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Histocytological study of *Orobanche crenata*

A two year effort in Morocco to control *Orobanche crenata* on broadbeans (*Vicia faba*) has resulted in good control using glyphosate on the host plants. However, successful treatments need a better knowledge of the biology of this holoparasite. As a result, an ontogenic and histocytological study has been carried out on the host parasite interface of *O. crenata* and broadbeans.

Embryos contained in mature seeds of *O. crenata* show the beginning of differentiation with two opposite zones of meristematic cells separated by parenchyma cells. Embedding with epoxy resins and thin sectioning allowed a cytological observation of the filamentous organ developed during germination. It is a parenchymatous organ, devoid of conducting elements, with groups of primary meristematic cells at its tip. This peculiar structure plays a basic role in the attachment of the parasite to the host. Terminal meristematic cells modify their original shape and form papillae. After attachment to the host (a very rapid process), a tubercle develops. The basal part produces a haustorium or endophyte which penetrates host tissues without crushing any host cells. Very rapidly, connections are established between

host and parasite xylem elements. The outer part of the tubercle is protected by two layers of vacuolated and degenerated cells. Meristematic cells are clustered in numerous groups under these protective layers and will give rise to many root apices and to one stem apex.

These morphological, anatomical, histocytological and ultrastructural results represent a basic approach that will be expanded upon in further work in greater detail and accuracy.

M. Mohamed Aber, Univ. Pierre et Marie Curie, Paris.

Low rates of Glyphosate Control Dodder Selectively in Alfalfa

Glyphosate (N-(phosphonomethyl)glycine) is usually applied at rates of 0.5 to 3 kg/ha to foliage of green plants for nonselective control of a broad range of annual and perennial weed species. Although glyphosate normally is not applied for selective weed control, low rates have been shown to control the root parasite Orobanche selectively in broadbeans (Vicia faba). Recently, it was found that low rates of glyphosate also controlled dodder (Cuscuta) selectively in alfalfa (Medicago sativa) after it had become attached as a shoot parasite.

Alfalfa was seeded in April 1981 in soil containing seed of field dodder (Cuscuta campestris) and largeseed dodder (C. indecora). In early July, when dodder was attached to the alfalfa, hay was harvested from the area. Dodder remaining on the alfalfa stubble grew and reinfested the alfalfa regrowth. In late July, when dodder was growing vigorously, had shoots 20 to 60 cm long and had begun to form buds, glyphosate at 0.075 to 0.6 kg/ha was applied in water at 860 L/ha.

One week after application, curtailed growth, reduced diameter of new stems and tendrils, and progressive necrosis were evident in dodder treated with all rates of glyphosate. The lowest rate applied, 0.075 kg/ha, caused almost no visible symptoms in the alfalfa. Stunted growth and small leaves were evident in alfalfa treated with higher rates of glyphosate. The injury increased as the rate of glyphosate increased.

Although glyphosate killed essentially all external dodder, some embedded haustoria and remnants of twined tendrils survived. A limited amount of normal and abnormal flowers and abnormal stems developed from this surviving tissue late in the season. Plots of alfalfa treated with glyphosate at 0.075 kg/ha remained green and vigorous, whereas untreated plants became yellow from the dense

infestation of dodder and the chlorotic leaves of parasitized alfalfa. Almost all of the recovering dodder was C. indecora.

At the present time, control of dodder in alfalfa after it has become attached to the host plant involves destruction of the alfalfa foliage as well as the dodder. No herbicide treatments are presently recommended for controlling dodder selectively after it has become attached to the host plant. The glyphosate treatment is of especial interest because it would fill the need for a treatment where none is presently available, and the extremely low effective rates would make it a very inexpensive treatment.

