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PRESIDENT'S MESSAGE

Dear IPPS members

Before you, a new issue of Haustorium, so diligently assembled by its editor, Chris Parker, who is constantly on the lookout for interesting news about our beloved parasitic plants. And is also listing upcoming meetings related to parasitic plants of which I especially want to mention the 17th WCPP that will be held in Nara, Japan, 3-7 June 2024 (https://www.kuba.co.jp/wcpp17/index.html). Keep an eye on the website for details and more information on this meeting. I hope that many of you will attend it.

If you are reading Haustorium but are not an IPPS member yet, consider becoming a member, see www.parasiticplants.org for details and an online membership fee payment option. Membership entitles you to a reduced fee for WCPP attendance and gives you access to the member area of the IPPS website. We use the member fees to run the society and to support the organization of the WCPP and its attendance by young researchers from developing countries.

Moreover, the IPPS has a lively website with dynamic features, such as a Scopus and Google Scholar feed readers showing the latest publications on parasitic plants, and a Twitter feed showing IPPS as well as #Parasiticplants hashtagged tweets. And the website has an option for IPPS members to post news and vacancies. Please check them out on www.parasiticplants.org! To post news, members can login into the member area where they can post recent papers or project funding, as well as job vacancies. These will also automatically be Tweeted from the IPPS Twitter account, giving even more exposure.

In this issue of Haustorium you can find again a great selection of parasitic plant related news, on the preservation of *Rafflesia* in the Phillipines and Green mistletoe in New Zealand, the use of *Viscum album* for treatment of cancer, the use of Yellow rattle to increase species diversity in meadows and the intriguing "mungee, the world's largest mistletoe". Enjoy reading!

I wish you all a good holiday season.

Harro Bouwmeester
IPPS President

EDITORIAL - SUICIDAL GERMINATION

In the course of monitoring the parasitic weed literature for Haustorium, I have been aware, over many years, of repeated statements of hope for applying synthetic strigolactones and other stimulants to cause suicidal germination and thus solving the problems from *Striga* etc in the field.

The summaries of two quite recent papers conclude with the claims for synthetic analogues that they could 'pave the way for integrating the suicidal germination approach in sustainable *Striga* management strategies for African agriculture' and 'These findings demonstrated, for the first time, the technical feasibility of suicidal germination for controlling *S. hermonthica*.

Unfortunately there is still no sign that these hopes could come to fruition, and these papers do not address the almost hopeless issue that, however cheap the chemicals themselves might be, it is highly unlikely that any company will be prepared to bear the cost of toxicological and other work required for registration and full commercialisation for a limited market of predominantly poor farmers. If the research involved has had practical application as its goal, then the funding for it should have included allowance for contribution to the costs of commercialisation.

One way to introduce natural stimulants for suicidal germination is via catch- and trap-crops and there have been efforts to select the best of these. But just as levels of stimulant exudation have been successfully reduced in crop varieties by breeding, perhaps a useful research target would be the enhancement of stimulant production in catch- or trap-crops to make them super-effective, making use of recent progress in understanding the processes involved in bio-synthesis. But perhaps the cost of registration could still be a barrier?

Comments will be very welcome!

Chris Parker.

MALTA SYMPOSIUM, 1973
50TH ANNIVERSARY

Half a century ago, someone had the excellent idea of calling for a meeting involving people, inter alia, botanists and geneticists, working on a set of almost neglected plants - plants feeding on other plants. I worked at that time on breeding legumes such as lentils and faba beans, and certainly I found a strong enemy: the broomrapes (*Orobanche crenata* in my case). As a fan of Asterix comics, I knew about mistletoes mostly as a magic curiosity, but excepting *Cuscuta*, because some cultivated as well as wild vegetation were destroyed by it, I was almost sure that the parasitic plant world was a rather small world, although a heavy problem for me as a breeder.

Malta 1973 was for me the discovery of a new and wide world, with enthusiastic people working in all possible aspects of these fascinating plants. I knew about other species that were also major problems in other crops and other climates. The whole meeting was a lesson to me; I knew that to progress in my breeding work I had to know many, but indeed many things about how these plant live, feed, interact with their hosts, reproduce, spread and adapt to survive. I knew that there were many people happy to exchange knowledge even working in other fields. I learnt that some species were protected in some countries as rare specimens, even of *Orobanche*…! I was about to shout, please, do come to my fields…! But especially I felt that the all the people attending the scheduled lectures were happy, as myself, to have found colleagues with whom it was possible to exchange knowledge about the real plant world, a non static but dynamic world of hosts and parasites, so similar to our own human world.

My gratitude to the organizers, Chris Parker at the forefront, of that first Symposium, the first in a series that, *in sha'allah* (we were in Malta), will continue forever.

Jose Cubero.

(Our thanks to Jose for his memories of that meeting and his reflections on it. We believe that he, Lytton Musselman, myself, and Job Kuijt (recently located in his retirement in Canada) may be the sole survivors from the meeting, but we shall be delighted to hear from anyone else who were there. Chris Parker.)

PROFILE

Prof. Salim Al-Babili , King Abdullah University of Science and Technology (KAUST), Saudi Arabia.

Salim Al-Babili received his PhD from the University of Freiburg, Germany. After his PhD, he obtained a Rockefeller Post-Doc fellowship to work on generating 'Golden Rice', a genetically modified rice variety with grains containing provitamin A, which was developed to combat Vitamin A Deficiency. In 2007, he received his Habilitation in Cell Biology at the University of Freiburg and is currently Professor for Bioscience at King Abdullah University of Science and Technology (KAUST) and Associate Dean for

Faculty Affairs. The general objective of his research group, the BioActives lab, is to improve the performance and nutritional value of crops by genetic engineering or through application of growth regulators. His lab combines enzymology-based, metabolomics and genetic approaches to elucidate metabolic networks and identify new signaling molecules related to abiotic/biotic stress, plant development and root parasitic plants. Salim Al-Babili has made essential contributions to engineering crops with enhanced pro-vitamin A content and to elucidating carotenoid/apocarotenoid metabolism in plants and microorganisms. His work on retinal biosynthesis in cyanobcateria led to the first structure elucidation of a carotenoid cleavage oxygenase.

Through the discovery of carlactone, his research deciphered the core-pathway in the biosynthesis of the carotenoid-derived plant hormone strigolactone. In the last year, he has been focusing on the identification and biology of novel apocarotenoid growth regulators, which revealed the regulatory metabolite anchorene, and the hormone-candidate zaxinone and an epoxidase-independet route for abscisic acid biosynthesis. Funded by the Bill & Melinda Gates Foundation and KAUST, he has been also heading the '*Striga* Solutions' project led by an international consortium to combat the root parasitic plant *Striga hermonthica*, a major threat to global food security, particularly affecting sub-Saharan Africa. The consortium is developing hormone-based approaches that aim at eliminating accumulated *Striga* seed banks accumulated in infested soils, interrupting the host-parasite interaction by inhibiting *Striga* seed germination, improving and accelerating host growth, and reducing the amount of host's released strigolactones that are responsible for inducing *Striga* seed germination.

In addition, Al-Babili's group is working on the identification of the genetic background of *Striga*-resistance in Pearl Millet. 'Striga Solutions' has shown that the suicidal germination strategy, which refers to diminishing parasitic seeds by inducing their germination through application of strigolactone analogs in the absence of host plants, is a promising approach for *Striga* control in infested pearl millet, sorghum and maize fields. The consortium is currently working on optimizing the suicidal germination strategy and the application of growth regulators that enhance host performance and reduce strigolactone release. Salim Al-Babili has several patents and more than 150-peer reviewed papers.

NEW PROJECTS

Filipino, British researchers save critically endangered 'Queen of Flowers' in the Philippines.

LAGUNA, Philippines – With five tongue-like petals encircling its bowl-shaped center, and with its distinctive odor, the world's largest solitary flower – *Rafflesia* – is hard to miss. University of the Philippines Los Baños (UPLB) researchers Pastor Malabrigo and Adriane Tobias, and University of Oxford Botanic Garden and Arboretum (OBGA) researcher Dr Chris Thorogood joined forces to pioneer a groundbreaking propagation attempt in the ex-situ conservation of *Rafflesia*.

The team uses the most widespread species of the *Rafflesia* genus in the Philippines, *Rafflesia panchoana.* Photo: Chris Thorogood.

The team, who has dedicated many of its years to exploring and protecting *Rafflesia*, used the most widespread species of the *Rafflesia* genus in the Philippines, the *Rafflesia panchoana*. This species grows on Mt. Makiling, where (with permission), the team collected their *Rafflesia*-infected vines and took them to the UP Laguna-Quezon Land Grant in Real, Quezon, for grafting in March 2023.
Prior to the collection of the *Rafflesia*-infected host *Tetrastigma* vine (a vine in the grape family), the team had identified *Tetrastigma* vines on the ex-situ site (Laguna-Quezon Land Grant) on which to perform the grafting.

Team effort. All smiles for the researchers with the forest guards of the UP Laguna-Quezon Land Grant, after grafting the *Rafflesia*-infected vine. Image courtesy of the researchers.

There have been no attempts, outside of Indonesia, to propagate *Rafflesia* with repeated success. The team found this concerning with most species being at severe risk of habitat destruction and land conversion. 'It's a very exciting first attempt and a bold step forward in the conservation of a plant in peril,' Thorogood shared with Rappler.

Indonesia hails *Rafflesia* as one of its three national flowers, and has many statues in celebration of the plant. Malaysia also features the plant on stamps, rice bags, and currency. The plant is used in cuisine in Thailand; meanwhile indigenous communities in Borneo believe that drinking *Rafflesia* tea after childbirth flushes out the placenta and restores the female figure. In the Philippines conversely, the flower receives less attention despite this being the center of diversity for *Rafflesia*: 15 of the c.42 accepted species worldwide have been identified to occur here. Some indigenous people in the Philippines perceive its presence as an omen.

The cryptic life cycle and biology of *Rafflesia* has been the focus of decades of research, and – usually unsuccessful – attempts at propagation. The researchers mentioned that only one botanical garden in the world has enjoyed the repeated success of propagation via grafting: the Bogor Botanical Gardens in Indonesia. While there is a case of propagation through seed germination in Bogor, it took the team 10 years. Currently, propagation via grafting, though requiring intricate and technical training, is the most feasible and ideal technique for researchers.

Malabrigo, Tobias, and Thorogood went to Bogor in November 2022 to learn from their colleagues to prepare for the ex-situ propagation attempt in the Philippines.
While it took Bogor two years to successfully grow the bud and another nine months for it to bloom, Malabrigo said they expected it to be faster in the Philippines, acknowledging that different species have different biology and life cycles. 'We felt very passionate and quite emotional about what we've achieved. It's a really momentous thing,' Thorogood said. If successful, the researchers plan to extend this propagation to other threatened species of *Rafflesia* in the Philippines. 'Luzon is interestingly rich in *Rafflesia* despite its small land area. Its *Rafflesia* content is comparable to Borneo, which has seven times its land area,' said Malabrigo, who is still amazed by the country's rich biodiversity even after decades of exploring and introducing numerous plant species to the scientific community.

