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Modest support for the future production and distribution of Haustorium now appear to be secure, so we look forward to maintaining our twice-yearly publication. News items for Haustorium 37 will thus be welcome.

HAUSTORIUM BY EMAIL AND THE WEB

Haustorium still has no significant source of funding and we need to reduce costs as much as possible. The great bulk of our costs are for mailing. Many readers are already helping us by receiving Haustorium by Email. We believe many others could do so but we do not have their Email addresses. If you are one of those, do please let Chris Parker know (Email address on the last page). If you cannot receive Email, or for any reason wish strongly to go on receiving hard copy, you will continue to receive by airmail.

Thanks to arrangement with the Institute of Arable Crops Research, Long Ashton Research Station, Bristol, UK, Haustorium 36 will also be available on the web site: www.lars.bbsrc.ac.uk/cropenv/haust.htm

PARASITIC WEED PROJECTS FUNDED BY DFID/CPP

The control of Striga on maize and sorghum: nitrogen x crop genotype interactions

Striga hermonthica and S. asiatica are important weeds of cereals in semi-arid tropical farming systems. There is an urgent need to develop control strategies consistent with the agronomic and socio-economic environments that prevail in the areas where the parasites pose major threats to food production. The inverse relationship between the incidence of Striga infection and soil fertility has resulted in the development of control strategies that aim to improve soil fertility through a number of approaches. In this DFID-funded project we have examined the role of nitrogen in modifying the interaction between parasite (S. hermonthica and S. asiatica) and host (maize and sorghum). We have taken a laboratory- and field-based approach, the latter using both on-station and on-farm studies, in Tanzania and Kenya.

The project has shown that the success of nitrogen fertilisers in both reducing the density of emerged Striga plants and in improving grain yield has been equivocal, varying greatly both geographically (e.g. between countries) and spatially (between cropping seasons) and also as a function of crop species (sorghum and maize) and genotype. Thus, we believe that there is not a universal relationship between the minimum amount of nitrogen, its form and time of application, that is required to elicit economic benefits. For this reason, it is essential to understand how nitrogen alters the interaction between Striga and its cereal hosts, so that it can be used more efficiently with regard to interactions between genotype and environment.

In a previous DFID-funded project it was demonstrated that nitrogen depresses the germination and subsequent attachment of Striga to the host root system. It is less clear how nitrogen exerts its effects after parasite attachment but recent work on the current project shows that these may arise through disturbance of host nitrogen metabolism by the parasite. Infected cereals maintain very high levels of free amino acids in their leaves and sap, particularly those amino acids that are commonly transported. How the parasite causes this change is unclear, but one consequence for the host is that rates of amino acid incorporation into proteins are lower than those for control plants, thus potentially depressing growth and production of photosynthetic machinery.

Our earlier studies showed that Striga also lowers the capacity of infected cereals to fix carbon, through both direct effects on photosynthesis and indirect effects on allometry and plant architecture. Striga causes stomatal closure, thus restricting the influx of carbon dioxide to the mesophyll cells, and thereby lowering rates of photosynthesis. Infected plants also have lower leaf surface areas, again resulting in less carbon fixation, coupled with greater self-shading in the canopy that results from the failure of internodes to elongate. Recent field studies in Tanga, Tanzania, on maize cultivars, in collaboration with Dr Mbwaga (Agricultural Research Institute, Ilonga), suggest that the parasite also predisposes the cereal to photoinhibition during periods of high irradiance. The techniques used here (chlorophyll fluorescence) provide a rapid and early screen for the presence of Striga long prior to emergence of the parasite above-ground and allow some assessement of the likely impact of the parasite on crop yield.

The differential sensitivity of species and genotypes to infection may result partially from the extent to which carbon and nitrogen metabolism in the host are perturbed. There is certainly some evidence to support this assertion, for example, in on-station trials at Kibos, Kenya (in collaboration with KARI and CIMMYT), the sorghum variety 'Ochuti' appears to show some tolerance that is correlated with an ability to maintain higher rates of canopy carbon fixation when infected with S. hermonthica. Similarly, we have obtained promising results with the Tanzanian maize cultivar Staha, which yielded well in the presence of Striga and also showed positive yield responses to low additions of N (25 kg ha-1 urea). Understanding the mechanisms underlying the impact of Striga on its host and how these interact with components of the abiotic environment is important if control measures are to be applied in a directed way.

In contrast with associations between crops and Orobanche and Cuscuta, we have shown that the demands made by Striga for resources do not account for 'lost' productivity. This can be seen very clearly in our studies of the impact of Striga density on host response, where a very large reduction in density is required before any significant impact on the host is observed. This is one of our major findings, since it shows that while mechanisms that lower numbers of emerged Striga may be effective in reducing the density of seeds in the soil seed bank in the medium to long term, they are unlikely to have any short term impact on crop yield. It seems that the metabolic perturbations caused by the parasite outweigh the direct loss of resources to the parasite.

A second source of variation observed between species and genotypes in response to Striga arises from differences in attachment time of the parasite to the host root system. We have demonstrated unequivocally during this project that later attachment greatly alleviates the impact of the parasite on the host (Gurney et al. 1999). Further, we suspect it is not just the time of attachment, per se, that is important but the proportion of the lifecycle that the cereal has completed prior to attachment. Thus, the combination of delayed attachment and the use early cropping varieties may hold promise as part of an integrated control programme.

Molecular techniques may allow us to both understand further the mechanisms through which Striga perturbs host growth and also to identify resistant genotypes. In collaboration with Dr Grimanelli and his colleagues at CIMMYT, we have conducted laboratory screening and physiological studies on crosses of maize with wild relatives that show resistance to Striga hermonthica under field conditions in Kenya. We hope to continue this collaboration to study resistance in transposon tagged populations of maize that CIMMYT have been screening in Kenya. These lines offer the possibility of understanding the mechanistic basis of resistance to Striga in maize and this information may also allow development of resistant genotypes in other cereals.

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Mistletoes on cocoa in Ghana

Mistletoes, (Loranthaceae) are common parasites of trees in the humid forest zone of West Africa. While it has been recognised for many years that a number of species are widespread in cocoa in Ghana, little recent information has been available about the problem or the extent to which farmers attempt any control. A DFID-funded evaluation, using rapid rural appraisal techniques including farmer focus group discussions, was therefore undertaken in 19 villages in cocoa growing areas of Eastern and Ashanti Regions during 1997 in collaboration with the Cocoa Research Institute of Ghana.

