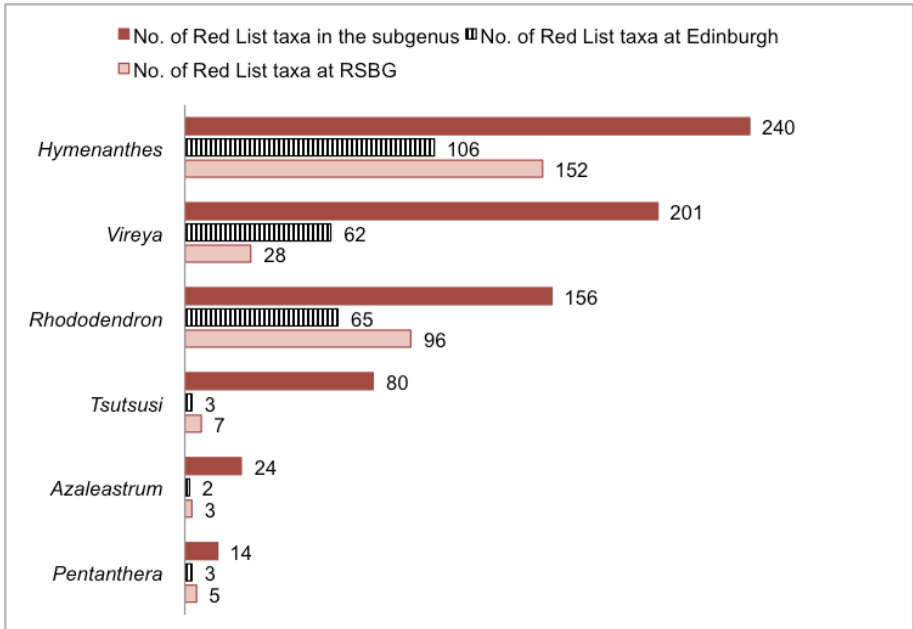


Fig. 2. Red List taxa in *Rhododendron* subgenera (Gibbs *et al.* 2011; Argent 2015): number of Red List taxa in each subgenus, number of Red List taxa in each subgenus at Edinburgh in 2017, and number of Red List taxa in each subgenus at RSBG in 2017 (three subgenera, total four taxa, have no Red List taxa and are not included in this figure). Total number of Red List taxa is 714. [Note: subgenus *Vireya* is not recognised now as a subgenus, with vireyas now incorporated into section *Schistanthe* in subgenus *Rhododendron* (Craven *et al.* 2011).]

The ‘collection score’ method (BGCI 2012)

The BGCI study surveyed 304 collections and found that Royal Botanic Gardens Edinburgh and Kew were the two largest collections of *Rhododendron* globally with 734 and 404 taxa respectively and 1470 and 729 points from the ‘collection score’ respectively (BGCI 2012). MacKay *et al.* (2017) found that Pukeiti in New Zealand had 483 taxa and a collection score of 1368 and therefore ranked ahead of Kew but second to Edinburgh. Of the 48 most endangered taxa (Extinct in the Wild, Critically Endangered, Endangered) that were in cultivation as described by BGCI (2012) at the

time, Edinburgh held 32 of these taxa (BGCI 2012), Kew held 12 (BGCI 2012), and Pukeiti held 27 (MacKay *et al.* 2017).

When the same method is applied to RSBG (Table 1) that collection achieves 1678 points and is placed ahead of Edinburgh, Pukeiti and Kew. RSBG also holds (in 2017) 33 of the 48 most endangered taxa that were listed as in cultivation in 2012 (BGCI 2012).

Table 1. No. of *Rhododendron* Red List taxa (Gibbs *et al.* 2011; Argent 2015) at the RSBG in 2017, and calculation of the ‘collection score’ using the method from Botanic Gardens Conservation International (BGCI 2012).

Red List category	No. of taxa at RSBG	Multiplier (BGCI 2012)	Points contributed to collection score
Extinct	0		0
Extinct in Wild	0	15	0
Critically Endangered	18	10	180
Endangered	22	7	154
Vulnerable	144	5	720
Near Threatened	51	3	153
Data Deficient	56	2	112
Least Concern	359	1	359
Total collection score			1678

Thirteen critically Endangered taxa that were in cultivation in 2012 (BGCI 2012) held by RSBG in 2017: *R. acrophilum*, *R. amesiae*, *R. auritum*, *R. changii*, *R. chapmanii*, *R. coxianum*, *R. fleuryi*, *R. formosum* var. *formosum*, *R. griersonianum*, *R. hemsleyanum*, *R. mendumiae*, *R. subansiriense*, *R. taxifolium*

Twenty endangered taxa that were in cultivation in 2012 (BGCI 2012) held by RSBG in 2017: *R. adenosum*, *R. alborugosum*, *R. amagianum*, *R. arboreum* var. *nilagiricum*, *R. balangense*, *R. euryisiphon*, *R. farinosum*, *R. fletcherianum*, *R. huidongense*, *R. jingangshanicum*, *R. macabeanum*, *R. madulidii*, *R. mallotum*, *R. nakaharae*, *R. nitidulum* var. *omeiense*, *R. platypodum*, *R. pubicostatum*, *R. sanctum*, *R. santapau*, *R. viscidifolium*

Wild-source material

Of the 616 taxa recorded at Edinburgh, 555 (90%) are represented by wild-source material. Of the 241 Red List taxa at Edinburgh, 208 (86%) are represented by wild-source material.

