Preliminary Host Ranges of Some Strains of Economically Important Broomrapes (*Orobanche*)[1]

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Strains of Orobanche crenata, O. aegyptiaca, O. minor, O. ramosa *and* O. cernua *from different geographical areas and from different host species were potted with tobacco, tomato and other hosts.* Orobanche cernua, O. aegyptiaca *and* O. ramosa *from tobacco and from tomato did equally well on either host.* Orobanche crenata *grew vigorously on broadbean even when the original host was safflower or coleus.* Orobanche minor *has apparently developed several distinct strains.*

The genus *Orobanche* (broomrapes) includes widespread species of importance as parasites of several major crops. Most important species and their hosts are *O. aegyptiaca* Pers. (on tobacco, tomato, melons), *O. cernua* Loefl. (on tobacco, tomato, sunflower), *O. crenata* Forsk. (on broadbean, other legumes, safflower, carrot), *O. minor* Sm. (on clovers, tobacco), and *O. ramosa* L. (on tobacco, tomato, mustards). Thus, they seem to favor certain host families, e.g., Fabaceae, Solanaceae, Brassicaceae, and Asteraceae. Other information on hosts, geographical distribution and life history is summarized in King (1966) and Musselman (1980).

Little work has been done on screening putatively host-specific strains against other crops. Accordingly, the purpose of this work was to determine if parasites from one host could grow on other crop hosts. This is especially relevant to *O. cernua, O. ramosa,* and *O. aegyptiaca* where tobacco and tomato are frequently reported as hosts in the same geographical area and it is not always clear if parasites from one host have the capability of attacking the other potential host.

MATERIALS

Orobanche and host seed were obtained from the Weed Research Organization (WRO), Oxford, England, seed collection. Species and collection numbers are noted in Table 1. Hosts included in this study were: tomato 'Ailsa Craig,' tobacco 'Yellow Mammoth,' broadbean 'M. Blaze,' safflower 1503, white clover 'Milkanova,' red clover 'Redhead,' sunflower 'Mammoth Russian,' and coleus (var. unknown). Controls were uninfected host plants. All pots were broken down by 15 July and the number of stems counted.

Parasite seed was sown directly with host seed on 6 March 1980 except that tobacco was sown separately and month-old plants transplanted to pots and broomrape seed added. Seed was sown in the following manner: pots were filled half full of potting soil. Approximately 1,000 broomrape seeds were thoroughly

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TABLE 1. *Orobanche* SPECIES, SOURCE OF SEED, AND HOST.

Species/WRO collection	Source of seed	Host
O. aegyptiaca 76–2	Iran	Tomato (*Lycopersicon esculentum* Mill.)
O. cernua 77–1	India	Tobacco (*Nicotiana tabacum* L.)
O. cernua 77–2	Jordan	Tomato
O. crenata 70–1	Holland	Coleus (*Coleus blumei* Benth.)
O. crenata 76–2	Egypt	Broadbean (*Vicia faba* L.)
O. crenata 76–3	Egypt	Safflower (*Carthamus tinctoria* L.)
O. minor 69–1	Ethiopia	Lettuce (*Lactuca sativa* L.)
O. minor 76–1	England	Red clover (*Trifolium pratense* L.)
O. minor 78–1	Belgium	White clover (*T. repens* L.)
O. ramosa 73–1	Lebanon	Tomato
O. ramosa 76–1	Germany	Tobacco
O. ramosa 77–1	Jordan	Tobacco

mixed with soil in a plastic bag and were then added to the half-full pots. Host plants were thinned to one per pot.

RESULTS AND DISCUSSION

Results are summarized in Table 2. All parasites germinated and grew well. There was considerable variation in times of emergence relative to hosts and parasites. *Orobanche aegyptiaca*, *O. ramosa*, and *O. cernua* had all emerged in less than 60 days on tomato and began to flower and set seed shortly thereafter. Emergence of *O. crenata* on broadbean and safflower took about 75 days and *O. minor* was last, taking almost 115 days to emerge. Time to emergence is an important factor in pest management as serious damage occurs before the parasite is evident.

TABLE 2. GREENHOUSE HOSTS OF *Orobanche*.

	Hosts								
Parasite strain	Tomato	Tobacco	Broad-bean	Safflower	Lettuce	White clover	Red clover	Sunflower	Coleus
Oae 76–2	5[b]	5							
Oce 77–2	5	5						x[a]	
Oce 77–1	5	5						x	
Ocr 70–1			5						x
Ocr 76–2			5						
Ocr 76–3			5	5					
Omi 69–1	x	4			4	3	4		
Omi 76–1	x	2			x	3	5		
Omi 78–1		2			x	5	4		
Ora 73–1	5	5			2				
Ora 76–1	5	5							
Ora 77–1	5	5			x				

[a] x = no emergence of seedlings.

[b] Numbers are a subjective index of parasite vigor based on number of stems, rapidity of emergence, and height, e.g., 1 = single thin stem of parasite with few flowers; 5 = five or more thick stems emerge, several mature.

Blanks indicate no test.