Tapinanthus bangwensis was found to be an almost ubiquitous component of the cocoa canopy on all but the most recently planted farms in all areas studied. It is also common in forest shade trees of cocoa and in associated species of the tree crop system including avocardo, citrus and kola (Cola nitida). In the areas we visited cocoa remains the most important source of household cash income despite a decline in productivity since the 1960s. Growers ranked mistletoe, weeds, the capsid insects and black pod disease as the most important production constraints. Mistletoe is perceived in most villages as the number one problem which has been on the increase during the past 20 years. This has been principally due to the decline in the availability of serviceable pruners (last sold in 1991), ageing tree stocks (mistletoe is difficult to remove from tall trees) and an inflexible land tenure system which provided few opportunities for younger growers to control cocoa farms. Share croppers have ha d little incentive to maintain cocoa farms to their full potential due to poor returns from the widespread system of share-cropping and poor producer prices. Mistletoe removal with a cutlass, while using a ladder or climbing the infested tree, is the only alternative to using a pruner, but is perceived to be a dangerous, unpleasant task. In consequence labour hired for this purpose attracts a significant premium. Growers are well aware of the link between mistletoe infestation and the long term decline in viability of their farms. The study therefore identified a widespread demand for pruners. Future work needs to examine the re-establishment of the local manufacture of an inexpensive, robust and easily maintained pruner. The likely cost of a new pruner is relatively high compared to current returns from cocoa production and would probably be beyond the means of many growers, particularly as there are few sources of affordable credit available for cocoa farming in Ghana. Some enthusiasm was however found among growers for group participation in pruner ownership.

Charlie Riches, Natural Resources Institute, IACR-Long Ashton Research Station, Bristol, UK; Duncan Overfield, Natural Resources Institute, University of Greenwich, Chatham, UK.

Potential resistance to Striga in upland rice

As a result of previous DFID-funded glasshouse studies in UK, and field trials completed in Cote d'Ivoire, we have previously reported on potential sources of resistance to Striga aspera and S. hermonthica in both Asian (Oryza sativa) and African (O. glaberrima) rice germplasm (see Johnson et al., 1997. Crop Protection 16: 153-157). In comparison to the complete resistance seen in pots, a number of O. glaberrima accessions and two O. sativa lines were found to offer partial resistance in the field. Interestingly the O. glaberrima lines not only supported lower numbers of emerged parasite stems than the O. sativa susceptible check, a widely grown cultivator in Cote d'Ivoire, but their growth was also less affected by Striga suggesting they may possess a high level of tolerance to Striga. A breeding programme at WARDA has sought to combine some of the beneficial characteristics of O. glaberrima with the higher yield ing O. sativa. However, in pot screening the observed S. aspera and S. hermonthica resistance of O. glaberrima line CG14 was not expressed in the F7 generation of progeny from the cross with a susceptible O. sativa. In order to increase the fertility of these inter-specific crosses it is necessary to backcross the F1 generation twice to the O. sativa parent, a process in which the resistance to Striga appears to be lost.

Subsequently crosses were made between a range of cultivars or breeding lines and the resistant O. sativa lines IR47255-B-B-5-4 and IR49255-B-B-5-2 as male parents, with more promising results. In screening of 23 F1 progenies the susceptible Iguape Cateto supported a mean of 15.3 emerged S. aspera and 4.3 S. hermonthica per plant. No more than one parasite stem of either species was observed per plant of the resistant parents; IR49255-B-B-5-2 remained free of S. aspera until the trial was terminated 120 days after sowing. Four progenies, all derived from crosses in which IR49255-B-B-5-2 was used as the male parent were not attacked by either species. On the other hand, progeny of the corresponding crosses in which IR47255-B-B-5-4 was used as male parent proved susceptible to both S. aspera and S. hermonthica. The selected progenies now need to be evaluated in the field in order to seek confirmation that IR49255-B-B-5-2 is a useful source of resistance for use in future breeding programmes.

Charlie Riches and David Johnson, Natural Resources Institute, IACR-Long Ashton Research Station, Bristol, UK; Monty Jones, West Africa Rice Research Association, Bouake, Cote d'Ivoire.

Alectra vogelii resistance in common bean and cowpea in Malawi

A. vogelli is a widespread problem on a number of leguminous crops in Malawi including common bean (Phaseolus vulgaris) and cowpea. Using pot trials, undertaken in UK, variability in susceptibility to a sample of the parasite collected from the the Blantyre Shire highlands has been identified in beans. Mhkalira, a line recently introduced to Malawi from the Mesoamerican gene pool, supported on average the emergence of less than one A. vogelii stem per host plant compared to more than 20 on the most susceptible local cultivars. Field trials are now needed to examine the significance of this variation in bean susceptibility in terms of grain yield.

Cowpea line B359, a land race originating from Botswana was confirmed to be resistant to A. vogelii from Malawi, supporting no development of the parasite. This is an indeterminate, long duration line but would provide a useful source of resistance for incorporating into early maturing cultivars in future breeding programmes. In this study B311, which has been used as a source of resistance to both Striga gesnerioides and A. vogelii in improved cultivars released in west Africa, did support the emergence of Alectra. A mean of less than four stems emerged per B311 host compared to more than 60 on three local lines collected in Malawi. Emergence of parasite stems on B311 was however 10 to 15 days later than on the local materials.

Parasite seed germination assays indicated that the resistance identified in Mhkalira and B359 is not related to low germination stimulant production by the host plants compared to susceptible lines. This study also indicated that sun hemp (Crotalaria ochrelucra) and fish bean (Tephrosia vogelii) are potent sources of Alectra germination stimulant. There is considerable interest in Malawi, and other Alectra infested areas of Eastern and Southern Africa, in promoting these legume species as green manures for improving soil fertility. Our pot trials have shown that they are not hosts of the parasite and so would act as trap crops.

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(This study was supported through the DFID funded Farming Systems IPM project).

Striga workshop, Dar-es-Salaam, Tanzania, September 1999

The DFID-funded Striga research project Integrated Control of Striga in Tanzania described by Riches et al. in Haustorium 35 completed three years of activity in March 1999 and a 2-day stakeholder workshop also funded by DFID was held in September. It was attended by 25 participants variously involved in both the Tanzania project and that at Sheffield (see article above by Press et al.).

Objectives were given by Dr A.M. Mbwaga, the organiser of the workshop as:

a. to review the status of Striga problems in small-holder farming in Tanzania
b. to present approaches to the solution of these problems
c. to present the research findings to date
d. to discuss strategies for future work.

The Workshop confirmed that there is a serious, often severe, and generally increasing problem from Striga species on sorghum in at least four of the seven Zones of Tanzania, with somewhat less extensive problems in maize and a locally acute problem in rice in one district. Results presented suggest that the introduction of selected new varieties of sorghum would have the greatest impact, with or without other inputs such as farmyard manure. However, there is a particular need for problems of seed production to be addressed, while a further selection of new varieties continues to be critically evaluated for their ability to yield well under Striga attack, with the help of physiological techniques developed by the Sheffield project. Other work which could usefully be continued or initiated includes studies on the optimum methods for use of manure, inter-cropping, relay inter-planting with green manures, seed priming, etc, while socio-economic techniques continue to be employed to increa se farmers' awareness and understanding of Striga biology, and ensure that any new techniques are fully acceptable to them. There was strong pressure from participants for the project to introduce parallel work on Striga in maize, while continuing with work in rice. In maize there are promising leads to pursue in terms of apparent varietal tolerance, while in both maize and rice, urea appears to provide economic response.

The workshop papers are due to be prepared as a Proceedings within a few months. Meanwhile, work is in progress to develop new phases of both projects.

Chris Parker.

Acknowledgement The above items are based on research partially or completely funded by the UK Department for International Development's Renewable Resources Knowledge Strategy. However, DFID can accept no responsibility for any information provided or views expressed.

