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MESSAGE FROM IPPS PRESIDENT

Dear IPPS Members,

Parasitic plant researchers are interested in both applied and basic aspects of these peculiar plants, i.e. biological aspects and practical aspects related to their management. Obviously the two are mutually linked and by handling them together we allow accelerated progress in both. Indeed, parasitic plant research is currently developing very rapidly thanks to the availability of novel methods in molecular biology.

Among others, three main aspects are under detailed investigation: (a) the taxonomic position of parasitic plants, leading to reassessment of the phylogenetic understanding of the main parasitic plant groups; (b) 'horizontal gene transfer', i.e. the possibility that genes are transferred through the haustorium during host-parasite interaction, and (c) analysis of gene expression during host-parasite interaction in both compatible and incompatible interactions. All these aspects were dealt with during the Botanical Congress in Vienna last summer, and represent the ongoing attempt to understand plant parasitism and to find novel ideas for the management of those parasites that cause economic losses due to their weedy habit.

Yet some important aspects of parasitic weed management seem to be overshadowed by the new developments, and thus neglected by farmers and agricultural authorities. These are the 'primitive' approaches that limit seed transfer from infected areas and avoid seed import into non-infested areas. The gradual expansion of areas infested with various parasitic weeds like broomrape, witchweed, dodder and mistletoe definitely needs closer attention, and therefore, the recent COST849 workshop was dedicated to this subject, dealing

with means for limiting *Orobanche* propagation and dispersal in agricultural fields.

Whereas scientific collaboration is essential for rapid progress in research, international cooperation is essential for limiting parasitic plant dispersal. While recognizing the usefulness of international cooperation in controlling parasitic weeds and in preventing their spread, and especially their introduction across national boundaries, we should ensure close coordination of measures directed to these ends, and act, each in his or her own country, to convince the local authorities on the necessity to implement sanitation measures against parasitic weeds locally and worldwide, to discuss the parasitic plant problem with Plant Protection Organizations (like EPPO, SEAPPO and NAPPO), and to coordinate the efforts among all countries to protect plant resources from the entry, establishment and spread of parasitic weeds.

The next IPPS Congress, which is due for 3-7 June 2007 in Charlottesville, Virginia (USA) will deal with all aspects of parasitic plants, whether weedy or native, and discuss both aspects of their biology and their management. A special session will be dedicated to the prevention of parasitic weed dispersal. The first circular will soon be issued and we are looking forward to your participation in this important event. Please plan to attend this meeting.

All parasitic plant researchers are encouraged to contact me or any member of the Executive Committee with concerns about the society or items that you would like to see addressed, including suggestions regarding the IPPS Congress. The society will remain strong if it meets the needs of its members.

Danny Joel, IPPS president
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LITERATURE HIGHLIGHT – GENE THIEVES, GENE DONORS

Parasitic plants have a growing reputation as thieves. Not only do they steal water and other resources from their hosts, it now seems clear that they are taking genes as well. This issue of *Haustorium* contains two literature items dealing with the transfer of genes between parasitic plants and their hosts (See Davis *et al.*, 2005; Davis and Wurdack, 2004). In addition, the previous issue of *Haustorium* listed an article on this same subject (Mower *et al.*, 2004).

Evidence for horizontal gene transfer (HGT) involving parasitic plants comes from phylogenetic studies based on gene sequences. In the case of Rafflesiaceae, the genes *matR* and *PHYC* (representing mitochondrial and nuclear genomes, respectively) place it solidly in the Malpighiales, while another mitochondrial gene, *nad1B-C*, strongly supports its placement in the host's family, Vitaceae (Davis and Wurdack, 2004). When viewed in the context of morphological evidence, it appears that the *nad1B-C* gene must have been obtained from a host and incorporated into the parasite's genome at some point in evolutionary history.

On the other hand, parasites may also be giving up genes to their hosts. HGT seems to occur in both directions, as members of the Plantaginaceae contain copies of a mitochondrial gene (*atp1*) that are very similar to those in Orobanchaceae or *Cuscuta* parasites (Mower *et al.*, 2004). The latest example involves a fern that has acquired genes from a parasitic flowering plant. In this case, two mitochondrial genes (*matR* and *nad1B-C*) from the rattlesnake fern (*Botrychium virginianum*) appear to have moved in a single event from the Santalales (Davis *et al.*, 2005).

HGT is not unique to interactions involving parasitic plants. Mitochondrial genes have been shown to move widely among plants without limitation by normal mating barriers (Bergthorsson *et al.*, 2003). The mechanism by which HGT occurs remains unknown, and while viruses, bacteria, fungi, and insects have been proposed as potential vectors, the direct connections between parasitic plants and their hosts offers the simplest explanation. Recently, the nonparasitic, tropical shrub *Amborella trichopoda* has been hailed as the greatest gene thief among flowering plants, containing at least 26 foreign genes (Bergthorsson *et al.*, 2004). As research on HGT expands, it will

be interesting to see how parasitic plants compare to their nonparasitic counterparts.

On a related subject, a recent article by Randle and Wolfe (2005) suggests that the parasite *Hyobanche* (Orobanchaceae) absorbs the large subunit of Rubisco from its host. In this case, it is the protein that appears to move rather than the gene (*rbcL*). Rubisco protein was detected in the parasite despite the finding that the *Hyobanche rbcL* genes are non-functional and should not produce a complete protein.

All of this work raises questions about host-parasite connections and the transfer of materials among species. But one thing is clear; these plants are known thieves and we will need to keep a close watch on them.

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- Jim Westwood, Virginia Tech, Blacksburg, USA. westwood@vt.edu

OROBANCHE CRENATA IN ETHIOPIA**An emerging, formidable challenge to rural communities in northern Ethiopia.**

Initial infestation of *Orobanche crenata* was first reported in the late 1980s from a remote locality of south Wello region in northern Ethiopia. Immediately following the report, controversy ensued between different organizations over the exact identity of the parasitic weed. In the mid 1990s, however, it was confirmed that Ethiopia was, yet again, up against one of the dreaded scourges known in agriculture - *Orobanche crenata*. It has become increasingly difficult to grow pulse crops, the main source of dietary protein and cash for local farmers, economically, especially in the two badly hit districts of Kedijo and Kutaber.

