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1987/CS26C

COTTON RESEARCH COMMITTEE

REPORT ON TRAVEL TO SIXTH INTERNATIONAL SYMPOSIUM ON INSECT-PLANT
RELATIONSHIP, UNIVERSITY OF PAU, 1-5 JULY 1986, AND RESEARCH
INSTITUTIONS IN BRITAIN.

PROJECT CODE: CS26C FINAL REPORT

A travel grant of \$3,000 was allocated by CRC in 1984/85 to assist with the attendance of Dr. G.P. Fitt at the 6th International Symposium Insect-Plant Relationships, University of Pau, France (July 1-5 1986). A further sum of \$1,000 was allocated in 1985/86 to cover additional unexpected costs due to dramatic currency fluctuations since the initial proposal.

The funds were used mainly to cover the costs of a return airfare to Europe and attendance and registration at the Conference. However, the opportunity was taken to include visits to a number of research facilities in Britain dealing directly with Heliothis or with research relevant to Dr. Fitt's programme (see attached itinerary).

CONFERENCE REPORT

The conference was limited to 120 participants, though approximately 150 people attended the 4 days of spoken papers and posters. The Conference was organised into 8 sessions dealing with; the influence of host plant chemistry on insect physiology and behaviour, host plant influences on insect populations and community organisation, mechanisms of host-finding, the influence of internal rhythms, physiological state and learning on host selection, the selection of cultivars and improvement of host plant resistance to phytophagous insects, and the role of coevolution in insect-plant relationships. A total of 50 spoken papers and 74 posters were presented. Dr. Fitt presented a spoken paper in Session 7 entitled "Ovipositional responses of Heliothis spp. to host plant variation in cotton (Gossyium hirsutum)", a copy of which is attached. The symposium is being published in book form and written papers were limited to five printed pages.



This paper was well received and stimulated some useful comments and suggestions.

Since the aim of the Symposium was to bring together established scientists of high standing with younger colleagues just entering the field, there was a good mix of high class theoretical treatments and empirical studies dealing with many aspects of insect-plant interactions. There was a particularly strong emphasis on the roles of host plant chemicals and their perception by insects in mediating host finding and acceptance.

Heliothis spp. were the subjects of a number of contributions. H. Rembold (Max-Planck Institute, West Germany) presented laboratory data showing the role of, as yet unidentified, volatile chemicals in the attraction of female H. armigera to pigeon pea (Cajanus cajan). The aim of this work is to direct plant breeders in their efforts to develop Heliothis resistant strains of this legume by removing the attractive volatiles.

D.A. Nordlund (USDA, Texas, USA) discussed the role of host plant chemicals in mediating host-parasitoid interactions with particular reference to Heliothis and the parasitoids Trichogramma pretiosum and Microplitis croceipes. He presented data showing that tomato plants possess synomones which attract and/or stimulate searching behaviour in female Trichogramma. In other work differences in the chemical composition of Heliothis larval frass due to different host plants were shown to influence searching efficiency of Microplitis. Both these findings are being explored in the hope of using plant allelochemics to enhance the value of these parasitoids as control agents on field crops, such as cotton. S.B. Vinson (Texas A M University, USA) discussed the influence of volatiles produced by cotton plants on parasitism of Heliothis larvae by Camponotus sonorensis. Six volatile sesquiterpenes have been isolated from cotton and shown to attract Camponotus. Considerable differences in terpenoid composition were found between cotton cultivars which were correlated with their attractiveness to

the wasps and consequently influenced the proportion of Heliothis larvae parasitised.

Of relevance to studies of insecticide resistance in Heliothis in Australia was the paper by Dr. A McCaffery, University of Reading, showing the influence of consumption of different host plants on the susceptibility of H. armigera larvae to a range of insecticides. The consumption of legumes in particular confers considerable protection against some insecticides, primarily by induction of the mixed function oxidase detoxication systems.

Two poster papers dealt with evolutionary aspects of Heliothis host plant relations. F. Gould (North Carolina State University, USA) examined the genetics of host range evolution in H. virescens in multicropping systems taking into consideration genetic variation in larval physiology and adult behaviour and possible defensive responses by the host plants. T. Mueller (University of Arkansas, USA) discussed the roles of host plant chemistry (primary and secondary) acting in different ways on larvae and adults as factors determining host relations of H. virescens, H. zea and H. subflexa.