Analysis of a new Orobanche species From Tasmania

An unknown Orobanche species was found in Tasmania, Australia, two years ago heavily infecting a commercial carrot field. The infested crop was approximately 4 ha, with about 40% of all carrots infected. Flowering commenced within two weeks of emergence. Subsequent inspections revealed further Orobanche plants growing on pyrethrum in the neighborhood that may have been present in the area for several years escaping detection. Due to limited experience with Orobanche in Australia identification of the specimens was difficult.

Species identification is very difficult from morphological features, especially when the species related to O. minor (subsection minores) are concerned. We therefore analyzed the DNA extracted from the Tasmanian Orobanche (sample 1), and compared it with Orobanche samples from other sites in Tasmania (samples 2-4), and with samples of known species from South Australia (samples 5-6) as well as with samples from France, Israel, and the U.S.

Two questions were addressed: (a) species identification, based on the plastid genome, and (b) similarity to broomrape populations of known species, based on the nuclear genome.

Analysis of the rbcL gene and rbcL-atpB region of the plastid genome revealed that the nucleotide sequence of samples 1,2 and 3 was identical to that of O. minor collected in France, whereas the sequences of samples 4 and 5 were identical to those known for O. loricata. Therefore, molecular results based on plastid DNA strongly suggest two possibilities: either that all the Australian samples 1-3 and 4-5 belong respectively to the European species O. minor and O. loricata. One should, however, appreciate that the markers that were developed for the French populations of the above species have not previously been studied for Orobanche elsewhere. Precise identification of the Australian samples will be possible only after a thorough study of all O. minor group throughout the world.

For the analysis of nuclear genome we used two methods, i.e. RAPD and ISSR. With RAPD we found more than 270 polymorphic bands, which gave interesting results as follows:

Each one of the samples 1, 5 and 6, and of O. minor from the U.S were very different from the samples of all known species in France and Israel. The Tasmanian samples 2,3 and 4 were found to be slightly closer, in terms of electrophoretic band similarity, to the French subsection minores and to O. cernua and O. cumana from Israel. ISSR analysis of these samples leads to similar result, i.e. that Australian samples differ largely from Mediterranean samples belonging to species of subsection minores.

Based on these results we can conclude that the Tasmanian Orobanche samples do not directly originate from any known weedy Orobanche population in the Mediterranean and European area. Although the molecular results do not allow precise species identification, they do mean that the new Tasmanian population on carrot surely does not originate from the other known populations in Tasmania and South Australia that were examined in this study.

A more detailed study of Orobanche is required in order to understand the inter-relations between the broomrapes in Australia and the known broomrapes in Euroasia.

Daniel M. Joel, Newe-Ya'ar Research Center, Israel (I); Patrick Thalouarn, University of Nantes, France (F); Andrew Bishop, Department of Primary Industry and Fisheries, Tasmania, Australia; Hocine Benharrat (F); Vitaly H. Portnoy (I) and Stephen Welsh (A).

Workshop on Breeding for Striga Resistance in Cereals

A workshop on breeding for Striga resistance in cereals was held at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, from 18 to 20 August 1999. The meeting was organized by IITA, ICRISAT, the University of Hohenheim, Eberhard-Karls University of Tübingen, and the Rockefeller Foundation. Funding was provided by the Bundesministerium für wirtschaftliche Zusammenarbeit (BMZ), Germany, The Rockefeller Foundation, and the International Fund for Agricultural Development (IFAD). The 56 participants comprised 26 cereal breeders or weed specialists from 17 African countries, and 30 scientists or representatives from IITTA, ICRISAT, CIMMYT, WARDA, PASCON, CIRAD (France), John Innes Centre, UK, Natural Resources Institute , UK (NRI), ProAgro Seed Company, the Rockefeller Foundation, Cornell University, University of Hohenheim, Purdue University, University of Sheffield, University of Tübingen, and the Weizmann Institute of Science.

Objectives of the workshop were two-fold, 1) to summarise the "state of the art" of cereal breeding for Striga resistance (including biotechnological approaches) and 2) to develop with African scientists future strategies for Striga control in sorghum, maize, millet and rice, emphasizing host plant resistance. The workshop included presentations related to: physiology of the host/parasite interaction; resistance mechanisms; inheritance of resistance; new sources of resistance in wild relatives of sorghum; actual breeding programs for Striga resistance in maize, sorghum, millet, and rice; molecular markers for Striga resistance; identification of Striga tolerance genes in maize using transposable elements; other biotechnological approaches for Striga control; diversity of Striga populations and consequences for resistance breeding; and breeding towards integrated Striga control. Since so many presentations dealt with molecular markers, the workshop was preceded by a two-day training course on the application of molecular markers in plant breeding programs (16-17 August). Participants visited the IITA screenhouses at Ibadan, and several field trials (on-station and on-farm) at Mokwa. On the final day, working groups discussed future strategies in Striga research and developed the following recommendations.

Strategies essential for efficient conventional breeding for Striga resistance include:

- careful definition of target environments;
- determination of the most important selection traits for each target environment;
- identification of adapted parents for use in a back-cross program;
- training of NARS scientists to use both laboratory and field screening methods;
- transfer of available resistance into farmer-selected varieties, through combined use of laboratory (e.g., agar-gel and paper-roll assay) and field screening methodologies;
- combining different resistance mechanisms and tolerance to Striga in individual varieties;
- networking and exchange of useful plant genotypes.

Population improvement through development of a random-mating population combining several different resistance genes could be very useful, but would have to be carried out on a large scale by a dedicated, able breeder.

Targeted searches for new resistance sources in pearl millet, sorghum, and their wild relatives are important using recently perfected field and laboratory screening methodologies.

Marker technology and Quantitative Trait Locus(QTL) analyses were considered to be potentially very useful. Verification of results is essential, as preliminary results suggest complex QTL patterns and low repeatability of individual QTL across environments and different mapping population samples.

Future research efforts should continue to

- develop universal marker systems, especially allele-specific markers;

- develop isogenic lines to quantify QTL effects for Striga resistance;
- create an integrated, PCR-based sorghum reference map (begin by integrating Striga resistance mapping populations);
- identify adapted sorghum parents for use in marker-assisted selection programs;

- determine whether the low-stimulant genes in SRN 39 and IS 9830 are identical;
- develop a sorghum data base (ICRISAT leadership).

Once resistance genes have been identified, efforts should be made to exploit from synteny (overlapping genetic maps) in sorghum, maize, rice and millet. Transfer of resistance genes from cowpea into cereals was not considered a priority.

The continued search for resistance mechanisms and their genetic basis, should always run parallel to the marker approach, with a final aim of identifying allele-specific markers. Enhanced knowledge of the physiology of the host/parasite interaction is urgently required to:

- examine interactions between host root exudates and exudates from the Striga radicle;
- determine how Striga induces its strong sink reaction;
- study how early host plant flowering minimises the "bewitching" effect of Striga on its host;
- clarify the role of ABA;
- study mechanisms of antibiosis.