The propagation attempt is just the first step in their grand plan for *Rafflesia*. The researchers said that aside from propagating all the threatened *Rafflesia* species in the Philippines, they are also working toward a conservation network for one of the world's greatest enigmas, not only in the country but in the Southeast Asian region where it exists. 'We would like to popularize *Rafflesia* and make people understand that it is a very important part of our biodiversity,' Malabrigo said. He said they wanted to imitate Indonesia in the way the country values and raises awareness on *Rafflesia*. 'There is a growing problem of a lack of awareness on the importance of plants. People care deeply about animal conservation, but they struggle to identify with the need for conserving plants. We believe that *Rafflesia* can be an icon that can connect people with the importance of plant conservation,' Thorogood said.

According to the researchers, their partnership started when Tobias met Thorogood (parasitic plant expert) in the Plants, People, Planet Symposium in Kew Gardens, United Kingdom, in 2019, where he presented part of his thesis about *Rafflesia banaoana* and won the joint selected talk prize. The partnership between the UPLB and OBGA is flourishing; Thorogood is currently a Visiting Professor at the University of the Philippines. Aside from sharing their vast knowledge with students and a wider audience, they also have plans for species discovery, as well as the exploration and protection of the Philippines' unique biodiversity. 'As we dig deeper, we think that we will better understand *Rafflesia*; but in the end, we have more questions to answer,' Tobias said about their long and joyous journey toward *Rafflesia* exploration.

Field work to Indonesia was sponsored by the Helen Roll Charity.

Abby Paulyn Rae Duero
Environmental Conservation
Mar 18 2023.

Denbighshire's wildflower meadows to undergo natural grass control work

Preparations are underway to introduce a natural process across eight county wildflower meadows to control grass length. Following the end of the flowering season, Denbighshire County Council will be preparing the meadows for seeding with yellow rattle seeds.

A spokesman for the Council explains: 'Since the 1930s, the UK has lost 97% of its wildflower meadow habitats. That's nearly 7.5 million acres, with just 1% of our countryside now providing this vital home for pollinators such as butterflies and bees.
'This has impacted the wildlife that relies on these meadows for food and shelter such as hedgehogs, badgers and hares, as well as birds such as the Lapwing, Meadow Pipit and Skylark. 'Having more wildflower meadows is an important step in helping to reverse the decline and increase species richness.'

The Wildflower Meadows Project started in 2019 and has seen over 10,000 individual plants recorded across all sites involved so far. This year the project reached 129 meadows that are supporting biodiversity improvement across the county which include highway verges, footpath edges, cycleways and amenity grasslands. Combined with county roadside nature reserves, there is just over 70 acres of meadows helping and protecting local nature.

The work will take place after the eight sites have received their second seasonal cut. Each of the meadows will be scarified to allow the seeds, taken from existing yellow rattle plants growing at county meadows, to be sown and then rolled.

Yellow Rattle

Yellow rattle (*Rhinanthus* minor) is a parasitic plant which taps into the roots of grasses to steal their nutrients. This reduces the dominance and height of grasses within a meadow which also allows more native wildflowers to take hold. The process also results in more food for pollinating insects such as bees and makes it easier to introduce wildflower plants grown at the Council's tree nursery at St Asaph into the ground with less influence from grasses. Cllr Barry Mellor, Lead Member for Environment and Transport, said: 'We will be carrying out this natural method to reduce the grass control at these sites which will see changes to these meadows as the work is carried out. However once the yellow rattle takes hold and growth begins again at the sites, the grass will reduce in length, allowing more wildflowers to break through to improve the look of these sites and increase biodiversity.

'The work by our Biodiversity and StreetScene teams will benefit the health and wellbeing of local communities near these sites and also give a much needed helping hand to the native species and insects.'

Lisa Baker, Editor, Welsh Business News & News from Wales August 18, 2023

ZOOMINARS

June, 2023

James Bradley, University of Toronto, Canada. **The secret(ome)s of *Striga* and *Cuscuta*: what can we learn about virulence strategies of parasitic plants through inter-family secretome comparisons?**
Striga and *Cuscuta* are two genera of weedy parasitic plants that inflict huge agricultural damage, particularly on the African continent. Each parasitic plant genera evolved independently, and both have distinct life histories. Yet both must accomplish similar goals; penetrate the root (*Striga* spp.) or shoot (*Cuscuta* spp.) of their host plant while evading or suppressing a host immune response. As with other plant parasites, this is likely achieved in part through the deployment of secreted virulence factors (VFs) that can interact with components of host biology to facilitate colonisation. The availability of whole genome assemblies and the ease of in silico secretome predictions now permits multi-species comparisons of secretomes and comprehensive assessments of potentially secreted VFs. I will present a comparison of the *Striga* and *Cuscuta* secretomes. Specifically, I will describe orthogroup clustering and protein domain analyses that facilitated the identification of '*Striga*-specific' secretome features (i.e. gene families or protein domains that were common or specific to *Striga* secretomes but absent or rare in *Cuscuta* secretomes). This analysis was complimented with transcriptome profiling of *Striga* hermonthica infecting a susceptible rice cultivar to identify differentially expressed genes during penetration of the host. The intersection-section of genes encoding secreted proteins that were '*Striga*-specific' and that were differentially expressed during infection identified a small set of genes that are excellent candidate VFs in this parasitic plant and will be discussed.

Sylvia Mutunda, Mawazo Institute, Kenya. **Allele mining of the sorghum accession panel unravels new lgs1-1 mutants with resistance to the parasitic plant *Striga.***
Sorghum is a food staple for millions of people in sub-Saharan Africa, but its production is greatly diminished by parasitic weeds of the *Striga* genus. An efficient and cost-effective way of managing *Striga* in smallholder farms of Africa is to deploy resistant varieties. Here, we leverage genomics and the vast genetic diversity of sorghum – evolutionarily adapted to cope with *Striga* parasitism in Africa – to identify new *Striga* resistant sorghum genotypes. We exploit a *Striga* resistance mechanism that hinges on essential communication molecules – strigolactones (SLs) exuded by hosts to trigger parasite seed germination. We mined for mutant alleles of the LOW GERMINATION LOCI 1 (LGS1) that are ineffective in stimulating *Striga* germination from the sorghum accession panel (SAP). Our analysis led us to identify new lgs1-1 sorghum genotypes which we named SAP- lgs1-1. SAP lgs1 had the SL exudation profile of known lgs1-1 sorghum whose hallmark is production of the low inducer of germination, orobanchol. Laboratory and field resistance screens showed that the SAP-lgs1-1 genotypes also exhibited remarkable resistance against *Striga*. By potentially reducing crop losses due to *Striga* parasitism, our findings have far-reaching implications for improving food security in Africa.

5 July

Elvin Elizabeth Mulaa, Jomo Kenyatta University of Agriculture and Technology, Kenya. **Genetic diversity, virulence and cross-host interactions of *Striga hermonthica***
Striga hermonthica (hereafter referred to as *Striga*) is a persistent parasitic weed of major cereals across Africa, which causes up to 100% yield loss in endemic areas. In Kenya, *Striga* parasitizes mainly maize, sorghum and finger millet grown in the western parts of the country. Variation in the virulence and host specificity are major topics of interest given the high diversity observed among and within *Striga* populations. The main objective of our study was to establish the extent of *Striga* variation and virulence from within a single host and across multiple hosts. Root exudates were extracted from two genotypes each of maize, sorghum and finger millet, and tested for their ability to germinate 5 *Striga* ecotypes sampled from different hosts in Alomodoi and Bunyala (Busia County). Rhizotron assays were further used to

infer/deduce the virulence of the germinated *Striga* ecotypes by measuring *Striga* number, *Striga* length and *Striga* biomass. DArT-sequencing was used to characterize 94 samples of *Striga* collected from the same field of finger millet to establish the extent of genetic variation within a single host in the same environment. Highly significant differences 0.001) were observed in *Striga* germination percentages across host species,□(P genotypes and *Striga* ecotypes. Maize genotypes induced the highest germination percentages (52 and 47%) while *Striga* ecotype from Bunyala (maize host) exhibited the highest germination percentage (30.8%). As infection progressed, highly significant differences ($P \leq 0.01$) were observed across all hosts and genotypes for the *Striga* number, length and biomass at 28 days after infection (DAI). Interaction of genotype and *Striga* ecotypes for *Striga* biomass was highly significant ($P \leq 0.01$). High quality 9,144 SNP markers retained from 14,524 raw markers that were generated from DArT-sequencing revealed a high level of heterozygosity and genetic variation from the 94 *Striga* samples collected from finger millet field. We deduce that there is a genetic component to host and genotype range among the *Striga* populations, and that the parasite virulence depends upon the interaction of host genotype and the corresponding parasite populations. A detailed understanding of genomic regions responsible for the different virulent factors across a diverse set of *Striga* populations will be beneficial in understanding parasite specificity and race classification.

Natsumi Aoki, Nara Institute of Science and Technology. **Multiple signaling pathways for prehaustorium induction in Orobanchaceae parasitic plants.**
Orobanchaceae parasitic plants are major threats to global food security, causing severe agricultural damage worldwide. Parasitic plants deprive water and nutrients from their host plants through multicellular organs called haustoria. The formation of a prehaustorium, a primitive haustorial structure, is provoked by host-derived haustorium-inducing factors (HIFs). Quinones, including 2,6-dimethoxy-p-benzoquinone (DMBQ), and phenolic compounds, including syringic acid, are among the most potent HIFs for various species in Orobanchaceae hemiparasites, whereas the phytohormone cytokinins were found to induce prehaustoria in the holoparasite *Phelipanche ramosa*. However, little is known about whether cytokinins act as HIFs for hemiparasitic species. Moreover, the overlap and differences in signaling pathways for quinones, phenolics and cytokinins in prehaustorium induction are not well understood. We have shown that cytokinins act as HIFs in *Striga hermonthica* but not in *Phtheirospermum japonicum*. Using chemical inhibitors for each type of HIF, we confirmed that the signaling pathways of DMBQ and cytokinin are independent in their perception but converge downstream. Moreover, gene expression during prehaustorium induction by phenolic compounds was compared with that by quinones, indicating kinetic differences in gene induction by these HIFs. Our study revealed the presence of multiple signaling pathways for prehaustorium formation in Orobanchaceae parasitic plants, which may ensure the host infection by parasitic plants.

PRESS REPORTS

In Kenya using fungi to fight a war on weeds

The Toothpick Company turns fungi into bioherbicide to fight *Striga*, a devastating 'master weed' that has devastated an estimated 40 million farms in Africa.