Of the 650 taxa recorded at RSBG, 480 (74%) are represented by wild-source material. Of the 291 Red List taxa at RSBG, 210 (72%) are represented by wild-source material.

With respect to subgenera (Table 2) RSBG holds more wild-source material than Edinburgh for subgenera *Hymenanthes*, *Rhododendron*, *Tsutsusi* and *Pentanthera*, while Edinburgh has more wild-source material for section *Schistanthe*. The pattern is the same for Red List taxa.

Table 2. Numbers of 'all taxa' and Red List taxa for which wild-source (ws) material is held at Edinburgh and RSBG in 2017.

Subgenus	No. of ws 'all taxa' at Edinburgh	No. of ws 'all taxa' at RSBG	No. of ws Red List taxa at Edinburgh	No. of ws Red List taxa at RSBG
<i>Hymenanthes</i>	176	217	83	116
<i>Rhododendron</i>	125	151	56	73
section <i>Schistanthe</i>	216	52	62	12
<i>Tsutsusi</i>	18	26	3	4
<i>Azaleastrum</i>	8	8	2	1
<i>Pentanthera</i>	11	24	2	4
<i>Mumeazalea</i>	1	1	n/a	n/a
<i>Candidastrum</i>	0	1	n/a	n/a
<i>Therorhodon</i>	0	0	n/a	b/a

Detail of wild-source material in relation to geographic origin is found in Tables 3 and 4.

Numbers of taxa from each geographic origin (Table 3)

RSBG has more taxa from China, Myanmar, India, Nepal, eastern Russia, Japan, Vietnam, and USA than does Edinburgh, whereas Edinburgh holds more taxa from Indonesia, Malaysia, Philippines and Papua New Guinea than does RSBG. For those countries with relatively small numbers of taxa, both collections have similar holdings.

Holdings of wild-collected material show a similar pattern. The RSBG wild-collected material from China would appear to be a significant resource; it would be interesting to examine the detail of the wild-collected material and determine the extent of difference between the sets of sources held at each collection. Given that section *Schistanthe* was determined to be the highest priority for *ex situ* conservation (MacKay and Gardiner 2016) it might be useful to investigate the possibility of sending RSBG wild-collected material to Edinburgh to support that collection.

Table 3. Geographic origins of 1215 *Rhododendron* taxa (Gibbs *et al.* 2011; Argent 2015) ranked according to number of taxa: number of taxa at Edinburgh in 2017, number of Edinburgh taxa that are wild-sourced (ws), number of taxa at the RSBG in 2017, number of RSBG taxa that are wild-sourced (ws). (Total number of taxa=1215; however, column two will not sum to that number, as several taxa have more than one country of origin.)

Origin	No. of taxa	No. of taxa at Edinburgh in 2017	No. of ws taxa at Edinburgh in 2017	No. of taxa at RSBG in 2017	No. of ws taxa at RSBG in 2017
China	649	316	273	405	334
Indonesia	229	109	107	61	25
Myanmar	137	96	78	113	103
India	107	83	74	98	91
Papua New Guinea	100	57	56	45	20
Malaysia	83	60	60	31	13
Japan	74	34	27	48	35
Bhutan	57	46	46	50	49
Vietnam	40	24	24	30	25
Nepal	34	31	29	33	30
Philippines	33	26	26	12	4
USA	29	17	12	25	24
Taiwan	23	15	15	18	13
Russia: east	15	12	9	14	11
Brunei	12	10	10	5	1
Thailand	12	10	10	10	10
Korea Sth	11	9	8	10	9
'Europe' aggregate	10	9	9	10	10
Canada	9	7	7	8	8
Korea Nth	9	7	6	8	8
Laos	7	6	6	7	5
Hong Kong	6	4	4	6	2
Afghanistan	2	2	2	2	0
Pakistan	2	2	2	2	0
Mongolia	5	4	3	4	3
Greenland	3	3	3	3	3
Australia	2	2	2	1	1
Bangladesh	2	2	2	2	2
Solomon Islands	2	1	1	1	0
Cambodia	1	1	1	1	1
Sri Lanka	1	1	1	1	1

The 'Europe' aggregate is defined as countries as far east as the easternmost extent of *R. luteum* and *R. ponticum*. This comprises 24 countries: Armenia, Azerbaydzhán, Austria, Bulgaria, Czechoslovakia, Finland, France, Germany, Denmark, Georgia, Italy, Moldova, Lebanon, Norway, Poland, Portugal, Russia: west (Abkhasiya, Dagestan, Osetiya), Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, Yugoslavia.

Table 4. Geographic origins of 714 *Rhododendron* Red List taxa (Gibbs *et al.* 2011; Argent 2015) ranked according to number of taxa: number of taxa at Edinburgh in 2017, number of Edinburgh taxa that are wild-sourced (ws), number of taxa at the RSBG in 2017, number of RSBG taxa that are wild-sourced (ws). (Total number of Red List taxa=714; however, column two will not sum to that number, as several taxa have more than one country of origin.)