An unconventional approach to Striga control would reduce Striga vigour by genetic engineering. When enzymes are identified which reduce the vigour of Striga, use deleterious transposons (DTs) to reduce Striga vigour. (First model studies are underway at the Weizmann Institute of Science). (see separate item below 'TAC-TICS for Striga control' on this topic, Editors)

The development of cultivars with target site resistance to acetolactate synthase (ALS) inhibiting herbicides was considered to be (probably) appropriate for maize in Africa, and pearl millet and sorghum in Asia (i.e., in regions where the crops do not have feral or weedy relatives). It seems less appropriate for rice in Asia and Africa; pearl millet in West Africa, and sorghum in Africa (i.e., in crop/region combinations where feral or weedy relatives are present).

Transposon-based mutation breeding may allow researchers to:

- find resistant phenotypes that previously did not exist, due to transposon insertion into relevant genes;
- tag genes that are involved in host response to Striga (forward genetics);
- isolate and clone the gene;
- use the cloned gene in both the host and other host plant species.

Future research related to Striga variability should:

- study inheritance of isoenzyme and DNA markers; analyze linkage between markers;
- perform cytological studies on Striga chromosome number and degree of polyploidy;
- develop 10 to 15 micro-satellites for Striga diversity studies;
- estimate polymorphism in Striga hermonthica populations that are naturally adapted to different hosts; test more populations from wide geographic sites across Africa, and from a variety of different resistant and susceptible hosts; extend host range tests; standardize sampling procedures; include farmer consultation on field history;
- create genetic stocks of various Striga strains by developing full-sib families;
- develop a set of host plant differential lines;
- elucidate mechanisms and inheritance of Striga virulence; focus on: Striga sensitivity to germination stimulants; Striga penetration into host roots, role of exoenzymes.

Inter-Center collaboration is highly encouraged in this respect.

With respect to integrated Striga control, methodologies immediately available for technology transfer/extension services include:

- Maize/legume (groundnut, soybean, cowpea) intercropping plus weeding and fertilization: 100 - 120 kg N, 50 - 60 kg P2O5 - for moist savannas;
- sorghum/cowpea intercropping: two rows sorghum - four rows cowpea, strip planting;
- rotations of cereals and legumes;
- tied ridges for the Sahel.

Further research on integrated Striga control should focus on:

- location-specific laboratory screening of cultivars of non-host species for their ability to germinate Striga (cowpea, soybean, groundnut, cotton, pigeon pea, Phaseolus beans, cassava, sorghum, millet, maize, Stylosanthes, sesame);
- participatory, on-farm development of individual, integrated Striga control packages, adapted to each target area; especially consider rotation or intercropping of sorghum/maize with legumes (soybean, cowpea, ground nut, Phaseolus bean);
- impact studies.

Individuals/organizations have been identified to carry forward on most of the above topics. Proceedings of the workshop will be published by Margraf Verlag in early 2000.

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TAC-TICS FOR STRIGA CONTROL

The following is a verbatim extract from the paper presented by Dr Jonny Gressel at the recent BCPC Weeds Conference at Brighton (see Gressel, 1999 in Literature). It is reproduced by kind permission of Dr Gressel and of the British Crop Protection Council.

'Striga hermonthica, the major Striga spp. attacking maize is not a wild species; it is a truly co-domesticated man-made contrivance, just like maize. In its present evolutionary state it is not more competent than maize to exist in the wild as it can only grow on crops; it has few wild hosts. There is ample evidence that it evolved recently from S. aspera, a parasite of many wild species, but is not a pernicious weed. It would be useful to reverse evolution i.e. to force Striga back to being an innocuous wild plant. We propose that it is possible, using genetic engineering to debilitate Striga (Gressel and Levy, 1999). If this solution is successful, it will integrate with and facilitate other successful control mechanisms, leading to more durable control. It is proposed to disperse genes that will be deleterious when turned on; genes that mimic herbicide action; that inhibit plant growth; that render super-susceptibility to herbicides; that participate in host-recogniti on; or modulate hormone levels. The seminal concept by Pfeiffer and Grigliatti (1995) proposed a means for controlling pests withTAC-TICs; 'Transposons with Armed Cassettes for Targeted Insect Control'. They suggested transforming insects with a gene which, if activatred by a chemically-induced promoter, would debilitate the insect. We termed these assisted-suicide genes as 'kev' (Kevorkian) genes. They postulated that releasing a few transgenic pests would be sufficient if the transgenes are coupled in a multicopy transposon. They suggested that the farmers use their normal methods of pest control during the period of transposon transmission throughout the population, and then chemically activate the promoter. The concept modelled for insects seems to be appealing for Striga if the proper kev genes and/or promoters can be found; the transposons available; the weeds can be easily engineered; and most importantly, id safety considerations can be met. S. hermonthica is singularly app ropriate for this technology as it must be cross pollinated.

The Ac/Ds transposon family, originally found in maize, has been shown to be active in all heterologous plant systems where it has been introduced (see Kunze, 1996). Ac is preferentially transposed during DNA replication, increasing its copy number while it transposes. The dominant kev genes can be introduced into a transposon cassette in high copy number and transformed into Striga to generate debilitated weeds after the chemical induction. These kev parents can be sown together with maize. There are many possible kev genes available that, when partially inhibited, cause the accumulation of lethal metabolites in plants, and are targets for known herbicides. Antsensing or overexpressively co-suppressing the gene encoding the enzyme can kill the plant when turned on (HØ fgen et al., 1995).

Chemically-induced genes that cause pollen sterility a generation hence have been proposed for protecting crop varieties (the 'terminator' genes of the popular press), could be considered as kev genes. When disseminated by transposons, they would prevent seed set but Striga would damage the crop. This approach could be used in conjunction with a herbicide-resistant maize; to eliminate late season Striga escapes that cause little damage as well as any herbicide-resistant Striga that evolves. The competition among Striga plants is quite fierce, both to fertilize and during the self-thinning' period when seedlings establish. Individuals bearing genes that are essentially unfit would be rapidly eliminated from the population.

Known antiweediness genes that limit competitiveness between weed and weed, and weed and crop are described in Gressel (1999) and gave been proposed for use in tandem with useful genes for rice (see below). Such genes under chemically induced promoters could be used as part of kev constructs.

A wide variety of promoters are available for chemically inducing the expression of genes in plants (Gatz and Lenk, 1998). No good chemical inducers of plants genes are known as yet that would fulfill all the requirements of the original TAC-TIC concept for Striga. An applied kev inducer would have to be translocated through the plant from the foliage to the Striga attached to the roots. The best known inducers are not translocated, or would affect the crop.'

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GOLDEN BOUGH

Roger Polhill writes that he has now retired and will not be attempting to resume publication of the mistletoe newsletter 'Golden Bough'. The last issue was No. 12. Haustorium will continue to cover mistletoes along with other parasitic plants, and literature and news items on them are always welcome.