According to elderly farmers, the weed was introduced via relief food aid during the famous Ethiopian famine in the mid 1980s. Faba bean and field pea were the two most susceptible hosts but the host range appeared to expand rapidly. After some time grass pea (*Lathyrus sativus*), lentil and chickpea succumbed to the pest. Chickpea, particularly, was until recently considered to be a suitable break crop. Complete crop failure of faba bean and field pea is now a common occurrence in the above two districts. As a result the land allocated to wheat is increasing in recent years since faba bean cultivation is scaled down because of the threat. The decline in faba bean production is depriving tef of a suitable rotation crop leading to progressively lowering yield performance of the latter.

The level of damage is already enormous for the small farmers affected but the impact that this noxious weed could potentially have on the country at large is even far greater if collective action is not taken to arrest the spread. Unconfirmed reports suggest that the infestation already affects many thousand hectares and that the weed was spotted further afield in south Tigray, Gonder and north Shewa, approximately in a 300 km radius from its origin. If this is true, it means the problem is getting out of hand and beyond the means of the country to launch an effective containment strategy.

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CUSCUTA SPP. IN INDIA

The genus *Cuscuta*, a stem parasite with branched climbing stem, is comprised of about 175 species world-wide. Of these, 12 species are reported from India. One of these species is severely infesting field crops such as niger (*Guizotia abyssinica*), blackgram (*Vigna mungo*), greengram (*Vigna radiate*), lentil, chickpea and linseed. However, there has always been confusion about the correct identification of the species. In most of the Indian literature, it is mentioned as *Cuscuta* spp. and in few cases, as *Cuscuta chinensis*. To identify the species correctly, *Cuscuta* seeds were collected from niger (Orissa), lucerne (Gujarat), blackgram/greengram (Andhra Pradesh) and linseed (Madhya Pradesh) and grown in pots with host plants. Photographs of *Cuscuta* vines, flowers, fruits and seeds were taken and sent to Mr. Chris Parker, U.K. and Dr. Lytton Musselman, Parasitic Plant laboratory, Virginia, USA for identification of the species of *Cuscuta*. Both of them unanimously identified the species as *Cuscuta campestris* Yuncker due to following reasons.

‘Capsules not circumscissile, corolla lobes are not keeled, the withered corolla is at the base of most of the capsules, lobes of calyx and corolla not thickened at their tips, filaments broadest at base, tapering distally’.

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INTEGRATED STRIGA MANAGEMENT

A pilot project on integrated *Striga* management (ISM) was conducted in Eastern Africa during the last three years. The project, deployed in Ethiopia, Eritrea, and Tanzania focused on the evaluation, through a farmer participatory approach, of the effect of combining multiple control options in reducing crop damage caused by *Striga*. The agronomic rationale for the pilot project was based on the belief that increased crop productivity and a more enhanced control of the parasitic weed, *Striga*, can be achieved by the synergistic combination of *Striga* resistant crop cultivars with one or more additional agronomic practices. Because damage caused by parasitic weeds is more severe on crops already under stress, we reasoned that an ISM package that integrates host plant resistance, soil fertility enhancement, and a water conservation measure will encourage a synergistic response that is greater than the sum of its

components. Our ISM package therefore includes tied-ridging (where crops are planted on ridges and these ridges are tied together with other small ridges that run perpendicular to the crop rows and serve to hold rain water), nitrogen fertilizers (organic or inorganic sources), and a range of our *Striga* resistant varieties. We reasoned that the additional moisture captured through tied ridging would enhance fertilizer response, which in turn promotes not only better plant growth, but (at the right dose) may also help with *Striga* control. Subsistence farmers often find cost of inputs unaffordable unless a better return to their investment is assured. The objectives of this project, therefore, was 1) to promote a technology package that offers an effective control of *Striga*; 2) to establish a community-based, entrepreneurial seed production activity, and 3) to increase profitability for farmers involved in the ISM project by promoting new markets and products for a sustainable use of the ISM package.

In each country, impressive field responses were obtained in *Striga* control and in generating farmer enthusiasm and acceptance through the ISM package. However, interest in seed production and distribution as well as emergence of opportunities for market development varied in the three countries. Where effectively deployed, crop yields have been increased and *Striga* infestation reduced very dramatically. Sorghum grain yields as high as 5 tons per hectare were recorded in some farmers' plots that received the ISM package. In contrast, under severe *Striga* infestation, some of the local sorghum landraces grown with no input and only the local practice of hand weeding failed totally with no measurable yield recorded. The ISM package proved successful having been adopted by thousands of farmers in these three countries. In Ethiopia alone, over 6000 organized demonstrations have been conducted. Both governmental and non-governmental organizations (NGOs) participated in input distribution and testing. Over 100,000 farm families received seed of *Striga* resistant varieties via these channels of distribution and informal exchange with fellow farmers. Inputs (seed, fertilizers, and tied-ridging implements) were given for free to farmers initially, but participants were required to purchase inputs in subsequent seasons. Seed production has been targeted either through national seed programs or by organizing farmers into seed-growing cooperatives. In some cases, parastatal seed programs have taken up production of sorghum seed as a result of the significant farmer demand and interest in the *Striga* resistant sorghum varieties. Success in our attempts to develop market opportunities has been mixed, however. The

greatest promise is in Tanzania where a local brewery has the capacity to purchase as much sorghum as can be made available if quality standards can be met. Currently, the brewery imports sorghum from South Africa. An organized body of stakeholders, the National Sorghum Forum in Tanzania, has recently succeeded in convincing the Government of Tanzania to also buy sorghum into the National Strategic Food Reserve, which provides an outlet for technology-adaptive farmers who often find themselves with low demand and collapsed farm prices at times of harvest. In Ethiopia, a local cookie factory has shown interest in adding sorghum in a composite flour mix if guarantees can be made for a uniform and acceptable quantity of grain on a regular basis. The biggest challenge, therefore, is in working with local authorities and non-governmental agencies in helping organize and empower farm communities so they can begin to participate and catalyze events and activities beyond the farm that often affect their livelihood.

The project was funded by the USAID Office of Foreign Disaster Assistance via INTSORMIL.

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BALANOPHORACEAE IN BRAZIL

During field work, we literally stumbled on an important discovery: a population of the little known *Lathrophytum peckoltii* Eichler, a monotypic genus, until then only found in the Atlantic Rain Forest, more precisely in the forests of Rio de Janeiro City. Its occurrence was lately confirmed in the Cerrado (states of Goiás and Minas Gerais).