Origin	No. of Red List taxa	No. of Red List taxa at Edinburgh in 2017	No. of ws taxa at Edinburgh in 2017	No. of Red List taxa at RSBG in 2017	No. of ws taxa at RSBG in 2017
China	447	157	130	226	170
Indonesia	114	23	23	9	3
Myanmar	62	38	26	47	36
India	45	30	24	40	35
Papua New Guinea	34	6	6	2	1
Malaysia	32	16	16	3	2
Japan	26	3	2	8	6
Vietnam	22	9	9	15	11
Philippines	19	14	14	8	2
Bhutan	13	9	9	10	9
Taiwan	11	5	5	7	5
USA	8	2	1	4	4
Nepal	4	4	3	3	2
'Europe' aggregate	2	2	2	2	2
Afghanistan	2	2	2	2	0
Pakistan	2	2	2	2	0
Russia: east	1	0	0	1	1
Hong Kong	1	1	1	1	0
Laos	1	0	0	1	0
Thailand	1	1	1	1	1
Australia	1	1	1	1	1
Brunei	1	1	1	0	0
Canada	1	1	1	0	0
Solomon Islands	1	0	0	0	0

Several origins have no Red List taxa so are not included in this table: Bangladesh, Cambodia, Greenland, Mongolia, North Korea, South Korea, Sri Lanka.

Numbers of Red List taxa from each geographic origin (Table 4)

For Red List taxa, RSBG has more Red List taxa from China, India, Myanmar, Japan, Vietnam Taiwan, and USA than does Edinburgh, while Edinburgh has larger holdings of Red List taxa from Indonesia, Malaysia, Philippines and Papua New Guinea. Wild-source material follows a similar pattern, with RSBG having a useful set of material from China.

Additional taxa (does not include aff. taxa and species nova taxa)

RSBG has 75 additional (to those considered by Gibbs *et al.* (2011) and Argent (2015)) named taxa, with 68 of those previously recorded 'in cultivation' (MacKay *et al.* 2017). RSBG also holds another approximately 55 taxa that are cultivars of species (cultivars of species have not been considered in this study) or taxa which have been 'lumped' (e.g., *R. aureum* is 'lumped' with *R. aureum* subsp. *aureum*). Of these additional taxa, RSBG has seven that have not previously been recorded 'in cultivation' (MacKay *et al.* 2017). Those 7 taxa (listed below), and another 22, comprise 29 taxa that are held at RSBG but are not at Edinburgh (see Table 7). Details of the additional taxa and their origins are found in Table 7.

Seven named taxa at RSBG that have not been recorded 'in cultivation' anywhere else in previous studies (MacKay *et al.* 2017) are *R. baihuaense*, *R. bainaense*, *R. breviperulatum*, *R. x chamaezelum*, *R. lilacinum*, *R. pseudomaddenii*, and *R. x verruculosum*.

When the additional taxa at RSBG are considered by country of origin (Table 5), the greatest numbers are from China, Myanmar and Japan. In total RSBG has 382 taxa from China; 334 that were Red List assessed by Gibbs *et al.* (2011) and an additional 48 that were not considered. Four of the additional taxa that have been described since the 2011 Red List assessment were assessed by their respective authors; *R. bainaense* was assessed as Critically Endangered (Chen *et al.* 2012), *R. baihuaense* was assessed as Data Deficient (Ma *et al.* 2013), *R. lilacinum* was assessed as Endangered (Chen *et al.* 2010) and *R. pseudomaddenii* was assessed as Least Concern (Mao and Bhaumik 2015).

When the additional taxa are considered by subgenus (Table 6), subgenera *Hymenanthes* and *Rhododendron* dominate the additional taxa that are held at RSBG.

Edinburgh also holds considerable numbers of named taxa that were not Red List assessed. The influence of these named taxa (and also the un-named taxa) on the comparison between the two collections has not been determined.

Table 7, on pages 13-14, lists the 75 additional named taxa that are held at RSBG.

Table 5. Countries of origin of 75 named *Rhododendron* taxa held at the RSBG which are additional to those considered by Gibbs *et al.* (2011) and Argent (2015).

Country of origin	Total no. of taxa	No. of taxa that are endemic
China	48	37
Myanmar	11	3
Japan	9	9
India	7	4
Vietnam	4	2
Bhutan	4	2
Korea Sth	1	1
Malaysia	1	1
Philippines	1	1
Taiwan	1	1
USA	1	1
Korea Nth	1	1
Circumpolar ('Europe', Russia: east, Canada)	1	0

Table 6. Subgenera groupings of 75 named *Rhododendron* taxa held at the RSBG which are additional to those considered by Gibbs *et al.* (2011) and Argent (2015).