While no attempt was made in this research to quantify growth loss, *O. aegyptiaca, O. cernua* and *O. ramosa* from tobacco and tomato appear to be equally damaging to either host without regard to the original host from which the parasite seed was collected. Compared to control pots, parasitized plants were always much smaller and soon developed chlorotic patches on leaves. Fruit production in all hosts was impaired although *O. minor* on tobacco seemed to have little deleterious effect on flowering. Root systems of parasitized plants were always reduced, especially with *O. cernua* where the major host-parasite interface is through a single, large haustorium.

There was considerable difference in the numbers of parasite stems that emerged. *Orobanche aegyptiaca, O. cernua,* and *O. ramosa* always had at least 10 stems and sometimes as many as 25 while *O. crenata* and *O. minor* had fewer, seldom as many as 10 stems. With *O. crenata* this may be a result of the very large size of this parasite.

Orobanche cernua was also tested against several strains of sunflower but did not parasitize this host despite the fact that sunflower is reported to be one of its important hosts. This may indicate a strain of the parasite specific for members of the Solanaceae. It is not known if the sunflower strain will attack tobacco and tomato.

Seeds of *O. crenata* were available from 3 diverse hosts (coleus, broadbean and safflower). Coleus was not parasitized, broadbean was an excellent host but safflower proved to be a poor host for pot studies as it usually succumbed before the parasite matured.

The situation in *O. minor* is of especial interest as this species, which reportedly has a broad host range, has strains which emerge only on certain hosts. While strain 69–1 from lettuce parasitized tobacco, lettuce, red and white clover (Table 2), the other strains of the same species (76–1 from red clover and 78–1 from white clover) never emerged on lettuce and showed some preference for their respective clover hosts as evidenced by comparatively spindly stems of 78–1 on red clover and 76–1 on white clover. There is also a difference in the rate of emergence as the red clover strain emerged very late on tobacco and was less vigorous.

These results are based on limited and preliminary data but show that some strains of *Orobanche aegyptiaca, O. cernua,* and *O. ramosa* attack tomato and tobacco with equal vigor regardless of the host that supported the parasite that supplied the seed. In other words, both tomato and tobacco were equally suitable hosts for these 3 species of *Orobanche*. Therefore, caution should be used when introducing tomato or tobacco into an area where either is parasitized by *Orobanche*. Although based on a smaller number of plants, a similar conclusion might be reached for *O. crenata* where seed from parasites on safflower and coleus produced large plants on broadbean. Results from host tests with the 3 strains of *O. minor* indicate that more experimental data are needed before the favored host can be determined. This is an important factor to consider when this widespread species is found as a new introduction.

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Book Review

Trees and Shrubs Hardy in the British Isles. W. J. Bean. 8th ed., edited by D. L. Clarke and Sir George Taylor. 4 vols. St. Martin's Press, New York, 1981. $280.00.

Edition one of Bean's *Trees and Shrubs* was published in 1913, a landmark in the literature of horticulture. Five further editions appeared in Bean's lifetime. Edition seven came out in 1950, three years after its author's death.

Editions two through seven had been "greatly restricted in scope by the impracticability of completely resetting the work and hence of making any substantial alterations to the text." For edition eight, prepared by a team of editors and writers, the decision was made to "reset the whole work and embark on a thorough revision while scrupulously trying to preserve the character of the original." Thus, this edition represents the most far-reaching revision to date. With 3,410 pages, it is said to be "three quarters as long again" as edition seven.

The volumes of edition eight were first published in England as follows: volume 1 (845 pp.), 1970; volume 2 (784 pp.), 1973; volume 3 (973 pp.), 1976; and volume 4 (808 pp.), 1980. St. Martin's has given us the first United States release of the edition.

Part One, "Historical Notes," gives an overview of plant introduction (and introducers) into Britain. Part Two, "Cultivation," has sections on propagation, hybridizing and selection, nursery methods, terms used in the "craft of growing trees," soil and topdressing, staking and other means of support, pruning, and care of old trees. Part Three, "Miscellaneous," includes a discussion of taxonomy, nomenclature, and cultivars, a glossary of botanical terms (about 210 entries), a select bibliography of "the chief botanical and horticultural works [used] in preparing the present work," and a table of metric equivalents.

Most of the work (95%) is devoted to the "descriptive list" of genera (about 625 of them) and species, which are alphabetically arranged. Data under most genera include number of species, overall range, brief description, and notes on culture. Each species is described, and data on range, introduction into Britain, culture, and varieties and cultivars (and their features) are given. Notable British specimens of various species are frequently mentioned. The accounts of *Rhododendron* (400 pages) and of *Rosa* (170 pages) are essentially books within a book.

Each volume includes a section of many black-and-white photographs (404 total in the four volumes) of habit or of flowers (fruits) and foliage of various species. Most of the photographs are good—some are spectacular—and a useful companion to the text. The volumes contain also about 330 black-and-white drawings of plants.

Each volume has its own index of English names, of the more important synonyms, and "of a number of trees and shrubs . . . not described in their alphabetical order but under related plants." "As the general arrangement of this work is alphabetical it has not been considered necessary to index names which appear in their proper sequence."

Although applying specifically to the British Isles, the work should—will—be quite useful in temperate sections of the United States, especially in the northeastern quadrant.

Edition eight of *Trees and Shrubs Hardy in the British Isles* has had many superlatives applied to it: "stunning," "immensely readable," "highly authoritative," "indispensable," "beautifully printed," "a magnificent achievement." I can but echo the kudos. The new Bean is indeed all these.

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