SEVENTH INTERNATIONAL PARASITIC WEED SYMPOSIUM

Arrangements are continuing for the Seventh International Parasitic Weed Symposium to be held in Nantes, France, 3-8 June, 2001. A first circular has been sent to all recipients of Haustorium. If you know of others who would be interested, or if there are any comments or suggestions on the format of this event please contact Haustorium editors, or Patrick Thalouarn, Laboratoire de Cytopathologie Vegetale, University de Nantes, 2, Rue de la Houssinière, BP 92208, F44322 Nantes Cedex 3 France. Email patrick.thalouarn@svt.univ-nantes.fr

The International Parasitic Plant Society

We thank all colleagues who sent us encouraging messages, and who already expressed their wish to become members of the International Parasitic Plant Society. In fact the list of interested people now includes people from more than a dozen different countries, including Tanzania, Bulgaria, India, Japan, USA, UK, Germany, France, Israel, China, Spain, Australia and the Netherlands. The list is gradually growing, with agronomists, botanists, chemists, weed experts, molecular biologists and taxonomists united to try and extend the activities that have so nicely been carried out by the informal Parasitic Seed Plant Research Group for so many years. The ad-hoc executive committee of the Society includes Andre Fer as president, Jos Verkleij as treasurer, and myself as secretary. Additional members of the executive committee are Jim Westwood and Dana Berner. The Society will be formally registered before the International Symposium on Parasitic Plants in Nantes, when a new executive committee will be elected.

At the moment it is highly important for us to have an idea who is interested in becoming a member of the new Society. We therefore kindly ask those of you who have not responded yet, to send us, with no obligation, your name, address, Email, and fields of interest. A cut-out form is printed at the end of this newsletter. We thank you in advance for your cooperation and help. Please bring our request also to other colleagues who may be interested.

Looking forward to fruitful collaboration in the new Society.

Danny Joel, Ad-hoc Secretary, International Parasitic Plant Society; Dept. of Weed Research, Newe-Ya'ar Research Center, P.O. Box 1021, Ramat-Yishay 30095, Israel. (N.B. The editors apologise that Danny Joel's address was given incorrectly in Haustorium 35.)

WEBSITES

For information on the 7th International Parasitic Weed Symposium at Nantes, 2001 see:

http://www.sciences.univ-nantes.fr/scnat/biologie/GPPV.web

(N.B. not ….biologie/scnat…as indicated in the first circular.)

For information on biology and control of parasitic weeds, and the relevant activities of the University of Hohenheim see: http://www.uni-hohenheim.de/~www380/parasite/start.htm

For IITA Striga Research Methods: a Manual, see: http://cgiar.org/iita

PROCEEDINGS OF MEETINGS

Report on the ICRISAT Sector Review for Striga Control in Sorghum and Millet. ICRISAT-Bamako, Mali 27-28 May 1996. 1999. Edited by Hess, D.E. and Lenn¾ , J. ICRISAT. 138 pp. ('An ICRISAT semi-formal publication issued for limited distribution without formal review.') Contents include:

An overview of the Striga control sector review.

Obilana, A.B. and Reddy, B.V.S. Host-plant resistance to Striga in sorghum and millet.

Hess, D.E. and Dembel¾ , B. Cultural manaement of Striga on cereals.

Hess, D.E. and Grard, P. Chemical control of Striga.

Kroschel, J. et al. Possibilities and constraint in implementing Striga control methods in African agriculture.

Riches, C.R. Sorghum and millet Striga research in UK: contributions to international programs.

Butler, L.G. and Ejeta, G. INTSORMIL-supported research on Striga.

Traor¾ , H. and Oedraogo, O. Research activities in integrated Striga management of pearl millet and sorghum in Burkina Faso - 1990 to 1995.

Bengaly, M. and Defoer, T. Farmer perception of the Striga problem in southern Mali.

Traor¾ , D. et al. Smicronyx guineanus Voss and Sm. umbrinus Hustache (Coleoptera: Curculionidae): potential biocontrol agents of Striga hermonthica Del.) Benth. (Scrophulariaceae).

Mbwaga, A.M. Striga research in Tanzania.

Mabasa, S. and Obilana, A.B. Striga research in sorghum in Zimbabwe.

Berner et al. Striga hermonthica management in sub-Saharan Africa.

Recommendations.

The 15th Conference of the Weed Science Society of Israel, Bet Dagan, Israel, March 1998.

Abstracts of papers presented at this meeting are included in Phytoparasitica 1999. Vol. 27. Relevant papers (pp. 109-115) are:

Eizenburg, H. et al. B. Effect of carrot sowing date on parasitism of Orobanche crenata and O. aegyptiaca.

Eizenburg, H. et al. B. Effect of temperature on host-parasite relationship in Orobanche spp.

Portnoy, V.H. et al. Diagnosis of soilborne Orobanche seeds.

Goldwasser, Y. et al. Studies of the resistance of Vicia atropurpurea to Orobanche aegyptiaca.

Shomer-Ilan, A. Proteolytic activity of germinating Orobanche aegyptiaca seeds controls the degrading level of its own excreted pectinase and cellulase.

Mayer, A.M. et al. Involvement of pectinases in plant infection by parasitic weeds.

Kleifeld, Y. et al. Control of Orobanche in tomatoes with sulfonylurea herbicides.

Kleifeld, Y. et al. Selective Orobanche control with imadazolinones herbicides in various host crops.

Amsellem, Z. et al. Isolation of mycoherbicidal pathogens from juvenile broomrape plants.

Cohen, B. et al. J. Green fluorescent protein (gGFP) as a marker in a phytopathogenic fungus, Fusarium oxysporum, on Orobanche.

Joel, D.M. et al. Grafting for Orobanche resistance.

Weinberg, T. et al. Effects of herbicide inhibitors of carotenoid biosynthesis on field dodder (Cuscuta campestris).

Joel, D.M. et al. Treatment of transgenic herbicide-resistant seeds for broomrape control.

Resistance to Orobanche: The state of the art. 1999. Edited by Cubero, J.I., Moreno, M.T., Rubiales, D. and Sillero, J. Congresos y Jornados 51/99. Junta de Andalucia. Direcion General de Investigacion y Formacion Agraria, 199 pp. Contents:

Cubero, J.I. and Moreno, M.T. Studies on resistance to Orobanche crenata in Vicia faba.

Cubero, J.I. and Rodriguez, M.F. Resistance to Orobanche: genetics and breeding.

ter Borg, S. Broomrape resistance in faba bean: what do we know?

Gil, J. Resistance in Vicia sativaL to Orobanche crenata Forsk.

Sillero, J.C. et al. New sources of resistance to broomrape (Orobanche crenata) in a collection of Vicia species.

Rubiales, D. et al. Resistance to orobanche crenata in chickpea.

Khalil, S. and Erskine, W. Breeding for Orobanche resistance in faba bean and lentil.

Kharrat, M. Orobanche research activities on faba bean in Tunisia.

Rubiales, D. et al. Broomrape (Orobanche crenata) as a major constraint for pea cultivation in southern Spain.

Joel, D. Understanding the biology of broomrape is required for manipulation of host resistances.

Roman, B. and Rubiales, D. Molecular analysis of Orobanche crenata populations from southern Spain.

Manschadi, A.M. et al. VIFOR - a simulation model that aids management decisions for orobanche control.

Dominguez, J. Inheritance of the resistance to Orobanche cumana Wallr. in sunflower: a review.

Alonso, L.C. Resistance to Orobanchje in sunflower: mechanisms of resistance in the host-plant/Orobanche system.

Gonz« lez-Carrascosa, R. New races of Orobanche cumana on sunflower.