Subgenus	Total no. of taxa	No. of taxa that are endemic to their country of origin
<i>Hymenanthes</i>	38	32
<i>Rhododendron</i>	25	18
<i>Tsutsusi</i>	8	8
<i>Pentanthera</i>	2	2
section <i>Schistanthe</i>	2	2

Table 7. List of 75 named taxa held at RSBG that are additional to those considered by Gibbs *et al.* (2011) and (Argent 2015). Shaded lines indicate taxa that have not previously been recorded 'in cultivation' according to MacKay *et al.* (2017).[Rhodo = *Rhododendron*.]

Species	Countries of origin	Endemic	Subgenus	Section Subsection	At Edinburgh	Notes
<i>R. aganiphum</i> var. <i>flavorifum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	y	
<i>R. augustinii</i> subsp. <i>chamanthum</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Triflora</i>	y	
<i>R. augustinii</i> subsp. <i>hardyi</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Triflora</i>	y	
<i>R. augustinii</i> subsp. <i>rubrum</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Triflora</i>	y	
<i>R. baihuaiense</i>	China, Myanmar	n	<i>Rhododendron</i>	<i>Rhodo.: Tephropepla</i>	n	DD (Ma et al. 2013)
<i>R. bainaense</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Heliolepidia</i>	n	CR (Chen et al. 2012)
<i>R x bakeri</i>	USA	y	<i>Pentanthera</i>	<i>Pentanthera: Pentanthera</i>	n	
<i>R. balfourianum</i> var. <i>aganiphoides</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	y	
<i>R. bathyphyllum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	y	
<i>R. breviperulatum</i>	Taiwan	y	<i>Tsutsusi</i>	<i>Tsutsusi: Tsutsusi</i>	n	
<i>R. calostratum</i> subsp. <i>riparium</i>	China, Myanmar, India	n	<i>Rhododendron</i>	<i>Rhodo.: Saluenensia</i>	y	
<i>R. calostratum</i> subsp. <i>riparoides</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Saluenensia</i>	y	
<i>R. campanulatum</i> subsp. <i>aeruginosum</i>	Nepal, Bhutan	n	<i>Hymenanthes</i>	<i>Ponticum: Campanulata</i>	y	
<i>R. campylocarpum</i> subsp. <i>caloxanthum</i>	China, Myanmar	n	<i>Hymenanthes</i>	<i>Ponticum: Campylocarpa</i>	y	
<i>R. carneum</i>	Myanmar	y	<i>Rhododendron</i>	<i>Rhodo.: Maddenia</i>	n	
<i>R. cephalanthum</i> subsp. <i>platyphyllum</i>	China	y	<i>Rhododendron</i>	<i>Pogonanthum</i>	n	
<i>R x chamaezelum</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Lapponica</i>	n	
<i>R. crinigerum</i> var. <i>euadenium</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Glischra</i>	y	
<i>R. cufeanum</i>	Myanmar	y	<i>Rhododendron</i>	<i>Rhodo.: Maddenia</i>	n	
<i>R. degronianum</i> subsp. <i>heptamerum</i> var. <i>hondoense</i>	Japan	y	<i>Hymenanthes</i>	<i>Ponticum: Pontica</i>	y	
<i>R. delavayi</i> var. <i>albotomentosum</i>	Myanmar	y	<i>Hymenanthes</i>	<i>Ponticum: Arborea</i>	n	
<i>R x detonsum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Unplaced</i>	y	
<i>R x erythrocalyx</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Selensia</i>	n	
<i>R. eudoxum</i> var. <i>brunneifolium</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Neriflora</i>	n	
<i>R. fansipanensis</i>	Vietnam	y	<i>Hymenanthes</i>	<i>Ponticum: Arborea</i>	n	
<i>R. fulvum</i> var. <i>fulvoides</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Fulva</i>	y	
<i>R. glischrum</i> subsp. <i>rude</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Glischra</i>	n	
<i>R. goreri</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Maddenia</i>	n	
<i>R. heliolepis</i> var. <i>brevistylum</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Heliolepidia</i>	y	
<i>R. heliolepis</i> var. <i>heliolepis</i>	China, Myanmar	n	<i>Rhododendron</i>	<i>Rhodo.: Heliolepidia</i>	y	
<i>R x hemigynum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Unplaced</i>	n	
<i>R. indicum</i>	Japan	y	<i>Tsutsusi</i>	<i>Tsutsusi: Tsutsusi</i>	y	
<i>R x inopinum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	y	
<i>R. irroratum</i> subsp. <i>ningyuense</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Irrorata</i>	y	
<i>R. irroratum</i> subsp. <i>pogonostylum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Irrorata</i>	y	
<i>R. keiskei</i>	Japan	y	<i>Rhododendron</i>	<i>Rhodo.: Triflora</i>	y	
<i>R. kesangiae</i> var. <i>album</i>	Bhutan	y	<i>Hymenanthes</i>	<i>Ponticum: Grandia</i>	n	
<i>R. kiustianum</i> var. <i>sataense</i>	Japan	y	<i>Tsutsusi</i>	<i>Tsutsusi: Tsutsusi</i>	y	
<i>R. kiyosumense</i>	Japan	y	<i>Tsutsusi</i>	<i>Tsutsusi: Brachycalyx</i>	n	
<i>R. lilacinum</i>	China	y	<i>Tsutsusi</i>	<i>Tsutsusi: Tsutsusi</i>	n	EN (Chen et al. 2010)
<i>R. longipes</i> var. <i>chienianum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Argyrophylla</i>	n	
<i>R. meddianum</i> var. <i>atrokermesinum</i>	China, Myanmar	n	<i>Hymenanthes</i>	<i>Ponticum: Thomsonia</i>	y	
<i>R. mimetes</i> var. <i>simulans</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	n	

Table 7 continued on next page.