These ecosystems represent two of the most endangered hotspots of the world. This taxon was very rarely collected since its discovery in 1867. The generic name comes from the Greek and its exact meaning is precisely "hidden-plant". The epithet is in honor of the Peckolt brothers, pharmacists and collectors of the type specimen. In 2004, for the first time, a population was photographed and collected for scientific studies. Forty three years elapsed since the last time it had been collected. Before that it had completely disappeared for 75 years. Hansen (1972) had considered it extinct because of the disappearance

of its habitat. *Lathrophytum* is very similar to *Ombrophytum*, except its androecium is the most reduced of all neotropical taxa. The inflorescence has a honey-like smell and was photographed being visited by bees and ants. The ants take almost all the anthers, probably pollinating some flowers on the way down. This population is being monitored and will soon be the subject of research on its biology. In 2004 another species was described to Brazil, *Lathrophytum rizzoi* Delprete, based on a collected material from the 1960's. Nowadays no population of this species is known. Brazil now has a count of 13 taxa of Balanophoraceae: one genera and four species of which are endemic to this country. Pictures of this and other Brazilian taxa can be found on the Parasitic Plant Connection website. This site also hosts probably the first *in loco* of *Scybalium glaziovii* Eichler, obtained in consecutive years in its type locality, the exuberant forest on Serra do Mar, on the Macaé de Cima Ecological Reserve in the state of Rio de Janeiro.

Once again allow me to reaffirm our wish to obtain material of taxa of Balanophoraceae that do not occur in Brazil, and the willingness of the herbarium of Rio de Janeiro Botanic Garden (RB) to trade duplicates of species that occur in our territory.

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RETIREMENT – JOS VERKLEIJ

Dr Jos Verkleij retired this month after a long and successful career in plant science which has included many studies on parasitic plants and involvement in the setting up of IPPS. A Symposium in his honour was held on Friday 27 January 2006. Presentations included several relating to metal tolerance in plants as well as:

Harro Bouwmeester (PRI, Wageningen) -
Underground communication between host and parasitic plant.

THESES

Bipana Devi Acharya (Ph.D., BRA Bihar University, India, December, 2004)
Studies on control of *Orobanche aegyptiaca* Pers. by crop rotation using trap and catch crops.
(Supervision: Dr S.C. Srivastava, Dr G.B. Khattri)

In Nepal, there are two agronomically important *Orobanche* species, *O. aegyptiaca* and *O. cernua* causing a threat to a range of important crops, particularly, tori (*Brassica campestris* var. *toria*), sarson (*Brassica campestris* var. *sarson*), rayo (*Brassica juncea*) and tobacco (*Nicotiana tabaccum*), grown in the plains (Terai) and dun valleys (Inner Terai). *O. aegyptiaca* attacks all four crops while *O. cernua* attacks solanaceous crops only.

The primary objective of the study was to search for trap crops for use in crop rotation in order to decrease the parasite seed bank in tori fields infested by *O. aegyptiaca*. Another objective was to evaluate tori as a catch crop.

In preliminary screening, 27 crop and fodder species were tested in the laboratory but only twelve could stimulate germination of *O. aegyptiaca*. Among these only cumin, radish and vetch allowed parasite attachment, while only cumin and radish supported further development.

Pot and field experiments were conducted for two years in soil naturally infested with *Orobanche aegyptiaca* to evaluate effects of 22 non-host crops on the *Orobanche* seed bank and seed viability. The two sites chosen were located in highly *Orobanche* infested areas of Nawalparasi district, an Inner Terai region of Central Nepal. *Orobanche* seed density in soil samples collected from pot/plot before planting and after harvest of each crop species was recorded using a technique slightly modified from that proposed by Ashworth, 1976 (Plant Disease Reporter 60: 380-383). Pre-plant and post-harvest data were compared in order to assess the effects of the test crops on *Orobanche* seed density. On this basis the investigated crop species could be classified into three categories: a) Highly potential trap crops: radish, lentil, linseed, fennel and cumin: b) Moderately potential trap crops: barley, onion and chickpea: and c) Non-potential trap crop: garlic, chilli, coriander, buckwheat, sunflower, French bean, pea, egg plant, potato, fenugreek, wheat and faba bean.

For the study of seed viability, *Orobanche* seed bags prepared in muslin cloth were buried 10 cm deep in the soil of all pots/ plots including fallow. The seed bags were kept buried in the soil throughout the crop season. The viability of the seeds was tested according to the method of

Aalders and Pieters, 1986 (in: S. J. ter Borg (ed.). Proceedings of a Workshop on Biology and Control of *Orobanche*. Wageningen, Netherlands: 140-149). Significant reduction in viability was found only under radish, lentil, chilli, fennel, barley, egg plant, maize, onion and fenugreek crops (cumin was not included in field trials).

The loss of viability in test crop treatments was greater than in control treatments, indicating that most of the non-host crops possess the ability to reduce *Orobanche* seed viability, although, the degree of reduction may vary from crop to crop. Viability loss was mainly due to germination induced by trap crops, but could also be due to soil factors and attack by soil microorganisms. Hence, the study suggests the option of using non-host crops in the crop rotation for reducing *Orobanche* seed density, rather than leaving *Orobanche* infested fields uncultivated.

A two-year field study was conducted at both experimental sites to evaluate effectiveness of tori plants as a catch crop. Tori was chosen due to following reasons: a) it is a one of the most ideal hosts of *O. aegyptiaca* in Nepal, b) it is easily and quickly grown, c) its cost of cultivation is low, d) the soil moisture regime needed for the crop is usually supplemented by winter rain d) prevailing temperature during the cropping period remains ideal for tori and *Orobanche* seed germination and, e) it could easily be sold in the local market as a green vegetable.

Two successive crops of tori were grown in each field. The first crop was planted at the usual sowing date (third week of October) and harvested in the third week of January, when *O. aegyptiaca* plants were flowering. The second crop was planted immediately after the harvest of the first crop. When the tori plants in the second crop were 1 month old (early flowering stage), they were harvested as green vegetable. At this stage *O. aegyptiaca* was at the early attachment stage – pre-caulome and tubercle, less than 5 mm in size. Soil samples were collected during pre-plant and post-harvest stages of each crop. *Orobanche* seed bank in soil samples was estimated as mentioned earlier.

On the basis of results obtained in the study, it can be said that, in spite of increased tori plant density in succeeding treatments, parasitization of the weed fail to increase. However, the reduction of the weed seed bank progressed with the increase of tori plant density. This seemed to have indicated that emergence of the parasite was depended not on host

plant density but on population of parasitic seeds in the soil.