In 2007, retired U.S. Navy surgeon Dr John Sands was volunteering at a hospital in Maseno, western Kenya, treating one severe malnutrition case after the other. Frustrated by the futility of treating patients in such advanced stages of malnutrition—and confused since there was no shortage of fertile fields around—Sands asked his longtime friend Florence Oyosi, an agronomist, what was happening. She brought him to a field of purple flowers and introduced him to *Striga*. Sands thought, 'I know just the guy for this.'

That guy was his brother, Dr David Sands, a plant pathologist at Montana State University who has always been, according to his daughter Claire Sands Baker (now Director of the Toothpick Project), an 'out-of-the-box thinker.' Among his many paradigm-shifting scientific discoveries, the one that led to The Toothpick Project was his decades-long research on *Fusarium oxysporum* ('FOXY'), a soil-borne fungus. Over 200 forms of FOXY are highly selective, attacking only one specific plant. It is a natural arsenal of potential bioherbicides.

The challenge was developing a FOXY strain that would kill *Striga* but not its hosts. Sands' first step was to find African scientists to lead the effort, a search that led him to Sila Nzioki, a plant pathologist at the Kenya Agricultural Livestock Research Organization. Together with Oyosi, Nzioki collected samples of wilted *Striga* in Maseno and found 17 different FOXY strains already in their roots. The *Striga* had succumbed to naturally occurring FOXY, killed by certain amino acids the fungus excreted. Nzioki and Sands identified which amino acids were deadly to *Striga* only and found a key trio—L-leucine, L-tyrosine, L-methionine—that they combined into FOXY-T14 ('T' for 'trio,' 14 for 2014). This is the active ingredient in what would, after Kenyan regulatory approval, become The Toothpick Project's commercially distributed product, Kichawi Kill.

Examining dowels at the Toothpick Project's offices in Kakamega. The tips of the dowels contain the key fungi in Kichawi Kill. Photo Brian Otieno.

In 2013, The Toothpick Project ran field trials with 500 members of Oyosi's farmers' group, called the Liberty Farmer Initiative. The results were so astounding that Nzioki, Sands, Oyosi and Baker squinted at the spreadsheet: FOXY-T14 increased crop yield by 56% in the long rains planting season and 42% in short rains. Yields increased in 499 out of 500 plots. 'That's better than chemicals,' explains Pam Marrone, former CEO of agricultural biologicals company Marrone Bio Innovations. 'They have a nearly perfect win rate, and you don't see that very often!'

In these field trials, they tested FOXY-T14 alongside the other main *Striga* control solution on the market: *Striga*way, a seed coated with—and bred to be resistant to—the chemical herbicide Imazapyr. But while farmers must purchase *Striga*way every season, FOXY-T14 persists in the soil, attacking *Striga's* seeds generation after generation. After a few consecutive seasons using FOXY-T14, farmers reported *Striga* disappearing altogether. Unlike the chemical herbicide, the non-toxic rice inoculum does not require gloves, plus farmers can use whatever seeds they like—zone-specific and drought-resistant seeds, or even saved seeds. Kichawi Kill is a bioherbicide tailor-made for smallholder farmers.

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In April 2018, The Toothpick Project director Baker officially registered its Kenya company, Toothpick Company Limited. Headquartered in Kakamega, Toothpick Company currently serves seven counties in western Kenya, where *Striga* is most prevalent, employing a team of eight and running on an operating budget of $160,000. Its aim to serve smallholder farmers has given Toothpick Company a mission to develop a farmer-centric approach to marketing and distribution. Farmers themselves perform the role of production sites, Kichawi Kill evangelists, planting instructors, and *Striga* educators.

In the Kakamega lab, the FOXY-T14 mycelia are introduced to a substrate, which looks like a toothpick on a petri dish, hence the organization's name. The secondary inoculation is done by village inoculum producers ('VIPs'), almost all of whom are farmers themselves and 80% of whom are women. The live FOXY-T14 are introduced to buckets of cooked, cooled rice, and after three days of incubation, the inoculum—a brownish, pungent rice mixture—is ready to distribute to farmers at 300 KES ($2.35) per bucket. The farmer coats each maize seed with the inoculum before placing it in the soil.

Lillian Makhoha plants maize at her farm. Makhoha has seen her yields improve since collaborating with the Toothpick Project. Photo Brian Otieno.

Baker, for her part, sees the Toothpick Project as 'a bioherbicide platform for the world.' The point is not to stop at *Striga hermonthica* in western Kenya, Baker says, but to create building blocks for the development of other bioherbicides. They will, in turn, be able to tackle food insecurity, biodiversity loss, pollution and toxicity in a variety of contexts. 'That's the global idea of the innovation of a bioherbicide,' she says, 'all dependent on host-specific virulent *Fusaria*.'

For all of its future global potential, however, the most important metric is visible within the changed fortune of a single family. In 2019, Lillian Makhoha's 3.5-acre plot, which should have produced up to 25 90-kilogram bags of maize per acre, produced only six. It wasn't enough to feed her eight-person household, let alone sell for much-needed cash. But then her friend Charity told her about Kichawi Kill, a product of Toothpick Company. 'Kichawi' means magic in Kiswahili, and, well, there was something magical about covering her maize seeds in a strange rice mixture that smelled like overripe bananas and could kill *Striga*. After a couple of consecutive good harvests, Lillian Makokha has built a new house on her homestead, its new corrugated metal roof still crisp and gleaming. The long rains are coming soon. The soil of her tilled fields lie waiting, face-up in the hot sun. She's ready for the flood of Kichawi Kill orders she'll receive once it's time to plant. 'This year, we thank God,' says Makokha. The curse is gone.

April Zhu, May 2022.

Can mistletoe cure cancer?

(This is a lengthy and very thorough survey of the topic
Available in full at: Can mistletoe cure cancer? - Health Feedback
Herewith the conclusions and useful references.)

Conclusion
In summary, while a fair amount of research on the use of mistletoe as cancer treatment exists, it has provided inconclusive results as many studies on the subject carry important methodological flaws and limitations. Overall, the results of the most robust trials available don't indicate that mistletoe cures cancer or improves the chances of patients' survival. But new clinical trials are underway which, if better designed, may provide clearer answers.

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Cancer Phytotherapy
16 May 2023 Editor: Pablo Rougerie

Green mistletoe returns to Pirongia Forest Park

The 10-year plan to re-establish tāpia/mistletoe (*Ileostylus micranthus* and *Tupeia antarctica*) in Pirongia Forest Park has been launched by Department of Conservation (DOC), with the support of local iwi, hapū, and the community. On Saturday 13 May 2023, members of the Pirongia Te Aroaro ō Kahu Restoration Society, Te Pahu Landcare, Waipa District Council, Pirongia Forest Park Lodge, Ngāti Hikairo and Ngāti Apakura gathered alongside DOC to mark the latest piece of work in a 22-year effort to bring native taonga species, including mistletoe, back to the maunga.

Photo P.B. Pelser

Long-term pest control efforts on the maunga have made it possible. 'Mistletoe is a highly desirable food for possums, and when combined with vegetation clearance, have caused the dramatic decline of these plants,' says Biodiversity Ranger Cara Hansen. 'Successful pest control by the Pirongia Te Aroaro ō Kahu Restoration Society, DOC, and Waikato Regional Council has made it a safe environment to bring this plant, and other species, back to the maunga.'

The intensive management of rats and possums on Pirongia has seen kōkako and the North Island robin/toutouwai reintroduced by the restoration society. Other native birds such as rifleman/titipounamu are thriving. Other rare plant species, such as pua ō te reinga/wood rose (*Dactylanthus taylorii*) are clawing their way back from the brink.

Opening with karakia, while a fantail/pīwakawaka weaved its way between speakers, Saturday's event involved a ceremonial placement of mistletoe seeds on a kōhūhū (*Pittosporum tenuifolium*) host tree, followed by a hands-on workshop led by DOC staff for community groups, mana whenua and landowners to learn the translocation technique and how to help mistletoe thrive. 'DOC is working closely with mana whenua to observe tikanga so we can incorporate it into everything we do,' says Community Senior Ranger, Andrew Styche. 'Mistletoe seed used in the translocation have been sourced from populations at Maungatautari and Lake Okareka near Rotorua, and we've been able to do this with mana whenua and community support.'

The project is part of a long-term vision for Pirongia Forest Park, one held by community groups, Waikato Regional Council and DOC for decades.

World, May 23 2023.

'WA's Christmas tree': what mungee, the world's largest mistletoe, can teach us about treading lightly

Noongar Country of southwestern Australia is home to the world's largest parasitic plant, a mighty mistletoe that blooms every December. That's why it's commonly known as WA's Christmas Tree. But it also goes by other names, mungee and moodjar. And it holds great significance for Noongar people including the Merningar people of the south coast.

Mungee in full flower at Stirling Range National Park, about 300km south-east of Perth. Photo: Steve Hopper

While the unique biology and charisma of the species (*Nuytsia floribunda*) has been recognised by Traditional Owners for millennia, such rich Indigenous knowledge is barely known to Western science. Our research team includes three generations of Merningar alongside non-Indigenous scientists. In our new research, we set out to explore mungee's physiology, ecology and evolution from both Indigenous and Western science perspectives. The plant's ability to access a wide array of resources is remarkable, enabling it to prosper in the hostile, infertile, but biologically rich landscapes of southwestern Australia. This is also the case for Noongar people, whose traditional diet reflects the biological richness of their Country. Mungee is a revered teacher to Noongar people, with lessons for us all about living sustainably and in harmony with one another.

Nuytsia floribunda is widespread across Noongar Country (Boodja) and known to most Noongar as moodjar. But it's also called mungee by Merningar and other southern Noongar groups. Being mostly Merningar, we call it mungee and use that term here.
Mungee is a mistletoe tree that grows up to 10m tall in sandy soils. It's endemic to southwestern Australia, but widespread throughout. The parasitic capability of the plant comes from highly modified, ring-shaped roots (haustoria) that act like secateurs to mine other plants for water and nutrients. We used 'two way science' (cross-cultural ecology) methods – including a literature review, shared recording of visits on Country, and an author workshop – to investigate mungee more thoroughly than would be possible through Western science alone.

Like other Indigenous Australian knowledge systems, Merningar lore is place-based. It inextricably links people, specific places, other organisms and non-living entities of Country. Mungee tells specific stories through where it lives, the plants it lives with, and when it flowers. The species is widely held as sacred among Noongar peoples. For Merningar, it has the highest status of all plants. Mungee holds important lore about how we as humans relate to each other and with the world around us, similar to a cornerstone religious text such as the Christian Bible. For Merningar, mungee is a powerful medium that helps restless spirits move on to the afterlife, known to us as Kuuranup. This enables those of us still living to be untroubled by their presence. Senior elder Lynette describes mungee as her teacher, providing guidance on how to exist in Merningar Boodja. The annual summer flowers represent her ancestors returning to their Country, reminding her to cherish and respect both her old people and her Boodja.