Table 7. continued.

Species	Countries of origin	Endemic	Subgenus	Section Subsection	At Edinburgh	Notes
<i>R. molle</i> subsp. <i>japonicum</i>	Japan	y	<i>Pentanthera</i>	<i>Pentanthera: Pentanthera</i>	y	
<i>R. mucronulatum</i> var. <i>chejuense</i>	Korea Sth	y	<i>Rhododendron</i>	<i>Rhodo.: Rhodorastra</i>	n	
<i>R. neriflorum</i> subsp. <i>phaedropum</i>	China, Myanmar, Bhutan, India	n	<i>Hymenanthes</i>	<i>Ponticum: Neriflora</i>	y	
<i>R. nivale</i> subsp. <i>boreale</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Laponica</i>	y	
<i>R. onii</i>	Vietnam	y	<i>Hymenanthes</i>	<i>Ponticum: Irrorata</i>	n	
<i>R. oreodoxa</i> var. <i>fargesi</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Fortunea</i>	y	
<i>R. otakumi</i> (<i>R. indicum</i> f. <i>otakumi</i>)	Japan	y	<i>Tsutsusi</i>	<i>Tsutsusi: Tsutsusi</i>	n	
<i>R x peregrinum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Unplaced</i>	y	
<i>R. phaeochrysum</i> var. <i>agglutinatum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	y	
<i>R. phaeochrysum</i> var. <i>laevistratum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	y	
<i>R. planetum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Unplaced</i>	y	
<i>R. pocophorum</i> var. <i>hemidartum</i>	China, India	n	<i>Hymenanthes</i>	<i>Ponticum: Neriflora</i>	y	
<i>R. poluninii</i>	Bhutan	y	<i>Hymenanthes</i>	<i>Ponticum: Lanata</i>	y	
<i>R. pseudomaddenii</i>	India	y	<i>Rhododendron</i>	<i>Rhodo.: Maddenia</i>	n	LC (Mao and Bhaumik 2015)
<i>R. roxieanum</i> var. <i>cucullatum</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	y	
<i>R. roxieanum</i> var. <i>oreonastes</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Taliensia</i>	y	
<i>R. rupicola</i> var. <i>chryseum</i>	China, Myanmar	n	<i>Rhododendron</i>	<i>Rhodo.: Laponica</i>	y	
<i>R. rupicola</i> var. <i>muliense</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Laponica</i>	y	
<i>R. saluenense</i> subsp. <i>chameunum</i>	China, Myanmar	n	<i>Rhododendron</i>	<i>Rhodo.: Saluensia</i>	y	
<i>R x sarcodes</i>	Philippines	y	<i>Rhododendron</i>	<i>Schistanthe: Malesia</i>	y	
<i>R x sheliae</i>	Malaysia	y	<i>Rhododendron</i>	<i>Schistanthe: Malesia</i>	y	
<i>R x sikkimense</i>	India	y	<i>Hymenanthes</i>	<i>Ponticum: Thomsonia</i>	y	
<i>R. sutchuenense</i> var. <i>geraldii</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Fortunea</i>	y	
<i>R. tanastylum</i> var. <i>pennivenium</i>	China, Vietnam	n	<i>Hymenanthes</i>	<i>Ponticum: Irrorata</i>	n	
<i>R. tiitapurense</i>	India	y	<i>Hymenanthes</i>	<i>Ponticum: Falconera</i>	n	
<i>R. tomentosum</i> var. <i>subarcticum</i>	'Europe', Russia: east, Canada	n	<i>Rhododendron</i>	<i>Rhodo.: Ledum</i>	y	
<i>R. triflorum</i> var. <i>bauhiniflorum</i>	India	y	<i>Rhododendron</i>	<i>Rhodo.: Triflora</i>	y	
<i>R. tschonoskii</i> var. <i>trinerve</i>	Japan	y	<i>Tsutsusi</i>	<i>Tsutsusi: Tsutsusi</i>	n	
<i>R. valentinioides</i>	China, Vietnam	n	<i>Rhododendron</i>	<i>Rhodo.: Maddenia</i>	y	
<i>R x verruculosum</i>	China	y	<i>Rhododendron</i>	<i>Rhodo.: Laponica</i>	n	
<i>R. viscistylum</i>	Japan	y	<i>Tsutsusi</i>	<i>Tsutsusi: Brachycalyx</i>	n	
<i>R. yuefengense</i>	China	y	<i>Hymenanthes</i>	<i>Ponticum: Fortunea</i>	y	

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An Update on *Rhododendron* Diseases