Fern« ndez-MartÍ nez, J.M. Development of broomrape resistant sunflower germplasm ultilizing wild Helianthus species.

Melero-Vara, J.M. Pathogenic variability in Orobanche cumana Wallr.

Press, M.C. Impacts of Orobanche on host source-sink relations.

Jorrin, J. et al. How plants defend themselves against root parasitic angiosperm: molecular studies with Orobanche spp.

Klein, O. et al. Potential of Phytomyza orobanchia for the biological control of Orobanche spp. and its possible application.

Salv« , A.J.P. Species of the family Orobanchaceae parasitic on cultivated plants and its relatives growing on wild plants in the south of the Iberian Peninsula.

Rubiales, D. Eating broomrape?

Availability of volumes listed in Haustorium 35:

'Advances in Parasitic Weed Control at On-farm Level' Volumes 1 and 2 are available from Margraf Verlag, P.O. Box 1205, D-97985 Weikersheim, Germany (Fax 49-79-348156; Email margraf@compuserve.com), price DM45.00 each (or approx 34 US dollars) plus postage and handling.

'Current problems of Orobanche Researches' - we have recently learnt that the Proceedings of the Albena meeting are exhausted and regrettably no longer available.

LITERATURE

Anon. 1998. Forest insect and disease conditions in the United States, 1997. USDA Forest Service, Washington. 81 pp. (Including information on Arceuthobium spp.)

Anon. 1999. Bericht 1999 Verein fò r Krebsforschung Asrlesheim Scweiz. (This annual report marks 50 years for the Hiscia Institute, where followers of Rudolf Steiner use extracts from mistletoe ('Iscador') to treat cancer. There is an article on mistletoe research as well as a helpful summary of publications including several dealing with the efficacy of mistletoe extracts in cancer treatment.)

Bannister, P., King, W.M. and Strong, G.L. 1999. Aspects of the water relations of Ileostylus micranthus (Hook.f.) Tieghem, a New Zealand mistletoe. Annals of Botany 84: 79-86. (Concluding that I. micranthus operates at higher water potentials and contents than other mistletoes and has less capacity to adjust to the water potential of its hosts - Kunzea ericoides, Ribes sanguineum, Teline monspessulana and Coprosoma propinqua.)

Berner, D.K., Schaad, N.W. and VØ lksch, B. 1999. Use of ethylene-producing bacteria for stimulation of Striga seed germination. Biological Control 15: 274-282. (In a 10-month experiment strains of Pseudomonas syringae caused germination of S. hermonthica, S. aspera and S. gesnerioides comparable to that from GR24 and superior to that from cowpea roots or ethylene gas.)

Besufekad Tadesse, Admassu Tadesse and Rezene Fessehaie. 1999. Orobanche problem in south Wollo. In: Fasil Reda and D.G. Tanner (eds.) Arem 5: 1-10. (A virulent form of Orobanche, possibly O. crenata, causes extensive and severe damage to faba bean in the Dessie district of Ethiopia, and is continuing to spread.)

Bewick, T.A. 1999. A bioherbicide for dodder: the long winding road. (Abstract) Proceedings North East Weed Science Society 53: 138. (Outlining the 15 year history of development of a fungus (Colletotrichum gloeosporioides?) from first observation to product registration in 1999.)

Bewick, T.A., Porter, J.C. and Warwick, D. 1999. Evaluation of raking as a means of mechanical control of dodder (Cuscuta gronovii L.) in cranberry. (Abstract) Proceedings North East Weed Science Society 53: 88. (Raking at flowering and/or at seed set reduced vines but failed to reduce seeding of C. gronovii (should be C. gronovii Willd., not L.) or to increase crop yield.)

Buen, L.L. de and Ornelas, J.F. 1999. Frugiforous birds, host selection and the mistletoe Psittacanthus schiedeanus, in central Veracruz, Mexico. Journal of Tropical Ecology 15: 329-340. (Liquidamber styraciflua was main host species, apparently because most visited by the three bird species responsible fro spread. Other hosts included Persea americana and Crataegus mexicana.)

Choudhury, N.K. and Sahu, D. 1999. Photosynthesis in Cuscuta reflexa: a total parasite. Photosynthetica 36(1/2): 1-9. (Reviewing the photosynthetic structures and processes in C.reflexa.)

Cornell, S.J., Desdevises, Y. and Rigby, M.C. 1999. Evolutionary biology of host-parasite relationships: reality meets models. Trends in Ecology and Evolution 14: 423-425. (Reporting on a workshop of the same title, held in France in May, 1999, to be published by Elsevier in 2000. Relevance of contents to parasitic plants not known.)

Cubero, J.I., Moreno, M.T., Rubiales, D. and Sillero, J. (Eds.) 1999. Resistance to Orobanche: The State of the Art. Congresos y Jornados 51/99. Junta de Andalucia. Direcion General de Investigacion y Formacion Agraria, 199 pp. (Proceedings of a meeting held in Cordoba in December, 1998 including 22 mostly quite short papers - see list of contents above.)

Dhopte, A.M. 1998. Inhibition of Cuscuta growing on Parthenium. Annals of Plant Physiology 12(1): 80-81. (Cuscuta 'sp.' apparently unable to survive on P. hysterophorus.)

Dzomeku, I.K. and Murdoch, A.J. 1999. Implications of seed dormancy for control of Striga hermonthica in Ghana. The 1999 Brighton Conference - Weeds, pp. 573-574. (Reporting the effects of temperature and moisture on conditioning and germination of S. hermonthica.)

Dutukner, I. 1999. (A study on the morphological features of Loranthaceae family within the Marmara region.) (in Turkish) Turkish Journal of Agriculture and Forestry 23(Suppl. 4): 983-989. (Giving distribution and host plants of Viscum album, Loranthus europaeus and Arceuthobium oxycedri.)

Efthymiou, M.L. 1999. (Toxicity of berries in public amenities. Species and their associated actions.) (in French) Dossier: Espaces verts. Phytoma 517: 28-29. (Listing Viscum album as having moderate toxicity.)

Gosheh, H.Z., Hameed, K.M., Turk, M.A. and Al-Jamali, A.F. 1999. Olive (Olea europea) jift suppresses broomrape (Orobanche spp.) infections in faba bean (Vicia faba), pea (Pisum sativum), and tomato (Lycopersicon esculentum). Weed Science 13: 457-460. (Jift, a solid by-product of olive oil processing incorporated at 25% of soil reduced O. crenata on faba bean and pea, and O. lavandulacea on tomato.)

Gressel, J. 1999. Herbicide resistant tropical maize and rice: needs and biosafety considerations. The 1999 Brighton Conference - Weeds, pp. 637-645. (Reviews progress so far with use of herbicide-resistant maize in control of Striga and outlines future possibilities for use of transposons in a programme of debilitation of Striga. See extract above under 'TAC-TICs for Striga control'.)

Gurney, A.L., Press, M.C. and Scholes, J.D. 1999. Infection time and density influuence the response of sorghum to the parasitic angiopserm Striga hermonthica. New Phytologist 143: 573-580. (Variety Ochuti, grown in infested and non-infested soil following fumigation, showed less damage than var. CSH-1: this was associated with delayed emergence of the parasite and attributed at least partly to delayed attachment. The latter was not directly demonstrated but pot experiments confirmed it could be important.)