J. H. Dawson and A. R. Saghir, USDA-Irrigated Agriculture Research and extension Center, Prosser, Washington.

Second International Striga Workshop 3-8 October 1981

This gathering, in Ouagadougou, Upper Volta, was arranged by Dr K V Ramaiah of The Institute for Crop Research in the Semi-Arid Tropics (ICRXSAT) and supported financially by International Development Research Centre (IDRC) as a sequel to that held in Khartoum in 1978. There were only about 25 workers from Africa, India, Europe and USA but there was valuable exchange of results and ideas. Much of the discussion inevitably revolved around the development of resistant sorghum and millet varieties and this is the only aspect to be currently receiving substantial support. The work of ICRISAT in collaboration with many local workers in Africa and India is leading to clearer ideas on the best sources of resistance to use in breeding work and some real progress has been made in selection and breeding of varieties with useful resistance, combined with improved agronomic and quality characters. Related work at Weed Research Organization (WRO) in England is helping to clarify resistance mechanism and factors influencing resistance, particularly drought stress and nitrogen. There was valuable discussion in true "workshop" sessions on research techniques. From the USA there was an updating on the eradication program for S. asiatica and some promising results presented on the strigol analog GR24 which appears superior to GR7 and comparable to ethylene in field tests. It was agreed there was urgent need for more study of the potential for germination stimulants in Africa, particularly ethylene, and it was pointed out that even if it was not a practical treatment for many situations it could be useful as a means of cleaning plots within infested areas and so allow more direct measurement of crop losses due to Striga; information badly needed as a means of persuading donor organizations to invest more in Striga research.

Very little agronomic research on Striga was reported but there were wide ranging discussions of all possible approaches and agreement on the need for good long term studies on the behavior of Striga seed

under field conditions as a means of interpreting and predicting the effects of trap cropping and other cultural approaches. Similarly there was little to report on biological control but good agreement that there are real possibilities deserving more direct investigation.

A number of general recommendations were agreed including one to the Food and Agriculture Organization (FAO) of the United Nations to include Striga as a major topic in the Sahel Crop Pest Management project and another to US Agency for International Development (AID) to implement the Striga research project, which had recently been formulated and agreed in principle.

One day was devoted to field visits when we saw the sorghum variety SRN 4841 performing well in experiments and farmers' fields. After the workshop three of us (C Parker, P Matteson, L Musselman) spent a further few days in the field with Dr Ramaiah and accumulated valuable observations on specimens of insect pollinators and predators which have been largely overlooked in the past, in particular a butterfly (Precis orithya = Junonia o.) . The larvae are known to be voracious feeders on Striga and related genera in the USA and Indonesia and were observed to behave likewise in Upper Volta. Another observation of note was the occurrence at several sites of Cycnium (previously Rhamphicarpa) fistulosa causing severe damage to partially flooded rice.

Identification of Indian Striga Species

Mr B V N Reddy of the Botany Department, Nagarjuna University, Guntur, India kindly sent a copy of his paper "Colleters on the cotyledons of in vitro raised seedlings of witchweed-Striga asiatica (L.) Kuntze" (Current Science 49: 595-597, 1980) to Chris Parker at WRO. The behavior of the Striga seedlings reported in the paper including development of cotyledons in the absence of any attachment to the host, seemed rather strange and the identify of the species was queried. Mr Reddy had been confident of his identification but did send seed and herbarium specimens and closer examination of these confirmed it was indeed S. euphrasioides (= S. angustifolia) rather than S. asiatica. It is not just a sporadic plant in the Guntur area but is apparently the dominant Striga species on sorghum in that district.

Following the Sorghum in 80's workshop, Chris Parker had the opportunity to make a brief field visit with Dr M J V Rao of ICRISAT to a village where S. asiatica had been particularly severe on sorghum planted dry before the monsoon rains and S. densiflora had also been abundant on immediately adjacent fields of — maize. A? one other site we observed another infestation in sorghum which one of us at first thought was S. asiatica and the other assumed was S. densiflora. In fact, on closer examination it was S. euphrasioides.

All three species in India have more or less similar white flowers, and it seems very probable that *S. euphrasioides* is being quite commonly overlooked despite the fact it is simply distinguished. The calyx ribs are the simplest feature—only five in *S. densiflora*, one running to the tip in each calyx lobe: approximately 10 in *S. asiatica*, the additional ones ending at the sinus between the lobes: and 15 in *S. euphrasioides*, additional pairs of ribs running up to the sinus and then continuing up the sides of the calyx lobes to meet at the tips. *Striga euphrasioides* is further distinguished by larger seed, about 0.5 mm long (versus 0.03 mm in the other two species) with distinct sculpturing as shown with scanning electron microscopy.