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Photos by the author

Rhododendrons have generally been considered to be fairly easy to grow and not prone to many diseases. My great uncle, J. G. Millais, writing in his 1917 first volume on rhododendrons, stated that rhododendrons were almost exempt from diseases, but mentioned the problem of leaf galls on rhododendrons and azaleas, as well as rust and “a mysterious disease causing the death of whole branches” which now sounds like a *Phytophthora*. In the 1949 yearbook, there is a report of the 1949 RHS Rhododendron Conference which had been postponed from 1940. Lord Aberconway reported disease at Bodnant was almost negligible, and that in 50 years the only treatment he had to give was to one plant with honey fungus “which was accomplished by a bonfire on the affected ground. There was no recurrence.” However in discussion, Captain Maitland-Dougall RN, who lived near Woking, described bud blast which was first noticed in his garden in 1945, and had spread rapidly to 1948 when no less than 60,000 buds were picked off and burnt (1020 buds were counted off one plant alone).

It seems there has been a gradual increase in the prevalence of rhododendron diseases during the last century, and perhaps we are less tolerant of blemished foliage in the same way that our supermarket fruit needs to look perfect, even at the expense of good taste. More recently, the “open borders” policy of plant movements within Europe without official inspection, and the international trade in plant novelties and propagation material has contributed to the spread of new pests and diseases around the world. There is now a growing call for stricter movement controls such as those in place in Australasia, and “Brexit” may enable this to be realised.

We are being challenged by new diseases, and a wave of diseases that have not been a problem until recently. But having worked with rhododendrons for more than 30 years, I continue to be amazed by nature’s way of dealing with diseases, especially when given an appropriate helping hand. This article will therefore look at some of the many cultural practices to improve the health of plants, and hence avoid diseases, rather than listing a diminishing range of chemical sprays to control the problems. Over the past ten years on the nursery, we are using more and more organic practices, and have



Mound planting on wet hillside.

reduced fungicide sprays from once every three weeks in the summer to perhaps four applications all year, and even those may not be necessary any longer.

Powdery mildew

Powdery mildew fungi produce microscopic air-borne dispersal spores which have a high water content, enabling them to infect under drier conditions. It is associated with water stress and is characterized by dark brown or black spotting on the upper and lower surfaces of the leaf. Marks are usually round, and often have a paler halo on the outside. The powdery white fungal spores can sometimes be seen on the leaf underside. Left untreated, these can spread across large areas of the leaf, weakening the plant, and causing leaf drop and plant death.

In the late 1980s and early 1990s, gardens were being decimated by rhododendron powdery mildew. Growers were applying copious quantities of now banned fungicides in what appeared to be a futile battle against this “new” disease. Like roses, I could see some varieties were far more prone than others, and I found that by dropping the worst varieties from production, that the health of the remaining plants started to improve. So out went a whole series of *R. cinnabarinum* hybrids such as the lovely

'Lady Chamberlain', and also 'Virginia Richards', which was a highly sought-after new American hybrid at that time. When it comes to hardy hybrids, there are so many good trouble-free clones that it just is not worth attempting to grow a troublesome substandard variety. But a lot of people were upset with the loss of *R. cinnabarinum* and the devastation this was causing in well-known collections. But the solution was to strip out the worst offenders, and to replace with new varieties. My father, Ted Millais, had spotted that his clone of *R. cinnabarinum* subsp. *xanthocodon* was resistant to powdery mildew, and so he started a breeding programme to create powdery mildew resistant *cinnabarinum* hybrids, the most successful being 'Pink Gin' and 'Crosswater Belle', both of which continue to be clean of mildew in most situations. Powdery mildew can still be a problem today, though it is much less devastating than it was 30 years ago. There seems to be a critical time in May-June and August-September, when humidity levels increase and average temperatures are around 15° C (59° F), and this can be enough to trigger an outbreak. Some of the *R. occidentale* deciduous azalea hybrids are especially prone at the end of August and early September. Good husbandry can be very beneficial, and includes pruning overhead branches and overgrown plants to enable some gentle air movement, and correct watering to prevent moisture stress. A good weekly soak that really gets down into the roots is much better than frequent misting in dry periods which only increases humidity, and fails to make the roots search for moisture. Avoid evening watering which can leave the foliage wet all night. Mulching and correct nutrition helps to reduce plant stress and reduce mildew. SB Plant Invigorator (an environmentally friendly UK pesticide and foliar feed), citrus seed oil and bicarbonate of soda (baking powder) are all useful in controlling powdery mildew.

Phytophthora

There are about 100 different species of *Phytophthora*, and these are mainly root diseases, particularly affecting plants such as *Chamaecyparis lawsoniana* cultivars on damp and heavy soils. In worst case scenarios, root rots such as *P. cinnamomi* can be seen travelling down a hedge line as the spores are splashed from one plant to another. *P. cinnamomi* also affects rhododendrons and azaleas, where again, it is worse on poorly drained and stagnant soils, with high rainfall and poor root aeration.