The second tori crop further decreased the parasitic seed bank, which was harvested in early flowering stages for vegetable uses. The climatic conditions, importantly temperature and soil moisture regimes were suitable for the growth of host plant and for *Orobanche* seed germination. From this study it can be concluded that the tori crop possesses all the necessary characteristics to be an ideal catch crop for the reduction of *Orobanche* seed bank.

Finally, it could be concluded that the inclusion of any of the crops listed as potential trap crops (radish, linseed, lentil and fennel) in crop rotation followed by the use of tori as a catch crop in the same field will be an effective measure to reduce *Orobanche* seed bank significantly in infested fields. The measures will be important components of an integrated management of *Orobanche* in our agronomic conditions.

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Jonne Rodenburg (PhD, Wageningen University, Wageningen, The Netherlands, October, 2005)
The role of sorghum genotype in the interaction with the parasitic weed *Striga hermonthica*.
 (Supervision, Martin Kropff)

This thesis presents a study on the interaction between the parasitic weed *Striga* (*S. hermonthica* [Del.] Benth.) and the cereal crop sorghum (*S. bicolor* [L.] Moench). Its main objective was to find suitable measures for the selection of breeding material (crop genotypes) with superior levels of resistance or superior levels of tolerance to *Striga*. To meet this objective the physiological background of tolerance, the relation between *Striga* infestation, infection and yield loss and the effect of host genotype on *Striga* parasitism and reproduction were studied.

These host-parasite interactions were studied with 4-10 different sorghum genotypes differing in level and mechanism of defence against *Striga*. Field experiments carried out in Mali were used for yield assessments and development and validation of selection measures. Through pot and agar-gel experiments, aboveground resistance measures were validated with observations on below ground stages. Pot experimentation was also used to create infection response curves and to measure

photosynthesis and chlorophyll fluorescence to develop tolerance measures.

Striga parasitism and reproduction, and the detrimental effect of *Striga* on crop yield can significantly be reduced through crop genotype choice. Maximum aboveground *Striga* number is a reliable selection measure for resistance. *Striga* flower stalk dry weight can be used to identify genotypes that reduce *Striga* reproduction. The maximum relative yield loss is a suitable selection measure for tolerance in susceptible genotypes, while for more resistant genotypes the relative yield loss per *Striga* infection seems more appropriate. For these tolerance measures, yield assessment of nearby uninfected controls is indispensable. Chlorophyll fluorescence, more precisely photochemical quenching and electron transport rate, may enable screening for tolerance without this requirement.

Sara Fondevilla (PhD, Córdoba University, Córdoba, Spain, June, 2005)

Resistance to crenate broomrape (*Orobanche crenata*) and foliar diseases in pea (Supervision, Diego Rubiales, Ana M^a Torres, Zlatko Satovic)

In this PhD different studies were conducted on resistance of pea (*Pisum sativum*,) to broomrape (*Orobanche crenata*), ascochyta blight (*Mycosphaerella pinodes*) and powdery mildew (*Erysiphe pisi*). Investigations concerning resistance to *O. crenata* are summarised as follows.

Orobanche crenata (crenate broomrape) represents the major constraint for pea production in Mediterranean areas (Rubiales *et al.*, 2003). Only incomplete levels of resistance to broomrape have been identified in pea germplasm so far, suggesting that it is a polygenic trait. Higher levels of resistance have been found in wild relatives of cultivated pea (Rubiales *et al.*, 2003; 2006; Pérez de Luque *et al.*, 2005). Thus, knowledge of the genomic location and linkage to molecular markers of these genes would facilitate gene transfer to pea cultivars through marker-assisted selection (MAS).

With this aim a population consisting of 111 RILs-F₆ (Recombinant Inbred Lines) derived from a cross between *Pisum sativum* ssp. *syriacum*, an accession partially resistant to *O. crenata*, and the susceptible pea cv. *Messire* (*P. sativum* ssp. *sativum*), was analyzed and a linkage map was developed. This map covers 1214 cM and contains 3 morphological, 1 isozyme, 12 STS and 235 RAPD markers distributed in 9 linkage groups. Of these, 6 groups

have been assigned to chromosomes using markers common with the consensus pea map.

The susceptibility of this RIL population to broomrape was screened at Córdoba, Spain in a plot heavily infested with *O. crenata* seeds. RILs were grown during 2003-2004 season in a complete randomised block design with three replicates, each having a row with ten plants of each family. Furthermore, in order to correct the possible differences in the density of *O. crenata* seeds in the soil between plots, each family row was surrounded by four rows, with 10 plants each, of the susceptible control cv. *Messire*. At the end of the crop cycle, the final number of emerged *O. crenata* shoots per individual host plant were scored for each RIL family and for the four adjacent rows of *Messire* check. In addition, host vigor was visually estimated using a 0-5 scale. QTL (Quantitative Trait Loci) analyses were performed by Windows QTL Cartographer 2.0 software and QTLs were identified by Simple Interval Mapping (SIM) and Composite Interval Mapping (CIM). Markers to be used as cofactors for CIM were selected by forward-backward stepwise regression. The threshold for the detection of a QTL was selected using permutation test suggested by Doerge and Churchill (1996).

The analysis of the mean number of shoots per plant of the susceptible control showed that the distribution of *O. crenata* seeds in the soil was quite homogeneous. However, parental lines showed substantial differences in *O. crenata* resistance. Thus, the female parent (*Pisum sativum* spp. *syriacum*) displayed 0.42 shoots per plant as a mean value while the male parent (pea cultivar *Messire*) reached an average value of 11 shoots per plant. An even wider range of variation was observed in the RIL population where this parameter followed a normal distribution. Three QTLs associated with resistance to broomrape were identified. Two of them, located in chromosomes 2 and 5 respectively, were situated in the same position as two QTLs identified for host plant vigor. These results reinforce previous studies suggesting that the number of broomrape shoots per plant is positively correlated with varietal vigor (Aalders and Pieters, 1987; Rubiales *et al.*, 2004). Therefore, in order to identify QTLs associated with genetic resistance to broomrape but not with vigor, a resistance index was calculated. Simple regression was carried out using the score of vigor of each RIL family as an independent variable and the *O. crenata* score as a dependent variable. The regression corrected values (residuals), considered as the *O. crenata* resistance index, were multiplied

by -1 in order to assign greater values to the more resistant plants and a constant (10) was added in order to avoid negative values. This index was successfully applied in the detection of one QTL involved in the resistance to this parasite but not associated with vigor. This QTL was located in chromosome IV and displayed a peak value of LOD of 3.86. This putative QTL explained 19 % of phenotypic variation of this trait and showed an additive genetic effect of 0.749.