Ultrastructural Studies on *Striga hermonthica* and *S. gesnerioides*

Light and electron microscopy have shown that there is no phloem in *S. hermonthica* only intertracheidal parenchyma cells between and along the xylem link between host and parasite. These parenchyma cells contain numerous ribosomes, rough endoplasmic reticulum, mitochondria, dictyosomes and vacuoles. The cell walls are irregular and possess numerous plasmodesmata. On the other hand, sieve elements are clearly evident in the haustorium of *S. gesnerioides* and form a sheath of phloem around the haustorial xylem. The relation of the phloem to that of the snoot and the host root have not been studied in detail although I assume that there is continuity based on preliminary studies with the light microscope.

A. T. Ba, University of Dakar, Dakar, Senegal

Medicinal Value of *Striga*

Members of the genus *Striga* in India have been used in the past for their therapeutic value. In *Ayurveda*, *S. asiatica*, pungent and bitter, are indicated to improve both appetite and taste and in treatment of blockage of the windpipe and diseases of the blood. *Striga gesnerioides* (or *S. euphrasioides*) has a use in diabetes. In addition to these uses recorded in the literature, we noticed in talking with some farmers from Maharashtra that *Striga* are used by them to increase the fertility of cows and buffalos, for treatment of dry cough, blisters on the tongue, and as a dermaticide.

M. J. Vasudeva Rao and V. L. Chidley, ICRISAT, Hyderabad, India

Symposium on Haustoria, Botanical Congress, Sydney, August 1981

Papers presented at this symposium included the following: J. L. Riopel-Host recognition in angiosperm root parasites. B. A. Fineran-Graniferous tracheary elements in haustoria. J. H. Visser-Host contact and initial development of the root parasite. I.

Dorr-The development of the haustorial phloem system of holo- and hemi-parasitic plants, as influenced by the host. H. C. Weber-Observations on the parasitism of Australian and New Zealand Mistletoes. M. A. Abou Raya-Observations on the parasitic behavior of Thesium humile Vahl (Santalaceae). III. Germination and chlorophyll status. M. A. Abou-Raya, M. A. El-Sharkaway and A. EL Taife-Mode of parasitism of Cistanche spp. J. Kuijt-Inflorescence geography in Loranthaceae. F. A. Onofeghara-Mistletoe parasitism in West Africa. P. Bernhardt-Reproductive isolation between Amyema species. For further detail, please contact Prof. Malcolm Calder, School of Botany, University of Melbourne, Parkville, Victoria, Australia 3052.

LITERATURE

- Visser, J. 1981. South African Parasitic Flowering Plants. Juta Co., Ltd., P O Box 30, Cape Town, South Africa. 184 pp. This volume could be recommended solely for its 184 magnificent color plates but there are in addition 36 in black and white, 67 each of distribution maps and bar charts showing flowering times and a text giving valuable descriptions and many original observations on selected species of the very wide range of South Africa parasitic plants in ten botanical families.
- Fer, A. 1980. Echanges de substances carbonees entre l'hote (Pelargonium zonale) et le parasite (Cuscuta lupuliformis) Brell. Soc. Bot. Fr.: 127 Actualites Botaniques, 169-174. Although at normal levels of atmospheric carbon dioxide C. lupuliformis is totally dependent on assimilated carbon from the host, it is shown that at high carbon dioxide levels the parasite can fix sufficient carbon to sustain its own growth.
- _____. 1981. Recherches sur le voies de transport impliquees dans l'alimentation, d'une phanerogame parasite sur des feuilles isolees parasitees par Cuscuta. Physiol. Vegetale 10: 177-196. This study demonstrates the importance of a phloem connection between host and parasite by which carbohydrates (mainly sucrose and an analog, deoxyglucosyi-fructoside) are transported. Water and calcium on the other hand are obtained through the xyiem.
- Panchenko, V. P. The biological protection of watermelons and tomatoes from broomrape in Astrakham Province. Dok. Vaskrnil no. 8: 25-27. Economic benefit was obtained by treatment of fields with a rice husk/maize meal culture of Fusarium oxysporum var. orthoceras. Orobanche aegyptiaca populations were reduced about 50% in alluvial soil and over 90% in sandy soil. Crops were found to act as hosts of the fungus but showed no damage symptoms.
- India Central Tobacco Research Institute. 1979. Control of Orobanche leaflet. no 1 (revised). 8 pp. Control methodes recommended include: weekly hand-pulling of shoots prior to flowering, deep ploughing, 3 or 4 weekly sprayings of 0.1-0.2% allyl alcohol on young shoots before flowering Kerosene is also effective but must not touch the tobacco and trap cropping during winter months.
- Bebawi, F. F. 1981. Intraspecific physiological variants of Striga hermonthica. Exp. Agr. 17: 419-423. Eleven Sudanese collections