Phytophthora species are microscopic fungus-like organisms which cause root rot and decay at the base of a plant stem. Symptoms show as wilting, poor and yellowing foliage, and shoot die-back until the whole plant collapses. In severe cases, it can be identified by a reddish brown discolouration that can be found when cutting into the stem at the base of the plant. *Phytophthora* spreads by tiny spores that swim in water and wet ground. Resting spores can remain in the ground for several years, so care should

be taken when removing dead plants and their associated soil to ensure that this is all disposed of, before fresh soil is brought in. The best avoidance strategy is to improve drainage with extra drainage channels, incorporate a course fibrous material such as leaf-mould, and pine bark to aid drainage, and to plant higher in the ground so that the rootball is lifted out of damp ground. There are no chemical cures.

In 2002, the first signs of *Phytophthora ramorum* were identified, and this was followed by *P. kernoviae* in 2003 which is more aggressive towards rhododendrons. These were new, and these were devastating, and unlike most *Phytophthora* which infect roots, *P. ramorum* and *P. kernoviae* affect leaves, shoots and stems. Known as “Sudden Oak Death” in America, where it kills native oak and tanoak, but thankfully it has little effect on English Oak, so “ramorum disease” is more appropriate. However, a wide range of plants including *Rhododendron*, *Camellia*, *Viburnum*, *Pieris*, *Kalmia*, *Larix* and *Taxus* can be affected. Recognition is difficult and can be confused with other diseases, and even normal winter maturity and change of stem colour. Shoots become darkly discoloured, and the blackening extends into the leaf stalk, and through the leaf. Symptoms include the wilting and death of a branch or part of a plant.

In an attempt to control the diseases, DEFRA (Department for Environment, Food & Rural Affairs, UK) made them notifiable diseases requiring the destruction of all host plants within two metres (6.5 ft) of the outbreak. In 2009, Japanese larch were found to be highly infectious by spreading spores from their high canopy, and this required



Pocket diagnostic phytophthora testing kit.

wide-spread felling of forests, especially in the South-West of Britain. Rhododendrons are also highly susceptible, but as we have learnt over time, it is *R. ponticum* which has been the main problem. A programme of grubbing it out to give more space and light, with better ventilation and humidity levels, has been effective and breathed new life into overgrown gardens and plantations. Like the powdery mildew problem, the removal of the most affected plants goes a long way to halting *P. ramorum*. In this case it is larch trees, and *R. ponticum* and those varieties closely associated with it, such as 'Blue Peter', 'Purple Splendour' and 'Cunningham's White' which are some of the main culprits.

Like other *Phytophthora*, good drainage is critical and helps to prevent infection. Zoospores are spread by splashing, so anything you can do to reduce surface water is helpful. For example, we completely rebuilt our nursery so that plants are stood on gravel which has broken the film of water that was previously around the base of the pot. Tracks have been surfaced to avoid water splash from wheels onto precious plants. Expensive, but this has made a huge difference to plant health and has contributed to avoiding *P. ramorum* and many other root diseases. In a garden situation, drainage can be improved with additional ditches, planting high in the ground to lift the plant into drier conditions, and by ensuring that water does not puddle on paths, ready to be splashed onto nearby foliage. Good plant management and hygiene goes a very long way in keeping plants clear of *P. ramorum*. Pruning out old branches, clearing the undergrowth, creating some space for the plants to breath, and growing a strong healthy plant all help. Then help your plants further with natural plant tonics, such as feeding with compost tea, seaweed, natural copper sprays, sulphur, citrus seed oil and garlic to strengthen your plant and build in resistance.

Xylella

We all need to keep a close eye on *Xylella* (*Xylella fastidiosa*) and its movement across Europe from the Mediterranean. Olives, citrus and vine crops have been devastated in Italy, Spain, southern France and Corsica since it was first identified there in 2013. There is a growing list of susceptible plants, including lavenders, maples, and red oaks. So far, rhododendrons, camellias and magnolias do not appear on the lists, but this is possibly only because they are not grown in these warm and predominantly limestone areas. The threat of *Xylella* is being taken seriously by DEFRA and the industry, and is subject to EU emergency measures, with movement restrictions on high risk plants. An outbreak in the UK could lead to the destruction of all host plants within 100m (330 ft), and a five km (3.1 miles) movement ban on "specified" plants for five years. This would be enough to make serious changes to the trees and plants in our landscape, and would cripple the whole horticultural industry.

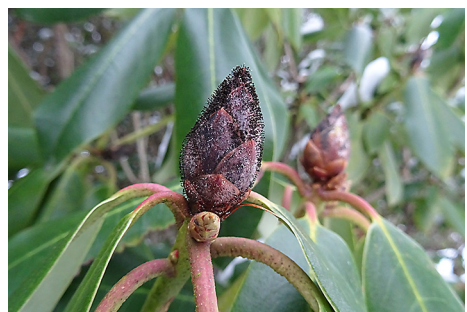
Honey fungus

Honey fungus is the most destructive fungal disease in the UK. It attacks the roots of many different woody plants and is characterised by white fungal growths between the bark and wood near ground level, and clumps of “honey coloured” toadstools in the autumn around infected plants. It spreads underground, developing brown or black rhizomorphs (“bootlaces”) which spread the fungus from plant to plant at the rate of about one metre (40 inches) per year, killing the roots and decaying dead wood. To reduce the incidence of honey fungus, it is worth considering the removal of any felled or dying trees, especially on damp heavy soils. Stump grinding as much of the old root structure as possible is also recommended, but with a diseased tree, be careful not to re-use any woodchips as mulch for several years in case these are carrying spores of honey fungus.