Lynette calls the ring-shaped haustoria of mungee her 'bush lolly'. Under Merningar lore, digging for these sweet treats is not allowed when mungee is flowering. This is when bush lollies are scarce, so the rule is about living within seasonal constraints.

Mungee primarily reproduces by cloning, sending out suckers up to 100m from the parent plant to produce identical copies. This results in patches of mungee clones gathered together in tight-knit populations. We saw parallels between patches of mungee and the communal kinship structures of Noongar society, where family is more important than individuals. Before European settlement, extended Noongar families lived in largely separate groups, interconnected with other family groups as part of a wider geopolitical system. We see mungee as a botanical exemplar of putting community before individuals, for the greater good. Mungee accesses water and nutrients by tapping into a wide range of host plants. This diversity of hosts enables mungee to live in many different landscapes. This parallels with the sophisticated, but often place-specific knowledge of Noongar peoples across their botanically rich Boodja, which has enabled use of a wide range of traditional plants.

Mungee's bright orange flowers bring joy to all who witness their display during the celebratory summer months in southwestern Australia. The plant's unique biology, ingenuity and charisma has long been recognised by Noongar peoples and their lore.
Prolific annual flowers are a memorial to the many old people who have cared for their Boodja through millennia. They also remind us to protect the old peoples' legacy.
To Merningar, mungee is a valuable teacher and exemplar of prosperous biological (including human) existence in the southwest Australian global biodiversity hotspot. It has much to teach the rest of us, too.

Alison Lullfitz, Jessikah Woods, Lynette Knapp, Shandell Cummings, Stephen D. Hopper AC
May 26, 2023

Elephants Head: A wildflower with an animal name

All plants have a scientific Latin name and a common name. Common names often refer to physical characteristics recognizable by whoever is looking at the plant. In the San Juan Mountains, for example, we have Elephants Head, with a spike of flowers that looks just like a tower of elephants' heads with floppy ears stacked atop one another.

Photo: M. Costea.

The Latin name for Elephants Head, *Pedicularis groenlandica*, refers to the assumption it was a lousewort and a reference to Greenland. Swedish American botanist Per Axel Rydberg wrote the first 'Flora of Colorado' in 1905 and called this specimen *groenlandica* as the plant was thought to have originated in Greenland. Now, its presumed to have originated in high elevations of North America, but it can also be found in Greenland.

Fun fact: Louseworts were once thought to repel lice. Additionally, any plant name with the word 'wort' in it was likely used medicinally or nutritionally in medieval times.

Elephants Head is a member of the Orobanchaceae . Most species of plants in this family are at least partially parasitic. In essence, an unrelated host plant transfers nutrients to plants in this family via root systems until the parasitic plant starts producing its own chlorophyll. They are particularly easy to spot in the early season as they have reddish, brownish or yellowish stems and leaves, instead of the usual green growth. Elephants Head features a reddish stem and reddish fern-like leaves that emerge from wet mountain meadows and tundra.

This perennial plant can appear alone or in large stands up to two feet tall. The deep pinkish purple flowers are show-stopping. In dry years, fewer plants will make an appearance. It's not common, but an occasional plant will be completely white instead of deep pinkish purple. This is true of many wildflower species.

Elephants Head is so brilliantly pink, it can often be seen from the trail. These plants prefer wet, marshy areas in elevations 7,500 to 13,000 feet and areas that were likely buried in snow during winter months. They can be seen with other species that enjoy the same habitat, such as Marsh Marigold, Marsh Buttercup and Parrys Primrose.

Mary Menz Special to the Plaindealer, on August 9, 2023

CSIC is researching how to create biofactories for root saffron, a healthy and scarce pigment native to South America

A team of researchers from the Higher Council for Scientific Research (CSIC) and several centers at the Federal University of Santa Catarina in Brazil analyzed how the plant *Escobedia grandiflora* (Orobanchaceae), commonly known as root saffron, parasitizing other plants, produces a red dye that accumulates in its roots, giving it its commercial value. The study, published in the journal Plants People Planet, reveals that the red pigment, saffron, is a derivative of carotenoids, vitamin A precursors that animals cannot produce. Therefore, the genes involved in saffron production in this plant were analyzed as a first step towards their use in other easier-to-grow plants or in optimizing the cultivation of saffron itself.

Photo: Edison Cardona.

Root saffron is a parasitic plant native to South America that has traditionally been used to add a red pigment to foods in the Andean region. In addition to being used as a food coloring, saffron root has several health properties: it is traditionally used to treat jaundice, hepatitis, and liver disease. However, its use is increasingly limited due to reasons such as habitat loss and difficulties in domestication and cultivation that lead to a narrowing of its distribution. The aim of the work was to investigate how the plant produces the red compound that gives it its commercial and medicinal value.

Our work showed that red pigments accumulated in the roots According to Manuel Rodríguez Concepción, a CSIC researcher at the Institute of Plant Molecular and Cellular Biology (IBMCP-CSIC-UPV) and coordinator of the study, it is saffron, a water-soluble carotenoid derivative. 'We also analyzed which genes are involved in the production of saffron from carotenoids in saffron roots, thereby identifying candidate genes for key stages of synthesis. Finally, we investigated how the parasitic plant adheres to the roots of the host plant, a prior and necessary step for saffron production,'

Carotenoids are natural pigments found in plants, algae, fungi and bacteria that are responsible for the coloring of many fruits and vegetables. Carrots get their bright orange color from beta-carotene, the best-known compound from which carotene gets its name. Animals cannot synthesize carotenoids and must obtain them through their diet, and these compounds are important for their biological function as vitamin A producers and their antioxidant properties.

The commercial development of saffron, a natural and healthy colorant derived from carotenoids, is hampered by the lack of saffron root plant for extraction. It will require the use of other easily cultivated plants as saffron biofactories. For this, the genes identified in the study could be cloned and transferred into species such as carrots, whose roots accumulate large amounts of saffron carotenoid precursors.

In addition to using the identified genes to produce saffron in otherwise easy-to-grow plants, knowledge of how parasitic plants attach to host plant roots will be key to optimizing conditions for possible future commercial cultivation of saffron roots.

This work arose out of a collaboration between the Federal University of Santa Catarina in Brazil and CSIC, with the participation of several centers: In addition to IBMCP, the Institute of Integrative Systems Biology (I2SysBio, CSIC-UV) and the Institute of Fat Research (IG – CSIC).

Bigflower, August 28, 2023

Watch for ghost pipes

Photo courtesy of foragingguru.com, Melondy Phillips

This delicate and unusual flower lives a secluded life and can only be observed for about one week a year.

Some herbs are common backyard 'weeds,' but others are a lot more obscure.
It spends most of its life underground and only blooms for about one week per year, and only then under specific conditions. Sometime between early summer to early fall, when the air is warm after a rain, they stretch toward the sky with their ghostly presence.
Ghost pipe (*Monotropa uniflora* L.), also called Indian pipe, Corpse plant, Ice plant, Death plant, Ghost flower, and Bird's nest, is a perennial woodland flower in the Ericaceae family. The lack of chlorophyll causes its translucent ghostly white-to-pale pinkish color. Rare individuals may show a dark red tinge. The stems can stretch up from two to 12 inches high. The singular bell-shaped flower heads have very little to no smell, and the plant can bruise easily or melt when touched.

This interesting plant has an unusual parasitic relationship with its tree host. Tom Volk's Fungus of the Month for October 2002 explains this relationship very well. Inside the leaves of the tree, 'the carbon dioxide is photosynthesized into sucrose, which is transported to the roots of the tree. The mycorrhizal fungus takes the sucrose and transforms it into trehalose or sugar alcohols, which are transported to the rest of the fungal mycelium. (In return the fungus aids the tree in absorption of water and essential minerals, especially phosphorous, but that's a whole 'nother story.) The *Monotropa* (ghost pipe) absorbs the sugars from the fungus by 'fooling' the fungus into thinking it's forming a mycorrhizal relationship – but, in fact, the *Monotropa* is really parasitizing the fungus! Thus, the radiolabeled carbohydrates pass from the tree to *Monotropa* via their common mycorrhizal partner, in what is termed a source-sink relationship. In other words, the sugars flow from where they are made to where they are being used. Thus, this is a three-way relationship between a photosynthetic tree, a mycorrhizal fungus, and a parasitic plant.' In other words, even though the ghost pipe is not directly connected to the tree roots, but is instead connected to the fungus on the tree roots, it feeds off of the sugars from the tree via mycorrhizal fungi, primarily *Russula* fungi, as opposed to receiving its nutrients via photosynthesis of sunlight. Ghost pipe could not survive without this host relationship, which is one reason it is very difficult to cultivate. Since they are not dependent on sunlight, ghost pipes can live in dark or shaded areas of the forest and it likes its feet wet.

Don't confuse ghost pipe, *Monotropa uniflora*, with pinesap, *Monotropa hypopitys*. Pinesap is a ghost pipe look-alike; although, unlike ghost pipe's single flower head, pinesap produces several flowers clustered close together which may appear as a single flower head and can have colors from creamy white or yellow to shades of red.

Emily Dickinson's first book of poetry pictured ghost pipe as its cover photo. She referred to ghost pipe as 'the preferred flower of life.'

In the past, ghost pipe has been used for conditions such as convulsions and epilepsies, eye infections, chlorea, toothache, sores that wouldn't heal, menstrual cramps, stress or anxiety, migraines, nerve pain, bunions and warts, colds, severe mental and emotional pain due to PTSD or panic attacks, and for general pain. Ghost pipe is an antinociceptive and works as a sedative; which means, it elevates pain thresholds or tolerance levels by reducing sensitivity. Some of the compounds found in ghost pipe are considered toxic in large doses. West Virginia is one of only five states where ghost pipe is considered 'secure' with an S5 subnational conservation status rating. These plants are rare and should be left to grow.

Rita Halterman, Pokahontas Times

RECENT THESES

Corey Burt. 2023. Discerning friend from foe: systematic revision of *Cuscuta* L. section indecorae using a combined ecological, morphometric, and phylogenetic approach. MSc, Wilfrid Laurier University, Canada. Advisor Mihai Costea.