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COST 849 - PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

This programme, funded by European Union via European Science Foundation, arranged 3 meetings in 2005, in Vienna, Austria; Reading, UK; and Neve-Ya'ar, Israel. The programmes, abstracts and/or reports of these meetings are on the COST849 web-site (<http://cost849.ba.cnr.it/>) or will be added in due course. More details appear below, together with lists of papers presented.

COST 849 MEETINGS

Genetic diversity of parasitic plants, held in Vienna, Austria, 18-19 July, 2005.

This was a discussion meeting with two main topics:

1. Taxonomy of parasitic plants and its implications on parasitic plant management.
2. Genetic diversity in parasitic plants (and the variety of molecular methods for its study).

Intended outputs include a list of actual and potential pest species of *Orobanche* and their host range, indicating the importance of each host on a four-stepped scale; also distribution maps for Europe and the Mediterranean, of the most important pest taxa.

Broomrape biology, control and management held in Reading, UK, 15-17 September, 2005.

Papers presented and discussed were:

- Working Group 1: Broomrape germination biology:
- Harro Bouwmeester *et al.* - Biosynthesis of germination stimulants of parasitic plants and their biological function.
- Radoslava Matúšová *et al.* - The biosynthetic origin of strigolactone germination stimulants of the plant-parasitic *Striga* and *Orobanche* spp.
- Nurit Bar Nun *et al.* - Inhibitors and stimulators of germination of *Orobanche*.
- Zhongkui Sun *et al.* - Isolation and characterization of genes involved in the formation of germination stimulants for the parasitic weed, *Striga*.
- Alistair Murdoch and Israel Dzomeku - Modelling seed dormancy and germination.
- Danny Joel *et al.* - Influence of fluridone on seed conditioning and germination of *Orobanche* seeds.
- Tom van Mourik - Processes and rates of *Striga hermonthica* seed bank depletion as a result of fallow and different crop covers.
- Sissy Lyra *et al.* - Preliminary results on genetic analysis of Greek *Orobanche* populations using RAPDs.
- Fred Rumsey - Taxonomic changes in *Orobanche* and related genera.
- Working Group 2: Biological control:
- Ziva Ansellem *et al.* - Transforming NEP1 toxin gene and other genes into two *Fusarium* spp. to enhance mycoherbicidal activity against *Orobanche* - failure, success, and progress.
- Maurizio Vurro and Angela Boari - Compatibility of irrigation systems with application of broomrape biocontrol agents.
- Angela Boari *et al.* - Use of fungal metabolites for broomrape suicidal germination.
- Peter Toth *et al.* - Natural enemies of *Orobanche* species in Slovakia.

Sissy Lyra *et al.* - Biocontrol agents for *Orobanche* - a seaweed product: a new potential germination stimulant for *Orobanche ramosa*.

Working Group 3: Resistance breeding:

Alejandro Pérez-de-Luque *et al.* - Involvement of protein cross-linking, peroxidase and β -1,3-endoglucanase in resistance of pea against *Orobanche crenata*.

Séverine Thoiron *et al.* - Search for a scheme of host responses to *Orobanche*.

Alexandre Lejeune *et al.* - Tomato/*O. ramosa* interaction: pathogen perception and defence elicitation.

Maria Joița Păcureanu *et al.* - Sunflower genotypes resistant to the most virulent populations of broomrape in Romania.

José M. Fernández-Martínez *et al.* - Resistance to new virulent *O. cumana* races.

Sara Fondevilla *et al.* - Mapping of quantitative trait loci for resistance to *Orobanche crenata* in pea.

Maria Carlota Vaz Patto *et al.* - Genetic variation in *Orobanche foetida* as revealed by AFLP analysis.

Working Group 4: Integrated control and biodiversity conservation:

Mónica Fenández-Aparicio *et al.* - *Orobanche crenata* control on legumes in various intercrops.

Eleni Kotoula-Sika and Garifalia Economou - Use of herbicide resistant crops in Greece for control of *Orobanche* and other weeds

Tal Lande *et al.* - New advances in chemical control of *Orobanche aegyptiaca* in tomato.

Nicos Vouzonis - Lessons learned from integrated control of *Orobanche* in Cyprus.

V. Jinga *et al.* - Control of *Orobanche* on sunflower and tobacco crops in România.

Hanan Eizenberg *et al.* - Minirhizotron- a new method for in-situ modelling of the underground development of *Orobanche*.

Duncan Westbury - *Rhinanthus minor* (yellow rattle) – grassland weed or the ecologist's friend?

Means for limiting *Orobanche* propagation and dispersal in agricultural fields held in Newe-Ya'ar, Israel, 4-6 December, 2005.

Papers presented and discussed were:

Orobanche infestation and economic impact:

D.M. Joel – The need to prevent further *Orobanche* spread.

D. Rubiales - The continuous *Orobanche* dispersal in Spain.

M. Delos - The occurrence of *Orobanche* in French agricultural areas.

D. Müller-Stover *et al.* – Occurrence of *O. ramosa* in Germany and prospects for its control.

M. Vurro and G. Domina- Development of the broomrape problem in Italy.

S. Lyra *et al.* – Variation in *Orobanche* populations in Greece.

G. Economou *et al.* - The extent of recent *Orobanche* infestation in Greece.

M. Pacureanu-Joita - *Orobanche* sp. in Romania - the impact of new races of the parasite in sunflower crop.

R. Batchvarova and S. Slavov- Broomrape expansion in Bulgaria.

Y. Goldwasser – Weedy *Orobanche* in Israel.

N. Vouzonis - Severity of parasitic weeds in Cyprus.

A. Uludag and M. Demiret - The *Orobanche* problem in Turkey and its economic impact.

Seed viability, germination and eradication:

A.M. Mayer – Metabolism of *Orobanche* seeds during conditioning and during germination.

Y. Kleifeld - Soil fumigation for broomrape seedbank control.

K. Wegmann – Stimulation of false germination in soil.

A. Murdoch and E. Kebreab - Temperature dependence of *Orobanche* germination and implications for the northward spread of *Orobanche* within Europe.