Unfortunately there are no chemical controls, and the recommended control is to excavate the top 45 cm (18 inches) of infected soil and dispose of it. The insertion of a vertical barrier of heavy grade polythene to the depth of 45 cm (18 inches) can contain any further spreading.

Bud blast

If your rhododendron isn't flowering and you can see some dark buds, this could be either frost or bud blast. If the problem is frost, the buds will be brown or black and smooth, and whilst a little unsightly, it is the result of adverse weather conditions. Bud blast shows as small black hairy growths (like a hedgehog!) growing on the flower bud. It is a fungal disease which turns the flowering bud mouldy over winter and prevents flowering. It is spread by minute insects called leaf hoppers (Cicadellidae) which are a pale green insect that appears between June and September, and have been seen in greater numbers in recent summers. Some varieties are affected more than others, but this varies from garden to garden. Certainly some mauves seem worse, and those more associated with *R. ponticum*.



A flower bud that has suffered frost damage (top); black spores growing on a flower bud (below).

To control bud blast it is best to pick off and destroy as many infected buds as possible, clear out dead branches, and prune back other trees and shrubs to allow free air movement in and around the plant. Bud blast is reduced when leaf hoppers are reduced, though recent research is challenging this link. I recommend non-chemical controls such as SB Plant Invigorator which coats the foliage with a soapy solution and deters the leaf-hopper from feeding. Applications at monthly intervals may be needed to control different generations from June to September. Dual action fungicide and insecticide sprays are also effective.

Leaf spots

Rhododendrons can be prone to a variety of different leaf spots, and plant collectors have noted these even in the wild. Many are cosmetic, and whilst they may be unsightly, they cause little long-term damage. Using just the naked eye, it is not possible to tell if a leaf spot has a fungal or a bacterial origin, but under magnification, tiny dot-like bodies associated with the lesions would indicate fungal spore-bearing structures. Fungal leaf spot symptoms are caused by the death of cells around the infection, and these often enlarge as the pathogen spreads.



Pestalotiopsis rhododendri (or *Pestalotia*) on 'Lem's Monarch'.



Leaf spots on rhododendron leaf.

Pycnidial leaf spot diseases include *Pestalotiopsis*, *Coniothyrium*, *Phomopsis* and *Phyllosticta*. These show symptoms on the upper leaf surface, often with irregular shaped markings, but spreading is by spore-bearing pycnidia (asexual fruiting bodies) within the leaf. This makes control more difficult and requires translocated fungicides. Spores often spread from infected fallen leaves, which mature in spring, ready to be splashed onto tender and newly emerging leaves. Infection is spread in damp wet conditions and develops in warm humid conditions. *Pestalotia* is primarily a secondary pathogen. It is saprophytic on dead and dying tissues and is weakly parasitic infecting wounds under moist conditions.

Good cultural growing methods which avoid plant stress do help prevent infection. This includes balanced feeding, good spacing, planting outside the drip line of trees, avoidance of late afternoon and evening watering so plants dry more quickly, and cleaning up any leaf litter and prunings which may carry disease from one season to the next. 'Lem's Monarch' and 'Markeeta's Prize' seem particularly prone to *Pestalotiopsis* when planted under dripping trees. Compost tea will increase the biological activity on the leaf surface and reduce leaf spots, and SB Plant Invigorator can act as a surface protector.

Azalea gall

The fungal disease *Xobasidium japonicum* disfigures the leaves of evergreen azaleas and is spread by airborne spores. Irregular shaped galls vary in size from that of a pea to a small plum, and form mainly on leaves, but also on flowers. They are pale green at first, later becoming white which is a superficial coating of fungal spores. Spores can be spread to healthy plants by insects or by air.

Galls tend to form in early spring and picking them off before they turn white and infectious is certainly recommended to prevent spreading. If growing plants indoors, avoid high humidity to reduce spores in the air. Some varieties such as the azalea 'Rosebud' are prone to azalea gall, so often it is best to select an alternative variety.

Throughout this article, I have made regular reference to growing plants in best conditions, so that plants grow strongly, and are much more disease resistant. A plant that is stressed through being too damp, too dry, in too much shade, or cooking in full sun is far more likely to be vulnerable to disease attack. Correct site selection, mulching, feeding and watering are fundamental to growing a healthy plant. Additional resistance can be built in with a range of organic tonics such as compost tea, low dose copper sprays, liquid seaweed feeds, (e.g., Maxicrop with Iron) garlic and citrus seed oils and SB Plant Invigorator. For those wanting or needing chemical controls, please refer to the RHS website for up to date information, as authorised chemicals face more restrictions and are withdrawn. Statutory control measures can be seen on the DEFRA website:

<https://www.rhs.org.uk/Advice/Profile?PID=573>

<https://www.gov.uk/guidance/disease-control-in-flowers-and-shrubs>

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