Abstract
The genus *Cuscuta* (dodder; Convolvulaceae) are obligate parasitic plants. In one clade known as section *Indecorae*, there are species which are considered pests that pose significant threats to agricultural crop production, while other species are rare or known only from historical records. Section *Indecorae* contains three species: *C. coryli*, *C. warneri*, and *C. indecora* (the latter with three infraspecific taxa: var. *indecora*, var. *longisepala*, and var. *attenuata*). The systematics of section *Indecorae* are not currently resolved. *Cuscuta indecora* has a long and complicated taxonomic history with many infraspecific varieties described, and recent phylogenetic analyses using molecular data inferred species level paraphyly and infraspecific level polyphyly, strongly suggesting that species limits and infraspecific variation should be reconsidered in this species. The objectives of my study were to characterize phylogenetic relationships within section *Indecorae* and test whether geographic range is related to genetic separation; conduct a morphometric analysis to assess morphological patterns and compare the results to the newly generated phylogeny; and conduct ecological studies using herbarium specimens and field surveys to expand the geographic, host and habitat range of section *Indecorae*. Results indicated that *C. warneri* is a distinct species using molecular, morphometric, and ecological analysis. *Cuscuta coryli* is a distinct species nested within a clade of *C. indecora*, therefore *C. indecora* is a paraphyletic species, and *C. coryli* is its derivative. *Cuscuta indecora* s.l. is confirmed at species level based on molecular and morphological evidence. Two clades of *C. indecora* were identified by the phylogeny; however, these clades did not correspond to the accepted varieties of *C. indecora*, and did not demonstrate morphological, ecological, or

geographic distinctiveness. Based on this evidence, *C. indecora* s.l. is tentatively conserved as one morphologically variable, paraphyletic species. *Cuscuta indecora*'s infraspecific ranks of *C. indecora* were not separated by the phylogenetic or morphometric analyses, and have broad geographic and host range overlap. Therefore, infraspecific ranks were not recognized anymore. Additionally, new geographic records for *C. coryli* and a new insect-plant interaction are reported.

Collin Hudzik. 2023. Investigating interface-induced microRNA accumulation and regulation of the parasitic plant *Cuscuta campestris*. PhD, Penn State University, USDA. Dissertation Advisor Michael Axtell.

Abstract:
Small regulatory RNAs can move between organisms and regulate gene expression in the recipient. Several studies over the last decade have also shown that some small RNAs are exchanged between plants and their pathogens and parasites. The natural ability of plants to exchange small RNAs with invading eukaryotic organisms can be exploited to provide disease resistance. Conversely, pathogens can export small RNAs into their hosts in an attempt to increase their virulence. Whether the trans-species small RNAs being exported are distinguished from the normal endogenous small RNAs of the source organism is not known. The parasitic plant *Cuscuta campestris* (dodder) is a holoparasitic stem parasite which cannot sustain its own life without invading and growing on a host plant. Every year, *Cuscuta campestris* is responsible for damage to agriculturally important crops, often by reducing yield and acting as a vector for viruses to move from infected plants to healthy ones. Previous research has found that *Cuscuta campestris* produces many microRNAs that specifically accumulate at the host-parasite interface, several of which have been demonstrated to have trans-species activity. We have termed these as interface-induced microRNAs. Induction of *C. campestris* interface-induced microRNAs is similar regardless of host species and occurs in *C. campestris* haustoria produced in the absence of any host. It is likely that accumulation of interface-induced microRNAs is an inherent part of haustorium organogenesis. The loci-encoding *C. campestris* interface-induced microRNAs are distinguished by a common cis-regulatory element. This element is identical to a conserved upstream sequence element (USE) used by plant small nuclear RNA loci. The properties of the interface-induced microRNA primary transcripts strongly suggest that they are produced via U6-like transcription by RNA polymerase III. The USE promotes accumulation of interface-induced microRNAs (IIMs) in a heterologous system. This promoter element distinguishes *C. campestris* interface-induced microRNA loci from other plant small RNAs. These data suggests that *C. campestris* interface-induced microRNAs are produced in a manner distinct from canonical microRNAs. All confirmed *C. campestris* microRNAs with documented trans-species activity are interface-induced and possess these features. It is speculated that RNA polymerase III transcription of the interface-induced microRNAs may allow them to be exported to their hosts, while completely avoiding loading into the RNA induced silencing complexes in parasite tissues.

Max Körner. 2023. Parasitic molecular strategies to influence host plant signalling and gene transcription. Dissertation max. Universität Tübingen, Germany. Advisor Markus Albert.

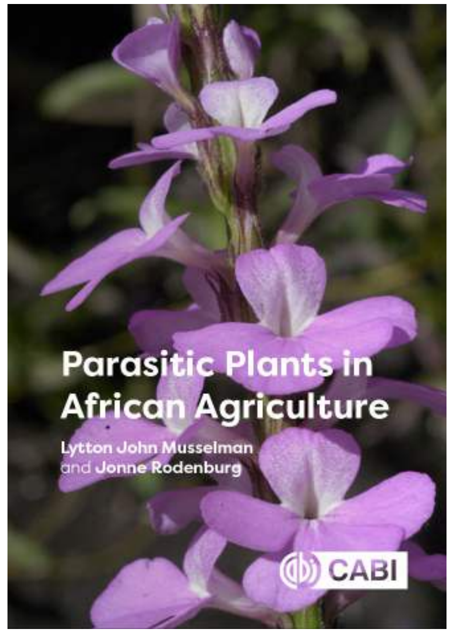
Abstract:
Parasitic plants are a constraint on agriculture worldwide. Plants of the genus *Cuscuta* are obligate holoparasites with a broad host spectrum for nearly all dicotyledonous plants. As leaf- and rootless plants, *Cuscuta* spp. wind around stems of host plants and penetrate host tissue with haustoria. They directly connect to the vasculature and exhaust water, nutrients and carbohydrates. Thus, the haustorium development and the establishment of a connection to the host represent essential steps in the parasite's life cycle. To date, little is known concerning the development of such host-parasite connections on molecular level. The aim of this work was to gain knowledge about specific molecular signals of *Cuscuta* spp. that get sensed by host plants and manipulate hosts towards susceptibility. On the host plant side, the major focus was to identify *Cuscuta*-derived transcription factor targets or receptors that recognize parasitic molecules and further induce cellular signaling programs related to susceptibility or development. To shed light on the transcriptomic reprogramming during the early stages of infection with *Cuscuta* spp., a transcriptome analysis by RNA sequencing after infiltration of *Cuscuta* extract into *N. benthamiana* leaves has been performed. Additionally, an intense literature search with a focus on RNA sequencing data providing

regulated transcripts of host and parasite genes was initiated. To investigate the molecular cues that might be necessary to switch-on host responses, intracellular processes and the connection to the host vascular system, promoters of up-regulated host genes at the *Cuscuta* spp. infection site have been used to control the expression of the luciferase reporter gene. To establish a promoter:luciferase based bioassay to screen for inducing *Cuscuta*-derived molecular cues, a promoter was needed to control luciferase expression leading to significantly increased light emission after treatment with *Cuscuta* Extract. The promoter:luciferase construct of USUALLY MULTIPLE ACIDS MOVE IN AND OUT TRANSPORTER 25 (pUMAMIT25:luc) that showed a specific reaction to *Cuscuta* extract was used to purify the *Cuscuta*-derived molecular cue. The purification and identification of the *Cuscuta*-derived molecule is part of an ongoing project. The molecule seems to be difficult to isolate since it did not bind to most of the tested chromatography columns. A characterization showed that the molecular cue had no charge, was hydrophilic and was not of proteidogenous nature. An in silico analysis of the host UMAMIT25 which seems manipulated by *C. reflexa* revealed its involvement in amino acid transport, that can be relevant for *Cuscuta* spp. nutrition and growth. Additional beneficial transporter genes like sucrose transporters were analyzed and the corresponding promoter:luciferase constructs showed increased light emission upon *Cuscuta* extract treatment. The experiments of this work leave it open whether the molecular cue might be a sucrose gradient, a *Cuscuta*-derived CLE peptide, a Transcription activator-like (TAL) effector-like or a still elusive molecular trigger.

NEW BOOK

Parasitic Plants in African Agriculture, 2023, by Lytton John Musselman and Jonne Rodenburg. CABI Digital Library. £95
https://www.cabidigitallibrary.org/doi/book/10.1079/9781789247657.0000

This new publication brings together for the first time in a single volume, the ecology, biology, damage, and control of all groups of African parasitic plants including both the relatively few parasites introduced to the continent as well as those native parasites that have spread from within Africa. The book covers the well-known witchweeds and broomrapes but also groups and species that have received less attention including mistletoes, dodders, rice vampire weed, and other species posing threats.



The book distinguishes between stem and root parasitic weeds and between holoparasites and (facultative or obligate) hemiparasites. Based on their research and experience collectively spanning six decades, the authors provide an authoritative and state-of-the-art overview of the distribution, biology and impact of these highly specialized weeds and include recommendations for their management. Since parasitic plants in African agriculture primarily affect smallholder farmers, these weeds are explicitly discussed within a context of resource limitations and global changes. Readers are informed on all parasitic plant species relevant to African agriculture and the impact these plants have on crop production and livelihoods of smallholders in a changing world. Current and future management strategies are outlined in terms of their principles and effectiveness as well as their feasibility and affordability for farmers, all of which determine farmer adoption. The final chapter synthesises some of the relevant findings and statistics regarding parasitic weed distribution and their host crops and discusses implications in terms of future crop protection concerns in African agricultural systems.

This book, highly illustrated with photos, graphs and species distribution maps, will be a valuable reference for students, researchers, extension workers, development officers, national agriculture researchers, plant pathologists, food security specialists, weed scientists, agronomists and botanists.

FUTURE MEETINGS

5th International Symposium on Broomrape in Sunflower, 1-3 November 2023, Megasaray Westbeach Hotel, Antalya, Turkey www.orobans.com

8th International and Interdisciplinary Mistletoe Symposium, Nonnweiler, Germany, 9-11 November, 2023, See: https://www.mistelsymposium.de

28th Asian-Pacific Weed Science Society Conference 2023. during 26-29 November 2023 in Phuket, Thailand. Will include a session on parasitic weeds.. www.apwss2023-phuket.com.

17th World Congress on Parasitic Plants Nara, Japan 3-7 June, 2024. https://www.kuba.co.jp/wcpp17/index.html

9th International Weed Science Congress, 7-11 July 2024 Jerusalem. https://www.iwsc2024.com/

GENERAL WEB SITES

For individual web-site papers and reports see LITERATURE
Some websites may need copy and paste.