H. Eizenberg - The growing degree days (GDD) model for *Orobanche* germination and development.

Means to prevent seed production and dispersal:

T. Nadler-Hassar *et al.* - The mode of action of herbicides in host-parasite interaction.

M. Vurro *et al.* – Natural compounds for the management of broomrape seed germination.

R. Aly *et al.* – A new approach for parasitic weed control.

S. Meir *et al.* – Biotechnology and the management of weedy *Orobanche*.

J. Hershenhorn *et al.* – Integrated broomrape management in tomato based on resistant varieties and chemical control.

M. Pacureanu-Joita – Resistance and the development of virulent *Orobanche* races.

D.M. Joel - *Orobanche* control in manure processing.

R. Aly - Genetically engineered resistance to *Orobanche*.

J. Herschenhorn – *Orobanche* control in tomato.

Evolutionary developments of *Orobanche* under cultivation:

- M. Pacureanu-Joita - Resistance and the development of virulent *Orobanche* races
 G. Domina – Distribution of weed *Orobanche* species in Europe and the Mediterranean.
 J. Sauerborn and J.H. Grentz - Potential distribution of *Orobanche* under current and predicted future climate.
 D. Opatowski - EU regulations to limit weed infestation.
 J. Verkleij - The *Striga* problem in Africa, a potential threat for Europe?
 D.M. Joel and H. Manor - Emergency plan for broomrape control in Israel.
 P. Warren - The branched broomrape eradication project in Australia.

Final discussions:

- Discussion on a draft policy document for circulation to policy makers, highlighting the risks from *Orobanche* and the need to implement quarantine and seed production measures to prevent further *Orobanche* spread in Europe, in particular with the potential for climate change.
 Discussion on research needed in support of the quarantine policy.

OTHER MEETINGS

International Botanical Congress, July 17-23, Vienna, Austria. Relevant oral and poster presentations are listed below. Numbers in brackets refer to the abstract in the full record of the meeting, available at:
http://www.IBC2005.ac.at/program/abstracts/IBC2005_Abstracts.pdf

- Joel, D.M. - Research on *Orobanche*: what do we know and what should we get to know? (1.7.1.)
 Schneeweiss, G.M. *et al.* - Molecular phylogenetics and taxonomy of *Orobanche* L. (Orobanchaceae). (1.7.2.)
 Verkleij, J.A.C. - *Orobanche*-host plant interactions: ecological and physiological aspects. (1.7.3.)
 Murdoch, A.J. and Kebreab, E. - Predictive empirical modeling of *Orobanche* life cycle and seed ecology. (1.7.4.)
 Satovic, Z. *et al.* - Population genetics in *Orobanche* species. (1.7.5.)
 Park, J. *et al.* - Evolution of Ty1-*copia* and Ty3-*gypsy* retro-elements in holoparasitic *Orobanche* (Orobanchaceae). (1.7.6.)

- Rubiales, D. *et al.* - *Orobanche* species as weeds and their management in sustainable agriculture. (1.7.7.)
 Palmer, J.D. - Horizontal gene transfer in the evolution of plant mitochondrial genomes. (12.4.1.)
 DePamphilis, C. - Evolution of RNA editing sites and its impact on phylogenetic signal in plant mitochondrial genes. (12.4.3.)
 Nickrent, D.L. and Blarer, A. - Hydnoraceae and its systematic affinities with Piperales. (12.9.3.)
 López-Curto, M. *et al.* - *Cuscuta jalapensis* parasite on *Coffea arabica* in Veracruz, México. (P 0259)
 Malécot, V. and Nickrent, D.L. - Acquisition of root hemiparasitism and other life history traits in Santalales. (P 0479)
 Khoshrang Golavar, S. and Kazempour Osaloo, S. - Pollen morphology of Orobanchaceae tribe Rhinanthae in Iran. (P 0553)
 Krause, K. *et al.* - Evolution of plastid genomes within the parasitic flowering plant genus *Cuscuta*. (P 0606)
 Rojas, M.M. *et al.* - Host specialization in *Orobanche foetida*. (P 1186)
 Bennett, J.R. and Mathews, S. - Evolution of phytochromes in parasitic Orobanchaceae. (P 1187)
 Roman, B. *et al.* - Genetic diversity in two variants of *Orobanche gracilis* Sm. [var. *gracilis* and var. *deludens* (Beck) A.Pujadas] from different regions of Spain. (P 1188)
 Armstrong, J.E. - Hemiparasitism: a way station to holoparasitism or an evolutionary stable strategy? (P 1189)
 Korol'kova, E.O. - Anatomical features of the stem structure in the *Orobanchaceae*. (P 1190)
 Jus, M.A. - The figwort family (Scrophulariaceae Juss.) in Belarussian Flora. (P 1191)
 Morawetz, J.J. and Wolfe, A.D. - Phenetic analyses of morphological traits in the *Alectra sessiliflora* complex (Orobanchaceae). (P 1192)
 Stefanovic, S. and Olmstead, R.G. - Phylogeny and plastid genome evolution in the parasitic genus *Cuscuta* (Convolvulaceae). (P 1411)
 de Vega, C. - Floral morphology, flower longevity, and nectar secretion patterns of the holoparasitic plant *Cytinus hypocistis* (L.) L. (Cytinaceae) growing on three different hosts. (P1671)

FORTHCOMING MEETINGS**International Workshop on faba bean breeding and agronomy, Cordoba Spain, 25-27**

October, 2006. Further information from Ana Maria Torres, email:

anam.torres.romero@juntadeandalucia.es

IPPS Congress, Charlottesville, Virginia, USA, 3-7 June, 2007.

A first circular will shortly be sent to all Haustorium recipients.

GENERAL WEB SITES

For individual web-site papers and reports see LITERATURE

For information on the International Parasitic Plant Society, past and current issues of Haustorium, etc. see: <http://www.ppws.vt.edu/IPPS/>

For past and current issues of Haustorium see also: <http://web.odu.edu/haustorium>

For the ODU parasite site see: http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page

For Lytton Mussleman's *Hydnora* site see: <http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/lecturesandarticles>

For Dan Nickrent's 'The Parasitic Plant Connection' see: <http://www.science.siu.edu/parasitic-plants/index.html>

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: <http://www.rmrs.nau.edu/mistletoe/welcome.html>

For information on activities and publications of the parasitic weed group at the University of Hohenheim see: <http://www.uni-hohenheim.de/~www380/parasite/start.htm>

For information on, and to subscribe to, PpDigest see: http://omnisterra.com/mailman/listinfo/pp_omnistera.com

For information on the EU COST 849 Project and reports of its meetings see: <http://cost849.ba.cnr.it/>

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' the address is: http://www.omnisterra.com/bot/pp_home.cgi

