Pisatin as a Major Phytoalexin in Lathyrus

David J. Robeson and Jeffrey B. Harborne
Phytochemical Unit, Plant Science Laboratories, The University, Reading, U.K.

(Z. Naturforsch. 32c, 289 [1977]; received December 13, 1976)

Leguminosae, Lathyrus, Phytoalexins, Pterocarpsans, Pisatin

The pterocarpans pisatin has been identified as a major phytoalexin in fifteen species of the genus Lathyrus. Thus, the genus is closer in its phytoalexin response to Pisum than to Vicia, which is known to produce furanoacetylenes on fungal invasion.

Recent studies 1 have indicated that the induction of phytoalexins in higher plants by fungi is interesting not only because it increases our understanding of disease resistance mechanisms but also because it provides new insights into systematic and evolutionary relationships among plants. Most attention has been given to the family Leguminosae, which in general produce isoflavonoid phytoalexins 2. Although an increasing number of legume genera have been studied, little attention has yet been paid to Lathyrus, which is one of the largest genera of the tribe Vicieae, with some 130 species, several of which are used for food or as animal fodder and one, L. odoratus, the sweet pea, is an important ornamental crop. Taxonomically, the genus is closest to Vicia and indeed taxa of the two genera are so closely similar morphologically that they are often difficult to separate 3. Lathyrus and Vicia are distinguished chemically from other Vicieae in having a rich assembly of non-protein amino acids in the seeds, some of which are toxic 4. Vicia is of particular interest from the pathological viewpoint, since at least three species including V. faba are completely anomalous among legumes in producing acetylenic phytoalexins, based on the furanoacetylenic acid methyl ester, wyerone 5; the only family where acetylenes occur otherwise as phytoalexins is the Compositae 6. It was, therefore, of interest to see if Lathyrus showed a similar response to Vicia in this way.

Using the now standard drop diffusate technique 2, leaves of fifteen Lathyrus species were variously induced to produce phytoalexins by inoculation with spore suspensions of Helminthosporium carbonum Ullstrup, water controls being set up at the same time. The substances so produced de novo were isolated, bioassayed for antifungal activity 7 and then examined by standard spectral and chromatographic procedures. In every case, pisatin (6z-hydroxy-3-methoxy-8z-methyleneoxypterocarpan), the characteristic phytoalexin of Pisum sativum 8, was present. It was identified by direct comparison (UV, TLC and MS) with an authentic sample.

The fifteen species tested variously represent six sections of the genus, so that pisatin formation would appear to be a representative feature of Lathyrus as a whole. In L. tingitanus, pisatin synthesis was induced in both pods and leaves. Certain species (e.g. L. odoratus) yielded other isoflavonoid phytoalexins, the identities of which are under active investigation. In no case yet, however, has any evidence been obtained of acetylenic derivatives being induced in the genus; wyerone, the major acetylene of Vicia faba, was available and run as a control during these investigations.

The results of a limited survey of the genus Lathyrus thus indicate that the genus is closer to Pisum than to Vicia in phytoalexin synthesis. This is because a major product is pisatin, which is characteristically produced not only by Pisum sativum but all other Pisum species investigated 9, a result confirmed in this laboratory. The response in Lathyrus is clearly different from that in Vicia faba and two allied species V. galilea and V. narbonensis, where the phytoalexins induced are acetylenic. Recent investigations of Vicia faba 10 have shown that this taxon is not completely anomalous in phytoalexin response, since trace amounts of medicarpin (3-hydroxy-9-methyleneoxypterocarpan) were formed in addition to the three major furanoacetylenes, following infection with Botrytis cinerea Fr. Pisatin, at least, is not present and we have tested a range of Vicia species for phytoalexin production and none has so far yielded any evidence of pisatin formation. The surprising conclusion that phytoalexin induction links Lathyrus to Pisum rather than to Vicia is based on a relatively small sampling and further work is in progress to clarify these biochemical inter-relationships among the Vicieae.

The authors are grateful to J. L. Ingham for advice and one of us (D. J. R) is in receipt of an S.R.C. CASE award, supported in part by I.C.I. (Plant Protection) Ltd.

1 J. L. Ingham and J. B. Harborne, Nature 250, 211 [1976].
3 P. W. Ball, Flora Europae 2, 136 [1968].

This work has been digitalized and published in 2013 by Verlag Zeitschrift für Naturforschung in cooperation with the Max Planck Society for the Advancement of Science under a Creative Commons Attribution-NoDerivs 3.0 Germany License.

Zum 01.01.2015 ist eine Anpassung der Lizenzbedingungen (Entfall der Creative Commons Lizenzbedingung „Keine Bearbeitung“) beabsichtigt, um eine Nachnutzung auch im Rahmen zukünftiger wissenschaftlicher Nutzungsformen zu ermöglichen.

Dieses Werk wurde im Jahr 2013 vom Verlag Zeitschrift für Naturforschung in Zusammenarbeit mit der Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V. digitalisiert und unter folgender Lizenz veröffentlicht: Creative Commons Namensnennung-Keine Bearbeitung 3.0 Deutschland Lizenz.