For information on the International Parasitic Plant Society, past issues of Haustorium, etc. see: http://www.parasiticplants.org/

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.parasiticplants.siu.edu/

For the Parasitic Plant Genome Project (PPGP) see: http://ppgp.huck.psu.edu/ (may be temporarily unavailable)

For Old Dominion University Haustorium site: see https://ww2.odu.edu/~lmusselm/haustorium/index.shtml

For information on the new Frontiers Journal 'Advances in Parasitic Weed Research' see: http://journal.frontiersin.org/researchtopic/3938/advances-in-parasitic-weed-research

For a description of the PROMISE project (Promoting Root Microbes for Integrated *Striga* Eradication), see: http://promise.nioo.knaw.nl/en/about

For *Striga* Solutions, led by Prof. Salim Al-Babili, KAUST, Saudi Arabia: https://strigasolutions.com

For the Toothpick Project – see https://www.toothpickproject.org/

For the Annotated Checklist of Host Plants of Orobanchaceae, see: http://www.farmalierganes.com/Flora/Angiospermae/Orobanchaceae/Host_Orobanchaceae_Checklist.htm

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

For information on the work of the African Agricultural Technology Foundation (AATF) on *Striga* control in Kenya, including periodical 'Strides in *Striga* Management' and 'Partnerships' newsletters, see: http://www.aatf-africa.org/

For Access Agriculture (click on cereals for videos on *Striga*) see: http://www.accessagriculture.org/

For information on future Mistel in derTumortherapie Symposia see: http://www.mistelsymposium.de/deutsch/-mistelsymposien.aspx (NB see above re 7th Symposium)

For a compilation of literature on *Viscum album* prepared by Institute Hiscia in Arlesheim, Switzerland, see: http://www.vfk.ch/informationen/literatursuche (in German but can be searched by inserting author name).

For *Viscum album* Genespace Database see: viscumalbum.pflanzenproteomik.de/

For an excellent publication by the Universidade Federal do Rio Grande do Sul on Southern Brazilian Mistletoes (Dettke, G.A. and Waechter, J.L. 2013) see: https://fieldguides.fieldmuseum.org/sites/default/files/rapid-color-guides-pdfs/493.pdf

For a participatory website cataloguing tools for the identification and localization of fauna and flora, including parasitic plants see: https://nadaba.net/fr

For Phytoimages, a useful source for photos of weeds, including many parasitic species, see: http://www.phytoimages.siu.edu

COMPOSITE FILES

A reminder that all previous issues of Haustorium are available in two PDF documents, 'Haustorium1-48' and'Haustorium 49-83 (shortly to be updated) via the ODU Haustorium website - https://sites.wp.odu.edu/musselmanpage/haustorium/

SELECTED LITERATURE

Albanova, I.A., Zagorchev, L.I., Teofanova, D.R., Odjakova, M.K., Kutueva, LI.; and Ashapkin, V.V. 2023. Parasitic flowering plants represent a diverse group of angiosperms, ranging from exotic species with limited distribution to prominent weeds, Plants 12(7). (https://doi.org/10.3390/plants12071447) [A review covering the main groups of parasitic plants, with emphasis on host resistance.].

Anwarali-Khan Mursyidah, Mohamad Hafizzudin-Fedeli, Nor Muhammad, N.A., Latiff, A., Mohd Firdaus-Raih and Wan KiewLian. 2023. Dissecting the biology of *Rafflesia* species: current progress and future directions made possible with high-throughput sequencing data. Plant and Cell Physiology 64(4): 368-377. [A review.]

Aoki, N.**,** Cui SongKui**,** Ito, C.**,** Kumaishi, K.**,** Kobori, S.**,** Ichihashi, Y. ***and*** Yoshida, S. ***2022.***. Phenolic signals for prehaustorium formation in Striga hermonthica. Frontiers in Plant Science 13: (https://doi.org/10.3389/fpls.2022.1077996) [Results show kinetic and signaling differences in quinone (e'g DMBQ) and phenolic (e.g. syringic acid) HIFs, providing useful insights for understanding how parasitic plants interpret different host signals for successful parasitism.]

Arellano-Saab, A., Skarina, T., Xu, Z., McErlean, C.S.P., Savchenko, A., Lumba, S., Stogios, P.J. and McCourt, P. 2023. Structural analysis of a hormone-bound *Striga* strigolactone receptor. Naturer Plants. 9(6):883-888. (10.1038/s41477-023-01423-y) [Finding that when stigolactone binds the *Striga* receptor, ShHTL5, a series of conformational changes relative to the unbound state occur, but these events are not sufficient for signalling. Ligand-complexed receptors, however, form internal tunnels that posit an explanation for how SL exits its receptor after hydrolysis.]

Araújo, F.H.V. and 7 others. 2023. Spread of *Striga asiatica* through suitable climatic conditions: risk assessment in new areas producing *Zea mays* in South America. Journal of Arid Environments 210: (https://doi.org/10.1016/j.jaridenv.2022.104924) [Risk assessment indicated that Southeast and Northeast of Brazil are at the most significant risk of *S. asiatica* invasion. Projections for climate change between 2040-2059 showed probable expansions in the areas at risk.]

Asfarina, I., Siti-Munirah, M.Y., Susatya, A., Norhazlini, M.Z. and Zulhazman, H. 2022. Examining the anatomical characteristics of *Rafflesia kerrii* in Lojing Highlands, Peninsular Malaysia. IOP Conference Series : Earth and Environmental Science 1102: (DOI 10.1088/1755-1315/1102/1/012068) [Describing the anatomical characteristics of *R. kerrii* using micro techniques analysis, and comparing with those of a similar species found in Thailand, finding minor differences such as in the presence of starch grains, distance between vascular bundles in perigone lobe, and the presence of trichome in the compartment of windows.]

Bilinozhko, Yu.O. and 7 others. 2022. (Some characteristics of woody plants inhabited by *Viscum album* (Santalaceae) in the city of Kyiv.) (in Ukrainian) Ukrainian Botanical Journal 79(6): 388-396. [*V. album* (ssp. not stated) occurred mainly on *Acer, Salix, Robinia, Populus, Tilia* and *Betula* spp.. *Quercus, Alnus* and *Ulmus* were unaffected.]

Calderón-González, Á., Pérez-Vich, B., Pouilly, N., Boniface, M.C., Louarn, J., Velasco, L. and Muños, S. 2023. Association mapping for broomrape resistance in sunflower. 14: (https://doi.org/10.3389/fpls.2022.1056231) [Identifying 14 SNP markers significantly associated with resistance *to Orobanche cumana*. including at two tightly linked SWEET sugar transporter genes.]

Chabaud, M. and 11 others. 2022.Wild *Helianthus* species: a reservoir of resistance genes for sustainable pyramidal resistance to broomrape in sunflower.Frontiers in Plant Science 13: (https://doi.org/10.3389/fpls.2022.1038684) [From 71 wild sunflowers and wild relatives accessions from 16 *Helianthus* species, screened in pots for their resistance to *Orobanche cumana*, 18 accessions from 9 species showed resistance, due to various mechanisms.]

Chen, X. and 30 others. 2023. *Balanophora* genomes display massively convergent evolution with other extreme holoparasites and provide novel insights into parasite–host interactions. Nature Plants: (https://doi.org/10.1038/s41477-023-01517-7) [Patterns of gene loss appear to be bubstantially divergent across distantly related lineages of hemiparasites. In contrast, *Balanophora* has experienced substantial gene loss for the same sets of genes

as an independently evolved holoparasite lineage, the endoparasitic *Sapria* (Malpighiales), and the two holoparasite lineages experienced convergent contraction of large gene families through loss of paralogues.]

Chitralekha, P. and Anita Rani. 2022. *Cuscuta reflexa* Roxb. parasitism: structural development of adhesive disk. Phytomorphology 72(1/2): 1-12. [Studying the initial adhesion of *C. reflexa* to various hosts. At the site of contact with the host, the epidermal cells develop a highly invaginated surface. The cementing material at the site of contact, material appears to be different from that of the primary cellulosic walls of the epidermis.]

Chitraleka, P., Anita Rani, Roma Katyal, Rashmi Mathur and Saloni Gulati. 2022. *Cuscuta reflexa* Roxb. parasitism: the development of haustorium. Phytomorphology 72(3/4): 55-68. [Studying the development of the haustorium in *C. reflexa* in a number of host plants, and concluding that a two-way interaction between the signals derived from the host vascular cells and the cells of the haustorium, is a prerequisite for the differentiation of not only the intrusive cells but also the (procambium-like) cells of the haustorium into conducting cells, to establish a continuous vascular connection between the host and the parasite.]

Costea, M. and Teillier, S. 2022. Taxonomic revision of *Cuscuta* (Convolvulaceae) in Chile. Gayana Botánica 79(2): 84-106. [Confirming 11 species of *Cuscuta* in Chile, providing identification key, typification, detailed descriptions and illustrations. Their taxonomy is discussed, geographical distribution, ecology and host range of species detailed. *C. andina*, *C. rustica*, *C. pauciflora* are rare and *C. werdermannii* probably extinct.]

De Menezes, M.O.T., Stannard, B.L., Caires, C.S., Loiola, M.I.B. and Moro, M.F. 2022.

Flora of Ceará, Brazil: Loranthaceae. Rodriguésia 73: (https://doi.org/10.1590/2175-7860202273082) [Providing distribution maps, identification key, and taxonomic descriptions for *Passovia pedunculata*, *P. pyrifolia*, *Psittacanthus cordatus*, *P. dichroos*, *P. eucalyptifolius*, *Struthanthus marginatus*, *S. polyrrhizus*, and *S..syringifolius*.]

En-Nahli, Y. Hejjaoui, K., Es-Safi, N.E. and Amri, M. 2023. Large field screening for resistance to broomrape (*Orobanche crenata* Forsk.) in a Global Lentil Diversity Panel (GLDP) (*Lens culinaris* Medik.). Plants 12(10): (https://doi.org/10.3390/plants12102064) [Out of the 1315 tested genotypes, only ILL7723, ILL 7982, ILL 6912, ILL 6415, ILL 9850, ILL 605, ILL 7915, ILL 1861 and ILL 9888 showed good resistance.]

Fedoronchuk, M.M. 2022. (Analysis of the range dynamics of rare species of vascular plants of the flora of Ukraine. 1. *Cymbaria borysthenica* (Orobanchaceae).) (in Ukrainian) Ukrainian Botanical Journal 79(6): 404-412. [*C. borysthenica* is endemic to the Northern Black Sea but is threatened by ploughing, hydroelectric schemes, mining and war.]

Feller, B., Dančák, M., Hroneš, M., Sochor, M., Suetsugu, K. and Imhof, S. 2022. Mycorrhizal structures in mycoheterotrophic *Thismia* spp. (thismiaceae): functional and evolutionary interpretations. Mycorrhiza 32(3/4): 269-280. [Describing the root anatomy and mycorrhizal pattern of eight mycoheterotrophic *Thismia* spp. all showing separate tissue compartments segregating different hyphal shapes - intact straight, coiled and peculiarly knotted, as well as degenerated clumps of hyphal material, potentially comprising exo-, meso- and endoepidermae, and exo-, meso- and endocortices,]

Flanders, N., Randle, C.P. Walters, E.L. and Musselman, L.J. 2023. Variation in establishment success for American mistletoe *Phoradendron leucarpum* (Raf.) Reveal & M. C. Johnst. appears most likely to predict its distribution in Virginia and North Carolina, United States. Botany (https://doi.org/10.1139/cjb-2023-0050) [Light availability proved the main predictor for the establishment of *P .leucocarpum* in wetlands.]