For a description and other information about the *Desmodium* technique for *Striga* suppression, see: <http://www.push-pull.net>

For information on EC-funded project 'Improved *Striga* control in maize and sorghum (ISCIMAS) see: <http://www.plant.dlo.nl/projects/Striga/>

For the work of Forest Products Commission (FPC) on sandalwood, see: www.fpc.wa.gov.au

LITERATURE

- Abdel-Kader, M.M. and El-Mougy, N.S. 2001. Evaluation of different approaches of mycoherbicidal application for controlling *Orobanche crenata* in pea field. Egyptian Journal of Phytopathology 29: 69-82. (Field trials suggested that mycoherbicides based on *Trichoderma harzianum* and *T. viride*, applied as sprays and soil drench may be useful for controlling *O. crenata* in peas.)
- Aflakpui, G.K.S., Gregory, P.J. and Froud-Williams, R.J. 2005. Carbon (¹³C) and nitrogen (¹⁵N) translocation in a maize-*Striga hermonthica* association. Experimental Agriculture 41: 321-333. (Showing that, once emerged, *S. hermonthica* depends on the host for only 22-59% of its carbon, but up to 100% of its nitrogen. The host was correspondingly depleted of only about 1% of its carbon but up to 10% of its nitrogen.)
- Aizen, M.A. 2005. Breeding system of *Tristerix corymbosus* (Loranthaceae), a winter-flowering mistletoe from the southern Andes. Australian Journal of Botany 53: 357-361. (Showing that flowers of *T. corymbosus* are self fertile when hand-pollinated but that self pollination is rare in the field. Thus seed-set depends heavily on the declining numbers of over-wintering humming bird *Sephanoides sephaniodes*.)
- Al-Eryan, M.A.S., Altahtawy, M.M.M., El-Sherief, H.K. and Abu-Shall, A.M.H. 2004. Efficacy of *Phytomyza orobanchia* Kalt. in reduction of *Orobanche crenata* Forsk. seed yield under semi-field conditions. Egyptian Journal of Biological Pest Control 14(1): 237-242. (Pupae of *P. orobanchia* were released on pots containing faba bean plus *O. crenata* (Forssk. not Forsk.) and were shown to cause a

- significant increase in insect parasite seed production.)
- Allard, D.J., Petrů, M. and Mill, R.R. 2005. An ecological study of *Pedicularis dendrothauma*, an arboreal hemiparasitic epiphyte from Nepal. *Folia Geobotanica* 40(2-3): 135-149. (Reporting and describing a new species of *Pedicularis* growing as an epiphyte on the trunks of *Abies spectabilis*, forming parasitic attachments to the tree and to other associated epiphytes including mosses; also apparently behaving as a saprophyte on dead wood.)
- Álvarez Puente, R.J. and Martínez Viciado, Y. 2004. (*Dendropemon claraensis* Leiva (Loranthaceae), a new enemy of coffee trees.) (in Spanish) III Congreso 2004 Sociedad Cubana de Malezología, Memorias, Jardín Botánico Nacional, Habana, Cuba, April 2004: 108-110. (Describing the first observation of the endemic *D. claraensis* ('palo caballero') on coffee. It flowers and bears orange fruits all the year round, which are dispersed by birds.)
- Ameloot, E., Verheyen, K. and Hermy, M. 2005. Meta-analysis of standing crop reduction by *Rhinanthus* spp. and its effect on vegetation structure. *Folia Geobotanica* 40(2-3): 289-310. (A quantitative literature review concluded that *Rhinanthus* spp. reduces above-ground biomass by an average 26% in the field. Grass and legume species are most reduced while non-leguminous dicots mostly benefit. Species number was increased in only 1 out of 4 studies.)
- Amusa, N.A. and Adegbite, A.A. 2005. An overview of the present situation of the major economic field diseases of cowpea in the humid agro-ecologies of southwestern Nigeria. Proceedings of the 1st International Edible Legume Conference in conjunction with the IVth World Cowpea Congress, Durban, South Africa, 17-21 April 2005. pp. 1-11. (Reviewing the current situation of diseases, including parasitic plants, presumably *Striga gesnerioides* and *Alectra vogelii*.)
- Arruda, R. and Carvalho, L.N. 2004. (Host specificity of *Struthanthus polyanthus* (Loranthaceae) in a Cerrado area at Serra de Caldas Novas State Park, GO, Brazil.) (in Portuguese) *Bioscience Journal* 20: 211-214. (Recording *S. polyanthus* on 9 hosts but highest levels on *Kielmeyera coriacea* and *Styrax ferrugineus*. Infestations were highest on horizontal rough-barked branches but also occurred on rough-barked vertical branches.)
- Asiwe, J.A.N., Terblanche, H., du Toit, J. and van der Merwe, P. 2005. Cowpea germplasm enhancement at the Grain Crops Institute, Agricultural Research Council (ARC), Potchefstroom, South Africa. Proceedings of the 1st International Edible Legume Conference in conjunction with the IVth World Cowpea Congress, Durban, South Africa, 17-21 April 2005. pp. 1-5. (Parasitic weeds, presumably *Alectra vogelii*, noted to be among the constraints influencing the breeding programme.)
- Aysan, Y. and Uygur, S. 2005. Epiphytic survival of *Pseudomonas viridiflava*, causal agent of pith necrosis of tomato, on weeds in Turkey. *Journal of Plant Pathology* 87: 135-139. (Showing that *P. viridiflava* may survive as an epiphytic population on *Orobanche ramosa*.)
- Bekker, R.R. and Kwak, M. 2005. Life history traits as predictors of plant rarity, with particular reference to hemiparasitic Orobanchaceae. *Folia Geobotanica* 40(2-3): 231-242. (Thirty rare and 105 common plant species were appraised for life span, clonality, breeding system, seed production, seed dispersal and seed bank longevity. The vulnerability of 8 hemiparasitic Orobanchaceae (*s.l.*) is explained on the basis of these traits.)
- Benharrat, H., Boulet, C., Theodet, C. and Thalouarn, P. 2005. Virulence diversity among branched broomrape (*O. ramosa* L.) populations in France. *Agronomy for Sustainable Development* 25: 123-128. (Populations of *O. ramosa* from varying host crops, including rapeseed, hemp and tobacco were compared for their virulence on a range of hosts. Results suggested that there are at least 2 'pathovars' which could be distinguished by molecular markers.)
- Benvenuti, S., Dinelli, G., Bonetti, A. and Catizone, P. 2005. Germination ecology, emergence and host detection of *Cuscuta campestris*. *Weed Research* 45: 270-278. (Reporting on various aspects of *C. campestris* germination and attachment (to sugar beet), including a demonstration of phototropic behaviour towards a dark green target with relatively low red: far-red ratio.)
- Botanga, C.J. and Timko, M.P. 2005. Genetic structure and analysis of host and nonhost interactions of *Striga gesnerioides* (witchweed) from central Florida. *Phytopathology* 95: 1166-1173. (Confirming narrow genetic variation in 4 populations of *S. gesnerioides* from *Indigofera hirsuta* hosts in USA, and their failure to develop beyond the tubercle stage on cowpea.)
- Bowie, M. and Ward, D. 2004. Water and nutrient status of the mistletoe *Plicosepalus acaciae* parasitic on isolated Negev Desert populations of *Acacia raddiana* differing in level of