Hammerschmidt, R. 1999. Induced disease resistance: how do induced plants stop pathogens? Physiological and Molecular Plant Pathology 55: 77-84. (No mention of parasitic higher plants but useful commentary on latest understanding of the processes involved.)

Hess, D.E. and Lenn¾ , J. (eds) 1999. Report on the ICRISAT Sector Review for Striga Control in Sorghum and Millet. ICRISAT-Bamako, Mali, May, 1996. (A belated compilation - see contents under Proceedings of Meetings above.)

Hibberd, J.M., Quick, W.P., Press, M.C., Scholes, J.D. and Jeschke, W.D. 1999. Solute fluxes from tobacco to the parasitic angiosperm Orobanche cernua and the influence of infection on host carbon and nitrogen relations. Plant, Cell and Environment 22: 937-947. (Carbon fixation 20% higher in infected than in uninfected tobacco. 80-90% of N, K, Na and S derived via the phloem; only Mg mainly from xylem. Plus much more on N metabolism, etc.)

Hudu, A.I. and Gworgwor, N.A. 1998. Preliminary results on evaluation of trap crops for Striga hermonthica (Del.) Benth. control in sorghum. International Sorghum and Millet Newsletter 39: 118-121. (In pots, growing bambara groundnut or sesame with sorghum markedly reduced S. hermonthica numbers and increased crop vigour: soyabean, cotton, sunflower and okra also showed moderate benefits.)

IITA. undated. Research highlights, Project 8. Integrated Management of Striga and other parasitic plants. Annual Report 1998 International Institute for Tropical Agriculture, pp. 55-56.

Karunaichamy, K.S.T.K., Paliwal, K. and Arp, P.A. 1999. Biomass and nutrient dynamics of mistletoe (Dendrophthoe falcata) and neem (Azadirachta indica) seedlings. Current Science 76: 840-842, (Concentrations of N, P, K, Mg, Na, and Ca all higher in the parasite than in the host. Prolonged infestation resulted in death of the host, and parasite.)

Kebreab, E. and Murdoch, A.J. 1999. A model of the effects of a wide range of constant and alternating temperatures on seed germination of four Orobanche species. Annals of Botany 84: 549-557. (Optimum temperatures for O. cernua, O. crenata, O. aegyptiaca and O. minor all in range 18-21oC. Alternating temperatures tend to reduce germination, due to adverse effect of higher temperatures.)

Klein, O. and Kroschel, J. (eds.) 1999. Rappport final d'activit¾ s du projet suprar¾ gional Ecologie et Gestion des Plantes Parasites 1992-1999. Description du projet, r¾ sum¾ des activit¾ s, recommandations et liste de publications. Projet suprar¾ gional Ecologie et Gestion des Plantes Parasites, Fès, Morocco, 136 pp. (Including 19 technical chapters, mainly on Orobanche but one on Cuscuta, covering survey, research, development and extension of techniques involving herbicides,cultural and biological control.)

Kuiper, E., Groot, A., Noordopver, E.C.M., Pieterse, A.H. and Verkleij, J.A.C. 1998. Tropical grasses vary in their resistance to Striga aspera, Striga hermonthica, and their hybrids. Canadian Journal of Botany 76: 2131-2144. (14 wild grass species all caused germination of both Striga spp but some showed resistance after attachment. The two species varied in their host range, while hybrids were intermediate in behaviour.)

Kunjo, E.M. and Murdoch, A.J. 1999. Integration of socio-economically appropriate management strategies for Striga hermonthica in The Gambia. The 1999 Brighton Conference - Weeds, pp. 575-576. (Tethering livestock on infested fields shown to be especially helpful.)

Lavorel, S. Smith, M.S. and Reid, N. 1999. Spread of mistletoes (Amyema preissii) in fragmented Australian woodlands: a simulation study. Landscape Ecology 14: 147-160. (Results support the hypothesis that fragmentation of Acacia woodlands in Northern Territory promotes infestation of A. preissii, assisted by the mistletoe bird Dicaeum hirundinaceum.)

Lei, S.A. 1999. Age, size and water status of Acacia greggii influencing the infection and reproductive success of Phoradendron californicum. American Midland Naturalist 141: 358-365. (P. californicum most abundant on older, larger trees. Infestation resulted in increased water stress.)

Looney, M.M. 1998. Differentiation of mistletoes (Santalales) on the basis of geographical origin. Texas Journal of Science 50: 315-326. (Results of gas chromatographic analysis of extracts from Phoradendron tomentosum and P. serotinum suggested this technique could be of taxonomic value.)

Lu YunHai, Gagne, G., Grezes-Besset, B. and Blanchard, P. 1999. Integration of a molecular linkage group containing the broomrape resistance gene Or5 into an RFLP map in sunflower. Genome 42: 453- 456. (Showing that the Or5 linkage group could be integrated with the linkage group 17 of the GIE Cartisol RFLP map.)

Maiti, A. and Chauhan, A.S. 1998. A preliminary census on the host-plants of Cuscuta reflexa Roxb. in Gangtok, Sikkim. Indian Journal of Forestry 21: 267-269. (Host plants included 53 species in 27 families, including some young woody species but no fully grown trees.)

Matiyas Mekuria. 1999. Major weed species in the Southern Nations, Nationalities and Peoples Region. In: Fasil Reda and D.G. Tanner (eds.) Arem 5: 11-13. (Striga asiatica widespread and damaging in Konso and Derashe districts in S. Ethiopia.)

Matthies, D. and Egli, P. 1999. Response of a root parasite to elevated CO2 depends on host type and soil nutrients. Oecologia 120: 156-161. (Complex interactions recorded between Rhinanthus alectrolophus, Lolium perenne and Medicago sativa, grown in all combinations and at different levels of nutrient and CO2. The presence of the parasite reduced the total productivity of the system, regardless of CO2 level: growth of all components, especially the parasite, increased by high CO2 level, but only at high nutrient level.)

Mika, J.S. and Caruso, F.L. 1999. The use of Colletotrichum gloeosporioides to control swamp dodder (Cuscuta gronovii Willd.). (Abstract) Proceedings North East Weed Science Society 53: 56. (C. gloeosporioides more pathogenic than C. acuatum.)

Mukherjee, A. and Banerjee, G. 1999. Ecological studies on the forests of Midnapore district, West Bengal: assessment of angiospermic parasites. Environment and Ecology 17(1): 214-221. (14 parasite spp. of 5 families identified in Shorea robusta forest, among which Dendrophthoe falcata the most important.)

Neumann, U. 1999. (Ontogenetic, structural and immunocytochemical investigations of haustoria of three African parasitic Scrophulariaceae.) (in French) PhD Thesis Universit¾ Pierre et Marie Curie, Paris. Volume 1; 144 pp, Volume 2; 44 plates. (Studies on Striga hermonthica, Buchnera hispida and Rhamphicarpa fistulosa. See other listings, e.g. the following, for detail.)