Gani, M. and Avidime, J.O. 2023. Baseline Survey on Sorghum (*Sorghum bicolor* L.) Production in Southern Taraba State. Inernational Journal of Agriculture and Earth Sciences 9(1)**:** (https://doi.org/10.56201/ijaes.v9.no1.2023.pg31.38) (Survey shows that the major problem for sorghum growers in Taraba State, Nigeria is *Striga hermonthica*.]

Garg, A. and Shukla, A. 2023. A new hemiparasitic species of *Pedicularis* (Orobanchaceae) from North Sikkim, India. Nordic Journal of Botany. 10: (https://doi.org/10.1111/njb.03966) [Describing *P. revealiana* distinguished from *P. gracilis* by perennial caespitose habit, stout and woody stems with decumbent branches and congested internodes, and other details of foliage and flowers.]

Gebereegziher, W.G., Alemu, A.K., Zebib, K. and Tarekegn, Y. 2023. Application of soil solarization and manure, individually and in combination, control broomrape infestation and improve tomato yield. International Journal of Vegetable Science 29(3): 205-214. [Soil

solarization depleted 'broomrape', presumably *Phelipanche ramosa* soil seed bank up to 85%. Wet solarization+cow manure improved tomato yield by 26.5 $t.ha^{-1}$ over the control with substantial net economic benefit.]

Gibot-Leclerc, S., Dessaint, F., Connault, M. and Peronne, R. 2023. Can amino acids be used to inhibit germination or deplete the soil seedbank of *Phelipanche ramosa* (L.) Pomel.? Journal of Plant Disease and Protection: https://doi.org/10.1007/s41348-023-00797-7 [Showing a strong but temporary inhibitory effect of concerning arginine and lysine, on the seed germination of *P. ramosa,* while the effect of phenylalanine and tryptophan was permanent, causing high inhibition of germination and high seed. Suggesting ways they might be used in the field.]

Glofcheskie, M., Long, T., Ho, A. and Costea, M. 2023. Inflorescences of *Cuscuta* (Convolvulaceae): diversity, evolution and relationships with breeding systems and fruit dehiscence modes. PLoS ONE 18(5): (https://doi.org/10.1371/journal.pone.0286100) [From a study of 132 *Cuscuta* taxa, three major types of inflorescences were observed: "*Cuscuta type*", a simple, monochasial scorpioid cyme; "*Monogynella type*", a compound monochasial scorpioid cymes with the longest primary axes having prolonged vegetative growth and giving the appearance of thyrses; and "*Grammica type*", a compound monochasial scorpiod cymes with up to five orders of axes. Maximum likelihood analyses suggested *Monogynella* as the ancestral type, while *Cuscuta* and *Grammica* were derived.]

Gressel, J. 2023. Four pillars are required to support a successful biocontrol fungus. Pest Management Science. (https://doi.org/10.1002/ps.7417) [Not specific to parasitic weeds, but… 1) virulence needs to be enhanced; 2) inoculum production must be cost-effective; 3) inocula need to have long shelf-life; and 4) must be bio-safe.]

Hartenstein, M., Albert, M. and Krause, K. 2023. The plant vampire diaries: a historic perspective on *Cuscuta* research. Journal of Experimental Botany 74(10): 2944-2955. [An interesting historical review, leading up to discussion of remaining as well as newly evolving questions and future directions in this research.]

Huizinga, S., and Bouwmeester, H.J. 2023., Role of strigolactones in the host specificity of broomrapes and witchweeds, Plant and Cell Physiology, pcad058, (https://doi.org/10.1093/pcp/pcad058) [An authoritative review discussing the molecular basis of SL sensitivity and specificity in these parasitic plants through HTL/KAI2s and review the evidence that these receptors contribute to host specificity of parasitic plants.]

Jamil, M., **Wang, J.Y.**, **Berqdar, L.**, **Alagoz, Y.**, **Behisi, A.** and **Al-Babili, S. 2023. Cytokinins as an alternative suicidal *Striga* germination compound**. Weed Research, **1**– **8**. (**https://doi.org/10.1111/wre.12585**) [Fluridone and cytokinins each at 100 µM showed 19% and 63% *Striga* germination. A combination of fluridone with thiadiazuron led to above 93% germination of treated seeds, and when added to pots of rice, led to 86-100% reduction in *Striga* emergence.]

Jamil, M. and 9 others. 2022. New **s**eries of zaxinone mimics (MiZax) for **f**undamental and **a**pplied **r**esearch. Biomolecules 13(8): (https://doi.org/10.3390/biom13081206) [Describing the synthesis and activity of two zaxinone mimics (MiZax3 and MiZax5) having remarkable growth-promoting activity on crops and a capability to stimulate germination of *Striga* through decreasing strigolactone (SL) production???]

Jhu MinYao and Sinha, N.R. 2022. *Cuscuta* species: model organisms for haustorium development in stem holoparasitic plants. Frontiers in Plant Science 13: (https://doi.org/10.3389/fpls.2022.1086384) [Reviewing the current understanding of haustorium development in *Cuscuta* spp. and the unique characteristics of their parasitizing behaviors, Describing the initiation phase stimulated by far-red light and mechanical contact, followed by adhesion, penetration and vascular connection. Noting the distinction from the processes in root parasites. Eg, see Aoki *et al.* above]

Jia Xin Yap snd Yuichiro Tsuchya. 2023. Gibberellins promote seed conditioning by up-regulating strigolactone receptors in the parasitic plant *Striga hermonthica*. Plant and Cell Physiology, 64(9): 1021–1033 .(https://doi.org/10.1093/pcp/pcad056)

Jose Mathew and Salim, P.M. 2022.*Christisonia flavirubens* (Orobanchaceae), a new species from south Western Ghats, India. Biodiversity: Research and Conservation 68: 1-7. [The diagnostic morphological characters, distribution and images of *C. flavirubens* the new species are presented. Images and comparative characters of the reddish yellow-coloured *Christisonia* species of the south Western Ghats are also provided for its easy identification.]

Krasylenko, Y. and 9 others. 2023. Druid Drone-a portable unmanned aerial vehicle with a multifunctional manipulator for forest canopy and mistletoe research and management. Methods in Ecology & Evolution 14(6): 1416-1423. [Describing an ingenious drone, which can not only survey forest canopy for the presence of *Viscum album,* but further can be fitted with an entomological unit for arthropod trapping, a forceps arm for soft plant tissue collection, a saw for cutting harder tree tissues such as twigs and a precision sprayer, which applies growth regulators or other compounds for tree and mistletoe management.]

Kusuma, Y.W.C., Matsuo, A., Suyama, Y., Wanke, S. and Isagi, Y. 2022. Conservation genetics of three *Rafflesia* species in Java Island, Indonesia using SNP markers obtained from MIG-seq. Conservation Genetics 23: 1039–1052. [166 samples of *R. patma*, *R. rochussenii*, and *R. zollingeriana* showed low genetic diversity attributed to bottleneck events. Clonality and existence of different genotypes within *Tetrastigma* host plants in two species was demonstrated.]

Lebedeva, M.A., Gancheva, M.S., Losev, M.R., Krutikova, A.A., Plemyashov, K.V. and Lutova, L.A. 2023. Molecular and genetic bases for sunflower resistance to broomrape. Russian Journal of Plant Physiology 70: (https://doi.org/10.1134/S1021443723600824) [Reviewing the molecular and genetic mechanisms of sunflower resistance to *Orobanche cumana* on the basis of mapping loci associated with resistance and identification of putative candidate genes, as well as on the basis of transcriptomic data.]

Le Corre, V., Reibel, C., Kati, V. and Gibot-Leclerc , S. 2023. Host-associated genetic differentiation and origin of a recent host shift in the generalist parasitic weed *Phelipanche ramosa.* Ecology and Evolution: (https://doi.org/10.1002/ece3.10529) [Studying the genetic structure of *P. ramosa* from a range of crops and concluding that that infesting oilseed rape has evolved relatively recently from an unknown source.]

Lepschi, B.J. 2022. *Exocarpos capnodioides* (Santalaceae), a new species from southern Australia allied to *E. aphyllus*. Nuytsia 33: 103-111. [Describing the diagnostic characters, distribution, phenology, conservation status, and etymology of *E.capnodioides* and providing a revised description of its closest relative, *E. aphyllus*.]

Lobulu, J., Shimelis, H.;,Laing, M.D., Mushongi, A.A., Shayanowako, A.I.T. 2023. Progeny testing of maize (*Zea mays*) genotypes for grain yield and yield components, *Striga* resistance and *Fusarium oxysporum* f.sp. *strigae* compatibility. Plant Breeding 142(3): 284-299. [Studies in Tanzania involving both *S. asiatica* and *S. hermonthica* led to the identification of genotypes SITUKA M1, TZA4010, TZA4016, TZA4203, JL01, JL05, JL13 and JL17 with less *Striga* infestation and higher maize yields. *Fusarium* treatment tended to improve suppression of *Striga*.]

Lombard, N. and le Roux, M.M. 2023. *Thesium hispidifructum* (Santalaceae), a new hispidulous species from Limpopo, South Africa and notes on enigmatic *T. celatum*. Taxonomy 3(1): 95-108. [Describing the new species *T. hispidifructum* and clarifying the status of *T. celatum*, providing morphological descriptions, information on their distribution and habitat, comparisons and an identification key with morphologically similar species and photo plates.]

Lu Zhang, Xiaolei Cao, Zhaoqun Yao, Xue Dong, Meixiu Chen, Lifeng Xiao, Sifeng Zhao. 2022. Identification of risk areas for *Orobanche cumana* and *Phelipanche aegyptiaca* in China, based on the major host plant and CMIP6 climate scenarios. Ecolog and Evolution 12(4) (https://doi.org/10.1002/ece3.8824) ?? [Xinjiang and Inner Mongolia were the highest-risk areas for the distribution of *O. cumana* and *P. aegyptiaca*. Elevation and topsoil pH were the decisive factors for *O. cumana* distribution; precipitation seasonality and annual precipitation were the dominant variables for *P. aegyptiaca*.]

Lüth, P., Nzioki, H., Baker, C. and Sands, D. 2023. Biological control of *Striga hermonthica* in Kenya, first results of a new seed coating technology. IOBC/WPRS Bulletin 165: 2-5. [Reporting 88% yield increase in a first field test of *Fusarium oxysporum* f. sp. *strigae* strain DSM 33471 as a powder seed coating.]

Maciunas, E.C., Watling, J.R., Facelli, J.M. and Packer, J.G. 2022.Seed traits and fate support probable primary dispersal of a native hemi-parasitic vine *Cassytha pubescens* (Lauraceae) by *Isoodon obesulus*, an endangered marsupial, in southern Australia. Transactions of the Royal Society of South Australia 146(2): 249-261.