- mortality. *Journal of Arid Environments* 56: 487-508. (Results indicate that *P. acaciae* takes up nitrogen by both passive (via xylem) and active (via phloem) routes, but also that the host can limit or have a negative effect on the parasite. Results somewhat unexpectedly do not support the hypothesis that the mistletoe contributes to host water stress and mortality.)
- Bullock, J.M. and Pywell, R.F. 2005. *Rhinanthus*: a tool for restoring diverse grassland? *Folia Geobotanica* 40(2-3): 273-288. (Proposing and demonstrating that *Rhinanthus* spp. can be used to suppress dominant grasses and *Trifolium repens* in fertile grassland, leading to greater species richness.)
- Buschmann H., Fan, Z.W. and Sauerborn, J. 2005. Effect of resistance-inducing agents on sunflower (*Helianthus annuus* L.) and its infestation with the parasitic weed *Orobanche cumana* Wallr. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* 112: 386-397. (Three foliar sprays of benzothiadiazole (BTH) at 250 mg/l reduced *O. cumana* by 71% without reducing sunflower biomass. Foliar applications of salicylic acid and acetylsalicylic acid gave comparable results. Also recording the non-selective action of 2,6-dichloroisonicotinic acid and negative results with *Bacillus subtilis*, *Trichoderma harzianum*, methyl jasmonate and harpin protein.)
- Buschmann, H., Gonsior, G. and Sauerborn, J. 2005. Pathogenicity of branched broomrape (*Orobanche ramosa*) populations on tobacco cultivars. *Plant Pathology* 54: 650-656. (Nine cultivars of Virginia (flue-cured), Burley (light air-cured) and dark air-cured tobacco were all susceptible to two populations of *O. ramosa* but dark air-cured varieties were least affected.)
- Cameron, D.D., Jun-Kwon Hwangbo, Keith, A.M., Geniez, J-M., Kraushaar, D., Rowntree, J. and Seel, W.E. 2005. Interactions between the hemiparasitic angiosperm *Rhinanthus major* and its hosts: from the cell to the ecosystem. *Folia Geobotanica* 40(2-3): 217-239. (Describing experiments to explore the direct effects of *R. major* on different individual species and resultant indirect effects on the plant community, as influenced by abiotic factors such as nutrient levels.)
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- Ducarme, V. and Wesselingh, R.A. 2005. Detecting hybridization in mixed populations of *Rhinanthus minor* and *Rhinanthus angustifolius*. *Folia Geobotanica* 40(2-3): 151-161. (Reporting the use of RAPD and ISSR markers to detect hybrids not readily distinguished morphologically. The study confirmed that hybridisation occurred within 2 years in a mixed population in Belgium, while in an old population of *R. angustifolius* in The Netherlands, there was evidence of some introgression from *R. minor* into *R.*

- angustifolius* before the disappearance of *R. minor* from the population.)
- Eizenberg, H., Shtienberg, D., Silberbush, M. and Ephraim, J.E. 2005. A new method for *in-situ* monitoring of the underground development of *Orobanche cumana* in sunflower (*Helianthus annuus*) with a mini-rhizotron. *Annals of Botany* 96: 1137-1140. (Describing clear Plexiglas mini-rhizotron plastic observation tubes, inserted into the soil, through which germination, penetration, and development of *Orobanche* can be monitored by mean of a mini-rhizotron camera.)
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- Gacheru, E. and Rao, M.R. 2005. The potential of planted shrub fallows to combat *Striga* infestation on maize. *International Journal of Pest Management* 51: 91-100. (Concluding that on moderately *Striga*-infected and N-depleted fields, one-year fallows that stimulate *Striga* germination and produce high amounts of biomass such as *Sesbania sesban*, *Crotalaria grahamiana* and *Tephrosia vogelii* can reduce *Striga* and greatly increase maize yields, but on severely infected fields longer-term fallows may be needed. Six other fallow species gave less promising results.)
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- Grenz, J.H., Manschadi, A.M., Uygur, F.N. and Sauerborn, J. 2005. Effects of environment and sowing date on the competition between faba bean (*Vicia faba*) and the parasitic weed *Orobanche crenata*. *Field Crops Research* 93: 300-313. (Field trials in Turkey involved 2 sowing dates and 3 levels of parasite seed in the soil. Parasite number was a function of seedbank density and host root length density (RLD). Vegetative growth of the crop was little affected but yields were affected via reduced pod number. Delayed sowing reduced parasite growth more than host performance.)
- Gressel, J. 2005. Problems in qualifying and quantifying assumptions in plant protection models: resultant simulations can be mistaken by a factor of a million. *Crop Protection* 24: 1007-1015. (Pointing out that the author's own model predicting that five herbicide-resistant *Striga* plants would appear per hectare per season was based on an inaccurate assumption that heterozygotes would be selected, and a heterozygous mutation frequency was used, while a recessive mutant frequency should have been used. A revised model would predict five resistant plants per million hectares per season.)
- Grostad, T. and Halvorsen, R. 2005. (Some interesting plant finds from Sandefjord in Vestfold.) (in Norwegian) *Blyttia* 63: 23-24. (Noting the occurrence of *Cuscuta europaea* ssp. *europaea*.)
- Haidar, M.A., Sidahmed, M.M., Darwish, R. and Lafta, A. 2005. Selective control of *Orobanche ramosa* in potato with rimsulfuron and sub-lethal doses of glyphosate. *Crop Protection* 24: 743-747. (Best results were obtained with a foliar application of rimsulfuron at 12.5 g ai/ha followed by three sequential applications of glyphosate at 100 g ai/ha.)
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