Neumann, U., Vian, B., Weber, H.C. and Sall¾ , G. 1999. Interface between haustoria of parasitic members of the Scrophulariaceae and their hosts: a histochemical and immunocytochemical approach. Protoplasma 207: 84-97. (Studies in all three species (see above) suggest that, even in susceptible hosts, there are defence reactions in the form of lignin, phenolics and HRGPs.)

Norton, D.A. and de Lange, P.J. 1999. Host specificity in parasitic mistletoes (Loranthaceae) in New Zealand. Functional Ecology 13:552-559. (Host range was narrowest for Alepis flavida, Peraxilla colensoi and P. tetrapetala (mainly on Nothofagus spp.) widest for Tupeia antarctica (on a wide range of hosts), intermediate for Ileostylus micrantha. Degrees of host specificity discussed in relation to relative host availability.)

Norton, D.A. and Smith, M.S. 1999. Why might roadside mulgas be better mistletoe hosts? Australian Journal of Ecology 24: 193-198. (Acacia aneura along roadsides more heavily infected by mistletoes , apparently associated with higher foliar water content.)

Nun, N.B., Mor, A. and Mayer, A.M. 1999. A cofactor requirement for polygalacturanose from Cuscuta reflexa. Phytochemistry 52: 1217-1221.

Obilana, A.B. 1998. Sorghum improvement. International Sorghum and Millet Newsletter 39: 4-17. (Screening in Botswana, Zimbabwe and Tanzania gave promising indications of Striga resistance in SAR lines 16, 19, 29, 33 and 35, but yields were poor.)

Pronier, I., Par¾ , J., Vincent, C. and Sall¾ , G. 1998. Impact of Smicronyx spp. (Coleoptera: Curculionidae) on fruit development of the parasitic weed Striga hermonthica (Scrophulariaceae): histological study and prospects for biological control. Acta Biologica Cracoviensia. Series Botanica 40: 9-13. (Observing development of galls with or without larval development, and sometimes larval development without formation of galls.)

Pundir, Y.P.S. and Dhan Singh. 1998 More unrecorded hosts of Scurrula pulverulenta (Wallr.) G.Don (Loranthaceae) from Doon Valley and adjacent areas. World Weeds

5(1/2): 147-148. (S. pulverulenta recorded vigorous on Colebrookea oppositifolia but weak on Bauhinia retusa.)

Rao, P.N., Neelai, K.K. and Basava Raju, G. 1999. Quisqualis indica L.; a reliable biosuppressor of the parasite China dodder, Cuscuta chinensis Lamarck. Abstracts, 8th Biennial Conference of the Indian Society of Weed Science, Varanasi, 1999, p. 136. (The ornamental climber Q. indica is resistant to C. chinensis and apparently reduces its spread.)

Rao, P.N., Neelai, K.K. and Basava Raju, G. 1999. Certain interesting aspects of utility of the parasitic weed Cuscuta chinensis Lamarck. Abstracts, 8th Biennial Conference of the Indian Society of Weed Science, Varanasi, 1999, p. 152. (Analysis of C. chinensis indicated ascorbic acid, alkaloids and a flavoured oil of conceivable commercial value.)

Robert, S., Dubreuil, D., Simier, P., Praderre, J-P and Fer, A. 1999. Inhibition studies on mannose 6-phosphate reductase purified from Orobanche ramosa. Carbohydrate Letters 3: 231-238.

Seel, W.E. and Jeschke, W.D. 1999. Simultaneous collection of sap from Rhinanthus minor and the hosts Hordeum and Trifolium: hydraulic properties, xylem sap composition and effects of attachment. New Phytologist 143: 281-298. (Hydraulic resistance high in unattached R. minor; much lower when attached to H. vulgare or T. alpestre, showing improved access to water. Asparagine the main amino acid transferred from host to parasite: this is naturally present in T. alpestre, but is induced in H. vulgare. Plus lots more.)

Sherman, T.D., Pettigrew, W.T. and Vaughn, K.C. 1999. Structural and immunological characterization of the Cuscuta pentagona L. chloroplast. Plant Cell Physiology 40: 592-603.

Stein, G.M., Schaller, G. Pfò ller, U., Wagner, M., Wagner, B. Schietzel, M and Bò ssing, A. 1999. Characterisation of granulocyte stimulation by thionins from European mistletoe and from wheat. Biochimica et Biophysica Acta, General Subjects 1426(1) 80-90.

Taylor, G.S. 1999. New species of Acizzia Heslop-Harrison (Hemiptera: Psyllidae) from Australian mistletoe (Loranthaceae). Australian Journal of Entomology 38(2): 66-71. (Three new species described, from Amyema spp. on eucalypts, but not on Acacia.)

Thomas, H., Sauerborn, J., Mò ller- StØ ver, D. and Kroschel, J. 1999. Fungi of Orobanche aegyptiaca in Nepal with potential as biological control agents. Biocontrol Science and Technology 9: 379-381. (21 fungal species of 12 genera isolated from O. aegyptiaca on mustard and tobacco, Fusarium spp. being the commonest. No results yet on pathogenicity.)

Thomas, H., Sauerborn, J., Mò ller- StØ ver, D., Ziegler, A., Bedi, J.S. and Kroschel, J. 1998. The potential of Fusarium oxysporum f.sp. orthoceras as a biological control agent for Orobanche cumana in sunflower. Biological Control 13: 41-48. (Pot experiments confirm damaging effects of F. oxysporum applied either pre-planting or post-emergence but most beneficial response of sunflower followed pre-planting inoculation of the soil. O. aegyptiaca was not damaged.)

Wigchert, S. 1999. Chemical studies on germination stimulants for seeds of the parasitic weeds Striga and Orobanche. PhD Thesis University of Nijmegen, Netherlands. 135 pp. (Including studies on the mechanism of action of sorgolactone, the range of activity of GR24 and Nijmegen 1, and detail of the synthesis and relative activity of stereoisomers of sorgholactone and GR-24. An impressive volume of work

Wilson, J.P., Hess, D.E., Ciss¾ , B., Hanna, W.W. and Youm, O. 1998. Striga hermonthica infection of wild Pennisetum germplasm is related to timing of flowering and downy mildew incidence. International Sorghum and Millet Newsletter 39: 149-150. (S. hermonthica emergence on 275 accessions of P. glaucum in the field were lower on early maturing lines and those with downy mildew infection.)

Wondimu WoldeHanna, Shemelis Hassen and Ayenalem Ayele. 1999. The distribution of Striga in Oromia region. In: Fasil Reda and D.G. Tanner (eds.) Arem 5: 75-84. (Striga spp., especially S. hermonthica continuing to spread in eastern Ethiopia.)

Yohannes Lemma, Taye Tessema, Ransom, J.K. and Beayneh Admassu. 1999. Incidence and distribution of Striga on maize in Ethiopia. In: Fasil Reda and D.G. Tanner (eds.) Arem 5: 66-74. (The first systematic survey of Striga on maize in Ethiopia reveals generally high and increasing infestations, mainly of S. hermonthica.)

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Preparation of this issue and maintenance of the website have been assisted by John Terry, Harry Anderson, Michail Semenov and others at Long Ashton Research Station, Bristol, UK.

Those interested in membership of a new International Parasitic Plant Society please send the following form to:

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