Makebe, A. and Shimelis, H. 2023. Diversity analysis for grain nutrient content and agronomic traits among newly bred *Striga*-resistant and *Fusarium oxysporum* f.sp. *Strigae* (*FOS*)-compatible sorghum genotypes. Diversity 15(3): (https://doi.org/10.3390/d15030371) [12 elite and newly bred sorghum lines screened for *S. hermonthica* resistance and nutritional traits, and

AS1, PAN8816, 672, Macia, AS436, 3984 × 630, AS426 × 672, and 105 × 654 were identified as having superior agronomic and nutritional qualities for commercialization and sorghum breeding programs.]

Makinde, S.A., Badu-Apraku, B., Ariyo, O.J. and Porbeni, J.B. 2023. Combining ability of extra-early maturing pro-vitamin A maize (*Zea mays* L.) inbred lines and performance of derived hybrids under *Striga hermonthica* infestation and low soil nitrogen. PLoS ONE 18(2): (https://doi.org/10.1371/journal.pone.0280814) [Describing the development of a number of maize lines with enhanced vitamin A and yiled across *Striga* infested and low N situations.]

Martinez, L. and 10 others. 2022. Comparative analysis of two neighboring conducive and suppressive soils towards plant parasitism caused by *Phelipanche ramosa* L. Pomel on *Brassica napus* L. Research Square: (https://doi.org/10.21203/rs.3.rs-3059250/v1) [Identifying suppressive soils in which *P. ramosa* was proving less damaging to rapeseed, and identifying a number of fungi associated with the suppression, including a *Berkeleyomyces* sp., a necrotrophic fungal genus known to cause black root rot.]

Menkir, A. and 11 others. 2022. Estimating genetic gains for tolerance to stress combinations in tropical maize hybrids. Frontiers in Genetics 13: (https://doi.org/10.3389/fgene.2022.1023318) [Results emphasize the need to screen inbred linens under both *Striga hermonthica* and drought stress conditions to enhance the rate of genetic gain in grain yield in hybrids for areas where the two stresses co-occur, nd claiming that that the sequential selection scheme has been successful in generating hybrids with dependable yields that are successful in the presence of both stresses.]

Mkala, E.M. M. and 7 others. 2023. Phylogenetic and comparative analyses of *Hydnora abyssinica* plastomes provide evidence for hidden diversity within Hydnoraceae. BMC Ecology and Evolution 23: 34. (https://doi.org/10.1186/s12862-023-02142-w) [Plastomes sequences from seven Kenyan *H. abyssinica* accessions as well one from Namibia and *H. arabica* from Oman were generated. Phylogenetic divergence in the Namibian specimen suggests it could be recognized as a distinct species (*H. solmsiana*) and the Oman collection as *H. hanningtonii*.]

Moncalvillo, B. and Matthies, D. 2022. Performance of a parasitic plant and its effects on hosts depends on the interactions between parasite seed family and host species. AoB Plants 15(2): (https://doi.org/10.1093/aobpla/plac063) [Studies with *Rhinanthus alectropholus* suggest their effects on host plants varied according to their maternal family]

Mutinda, C., Mobegi, F.M. Hale, B., Dayou, O., Ateka, E., Asela, W., Wicke, S., Bellis, E.S. and Runo, S. 2023. Resolving intergenotypic *Striga* resistance in sorghum, Journal of Experimental Botany 74(17): 5294–5306. (https://doi.org/10.1093/jxb/erad210) [Cell wall-based resistance was common to a range of sorghum genotypes but strongest in IS2814, while a hypersensitive response was specific to N13, IS9830, and IS41724. weighted gene co-expression network analysis (WGCNA) further allowed for pinpointing of *S. hermonthica* resistance causative genes in sorghum, including glucan synthase-like 10 gene, a pathogenesis-related thaumatin-like family gene, and a phosphoinositide phosphatase gene.]

Mwangangi, I.M., Büchi, L., Runo, S. and Rodenburg, J. 2023. Essential plant nutrients impair post-germination development of *Striga* in sorghum. Plants, People, Planet (https://doi.org/10.1002/ppp3.10418) [Showing that macronutrients not only reduce stimulant exudation but improve mechanical resistance, hypersensitive and incompatibility responses before *Striga* reaches the host-root xylem.]

Nabloussi, A., Perez-Vich, B. and Velasco, L. 2023. Virulence, genetic diversity, and putative geographical origin of sunflower broomrape populations in Morocco.

Sunflower broomrape (*Orobanche cumana* Wallr.) was detected for the first Phytopathologia Mediterranea 62(1): 65-72. [Noting that *O. cumana* was first detected in Morocco in 2016. two of three populations now found to be race G, while one is race E.]

Nuraliev, M. S., Van The Pham, Van Canh Nguyen and Parnell, J.A.N. 2023. Sorting out *Aeginetia* (Orobanchaceae) in Indochina: *A. sessilis* is a synonym of *A. acaulis*. Phytotaxa 597(4): 269-279. [Finding that *A. sessilis*, reported as an endemic from India, is in fact not distinguishable from the more widespread *S. acaulis*. The diversity of *Aeginetia* in SE Asia is summarized, and an identification key is provided.]

Olowe, O. M. and 7 others. 2023. Trenchant microbiological-based approach for the control of *Striga*: current practices and future prospects. Frontiers in Sustainable Food Systems 7: (https://doi.org/10.3389/fsufs.2023.1073339) [A review highlighting the major potentials of microbial-based approaches to the control of *Striga*.]

Ortega-González, P.F., Rios-Carrasco, S., Mandujano, M.C., Sánchez, D. and Vázquez-Santana, S 2022. Reproductive aspects and pollination biology in endoparasitic *Pilostyles thurberi* (Apodanthaceae). Plant Species Biology 38(2): 40-53. [Describing the hosts, sexual flower arrangement, floral concentration, rewards, and reproductive success in different populations of *P. thurberi*. It has unisexual flowers with male, female, and mixed sex arrangements. Bees and wasps are the effective pollinators.]

Qin Liu,Lu EnKe; Chen KeXin; Bao RiZhen; Liang LiNa Hu XiaoHu. 2023. ??

The complete chloroplast genome of *Striga asiatica* (L.) kuntze 1891 (*Orobanchaceae*), a hemiparasitic weed from Guangxi China. Mitochondrial DNA Part B 8(4): 97-500.

Quinodoz, P. and 10 others. 2023. Selective synthesis and biological profile of all stereoisomers of lactam analogues of strigolactones GR24 and GR18. Helvetica Chimica Acta 106(1): (https://doi.org/10.1002/hlca.202200145) [Describing the stereoselective synthesis of GR24 and GR18 lactams harnessing the chemistry of chiral keteniminium salts, the biological activity on maize of the 32 stereopure strigolactams prepared, and their variable half-lives in rthe soil.]

Parise, A G , Oliveira, T.Fd.C., Debono, M-W. and Souza, G.M. 2023. The electrome of a parasitic plant in a putative state of attention increases the energy of low band frequency waves: A comparative study with neural systems. Plants12(10): 2005. (https://doi.org/10.3390/plants12102005) [Finding that that most electrical band waves were in the lower frequencies in *Cuscuta racemosa* and that it invested more energy in these low-frequency waves when suitable hosts were present, supporting the hypothesis of attention in plants.]

Piwowarczyk, R., Kolanowska, M. Effect of global warming on the potential distribution of a holoparasitic plant (*Phelypaea tournefortii*): both climate and host distribution matter. Scvientific Reports 13(7): (https://doi.org/10.1038/s41598-023-37897-1)


[Discussing the serious risk of loss of this intensely coloured holoparasitic species from the Causcasus and Turkey.]

Roobroeck, D., Kimutai, G., Kanampiu, F., de Nowina, K.R. andVanlauwe, B. 2023. Effective *Striga* control and yield intensification on maize farms in western Kenya with N fertilizer and herbicide-resistant variety. Field Crops Research 296: (https://doi.org/10.1016/j.fcr.2023.108924) [Comparing N and IR maize, for their effects on *S. hermonthica* emergence and maize yields; concluding that IR maize is more effective than N fertilizer in reducing *Striga* emergence, while N fertilizer is more effective than IR maize in increasing maize yield.]

Sarika Singh, Moin Uddin, Khan, M.M.A., Chishti, A.S., Sangram Singh and Bhat, U.H. 2023. Plant-derived smoke has the potential to be used in tissue culture, agriculture, and ecological restoration Plant Stress 7: (https://doi.org/10.1016/j.stress.2023.100147) [A review.]

Sawadogo-Ilboudo, T. C., Guinko, A., Nare, Rayim-Wendé Alice, Zerbo, R.M.N. and Boussim, J.I. 2023. (Diversity of *Cuscuta australis* R. Br host 'plants in Ouagadougou city (Burkina Faso).) (in French) International Journal of Biological and Chemical Sciences 17(1): 106-116. [Reporting on a wide range of host plants of the apparently dominant *C. australis* in Burkino Faso, not *C. campestris.*]

Siddiqui, A.O., Zorilla, J.G., Cimmino, A., Fernández-Aparicio, M. and Masi, M. 2023. *Tragopogon angustifolius* as a source of specialized metabolites for the control of broomrape weeds. Conference paper. ?? [Showing that maceration of the roots of *T. angustifolius* yielded in an extrac;t having strong stimulatory effect on seeds of *Orobanche* and *Phelipanche* spp.]

Singh, Y.T., Laldinliana Khiangte, Singh, S.P., Hmingremhlua Sailo and Laldinfeli Ralte. 2022. New distribution record and DNA barcoding of *Sapria himalayana* Griff. (Rafflesiaceae), a rare and endangered holoparasitic plant from Mizoram, India. Journal of Threatened Taxa 14(12): 22215-22220. [*S. himalayensis* successfully identified using amplification of the internal transcribed spacer 2 (*ITS2*) region.]

Sonoda, M., Mimura, Y., Noda, S. and Okazawa, A. 2023. Synthesis of aryloxyacetylthiourea derivatives for the development of radicle elongation inhibitor of parasitic weeds. Tetrahedron 135: (https://doi.org/10.1016/j.tet.2023.133333)

Taşar, N., Tekbudak, I.K.,Demir, I., Açar, M. and Kürşat, M. 2023. Comparative karyological analysis of some Turkish *Cuscuta* L. (Convolvulaceae). Caryologia 75(3): 145-157. [Confirming the chromosome numbers of *C. kotschyana*, *C. babylonica*, *C. europaea*, *C. kurdica*, *C. planiflora* as 2n=14; *C. campestris*, *C. hyalina*, *C. approximata*, *C. lupuliformis*, and *C. palaestina* as 2n=28 and *C. brevistyla* as 2n=42. Those for *C. kotschyana* and *C. kurdica* taxa were defined for the first time in this study.]

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