- of *S. hermonthica* were exposed to root exudates of 27 sorghum cultivars. There were differences between *Striga* strains and between sorghum varieties, of which Petron shown low stimulant character comparable to that of the known resistant variety Framida.
- Bebawi, F. F. and A. F. Farah. 1981. Effects of nitrofoska and atrazine on relations between *Sorghum bicolor* and *Striga hermonthica*. Exp. Agr. 17: 425-450. Field experiments in two seasons demonstrated striking synergism between N and atrazine in reducing *Striga* populations and increasing yields.
- Musselman, L. J. and C. Parker. 1981. Surface features of *Striga* seeds (Scrophulariaceae). Adansonia 20: 411-437. This short. paper includes scanning electron micrographs of the seeds of nine species and several strains within *S. hermonthica* and *S. asiatica*.
- _____. 1981. Studies on indigo witchweed, the American strain of *Striga gesnerioides* (Scrophulariaceae). Weed Sci. 29: 594-596. Further studies are reported on the host specificity of different strains of *S. gesnerioides* and it is concluded that the Florida strain is unlikely to parasitize any economically important crop in the southern USA.
- Cetinsoy, S. 1980. Studies on the determination of effective chemical against *Melampyrum arvense* L. harmful in cereal fields in Central, Anatolia. Turkey Plant. Protection Research Annual, Arastirm Dairesi Baskanligi Sayi 15: 118-119. *Melampyrum arvense* is sufficiently important as a weed of wheat in central Anatolia that it was the subject of special herbicide experiments, from which Brominal Plus (bromoxynil +MCPA) proved to be most effective.
- Zahran, M. K., Ibrahim, T.S. El-N., F. H. Faraq, and Korollos, M. A. 1980. Chemical control of *Orobanche crenata* in *Vicia faba*. FABIS Newsletter no. 2, 47-48. In addition to confirming selective control of *O. crenata* by repeated post-emergence sprays of glyphosate, the authors report success with propyzamide at 7.5 and 10/kg/ha applied in high volumes of water four weeks after sowing *V. faba*.
- Petzoldt, K. 1981. Control of *Orobanche crenata* Forsk. in broadbeans (*Vicia faba*) by means of combined cultivation and plant protection measures. Z. Pflanzenkrank. u. Pflanzensch. 9: 365-369. Glyphosate is shown to be an effective means of control. In addition, seeds treated with Benomyl and fertilization with nitrogen increased yields even in an *Orobanche tolerant* cultivar (ICARDA F 402).
- Weber, H.-C. 1981. Orchids on the way to parasitism? On the possibility of an evolutionary transformation of the organs of contact of *Corallorhiza trifida* Chat. (Orchidaceae) to organs of attachment of parasitic angiosperms. Ber. Deutsch. Bot. Deutsch. Bot. Ges. 94: 275-286. This paper sets forth the interesting idea that there is a similarity between the behavior of the hairs of the achlorophyllous orchid and primitive haustoria of parasitic plants.

HAUSTORIUM is edited by Chris Parker and Lytton Musselman. Please send suggestions for its continued existence as well as any material for a future issue to either of the authors.

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