Other highlights included; papers on induced plant defenses and their roles in insect-plant relations by P.S. Edwards and S. Wratten (University of Southampton, England) and E. Haukioja (University of Turku, Finland), a review of the roles of plant chemistry in associations between swallowtail butterflies and their host plants by P. Feeny (Cornell University, USA), a concluding paper by host plant selection and the role of plant chemistry by Prof. Vincent Dethier (University of Massachusetts, USA) and round table discussions on Insect Herbivores and the Population Dynamics of Plants (chaired by H. Crawley, Oxford) and Host Finding (chaired by J.S. Kennedy, Oxford).

Overall the conference was well worth attending primarily because of the new contacts established, particularly with Heliothis workers in Europe.

VISITS TO RESEARCH INSTITUTIONS

A detailed itinerary of visits is attached. Most were organised prior to leaving for overseas, but contact with Drs. M. Simmonds and J. Horn at the Insect-Plant Symposium resulted in the visits to Jodrell Laboratories, Royal Botanic Gardens, Kew.

1. TROPICAL DEVELOPMENT AND RESEARCH INSTITUTE (TDRI), LONDON.

TDRI is a unit of the Overseas Development Administration and is involved in wide-ranging research on agricultural production systems in developing countries.

Discussions were held with Dr. D. Cooter (Head of Physiology and Behaviour, Dept. of Applied Ecology) and Dr. N. Ames on their current work with Heliothis. Dr. Cooter is involved in two projects, one (with Dr. Ames) dealing with flight and reproductive performance of Heliothis in relation to larval and adult diet, fecundity and adult survival. This involves field studies at ICRISAT, India and laboratory studies in Britain where flight mills are used for studying flight capabilities of moths reared under different environmental conditions. The latter measurements are designed to examine extrinsic factors influencing the proportion of individuals making long, presumably migratory, flights. The second project, based in the Sudan and involving collaboration with researchers at the University of Khartoum, aims to develop an integrated pest management scheme for Heliothis on small farm plots of vegetable crops, particularly tomatoes, and in sorghum. The project will consider damage levels due to Heliothis, aspects of chemical control and studies of population dynamics including movement from other crops, such as groundnut and cotton. Dr. Cooter was most interested to hear of Heliothis population studies in Australia, and particularly Dr. Fitt's

work on methods for quantifying intercrop movement using elemental analysis.

Discussions were held with Dr. D. Pedgley and Dr. J. Riley on insect migration in general as influenced by meteorological conditions and the use of radar for studying migratory movements in the African Armyworm. Dr. Riley is now involved in a radar study of Heliothis movement in the area around ICRISAT, India, similar to those undertaken or planned by CSIRO Division of Entomology Insect Migration Group in Australia.

TDRI has a small pheromone research group involved in practical and theoretical aspects of the use of pheromones for insect monitoring and control. They also have a pheromone chemistry group involved in pheromone identification and synthesis and work closely with commercial organisations involved the application of this technology to the field. The major emphasis is on the use of pheromones for pest control by means of mating disruption or confusion. The most successful example developed by TDRI has been the use of mating disruption for the control of pink bollworm, Pectinophora gossypiella in cotton in Egypt, using field applications of microencapsulated pheromones. Similar studies are now underway in Pakistan, where pheromonal control of Earias spp. is also being investigated. The possibilities for pheromonal control of Spodoptera in cotton is being pursued in Egypt. Discussions were held with Dr. J. Murlis on the structure of volatile odour plumes in open air and the influence of odour dispersion patterns on the perception of sex pheromone sources by flying insects. Dr. Murlis has developed a technique involving the use of ionised particle sources and detectors to characterise the structure of odour plumes in the field. The problems involved in interpreting pheromone trap catches were discussed. Work is now underway using wind tunnels and video recording techniques to characterise the sequence of behaviours involved in perception and response of male H. armigera to particular pheromone components.

2. UNIVERSITY COLLEGE OF NORTH WALES, BANGOR, NORTH WALES

The purpose of this visit was to meet with Dr. A.G. Gatehouse and his students to discuss their long-term research on migration and its influence of population dynamics in the African armyworm, Spodoptera exempta. This was a most stimulating visit to an extremely able and productive research group. Dr. Gatehouse has developed an automated tethered flight system for laboratory studies of factors influencing flight potential in S. exempta, with particular emphasis on the genetic factors underlying variation in flight capacity. These studies are now being extended to include estimates of the heritability of flight capacity and to examine the genetics of pre-reproductive periods in relation to the long and short flying phenotypes. This group is now commencing similar studies of the intrinsic factors controlling flight potential in Heliothis armigera, in collaboration with Dr. Cooter at TDRI. Although the data obtained in flight mill studies must be interpreted with caution, the possibility of using similar laboratory techniques for studies of flight capacity and migration in Australian Heliothis should be investigated. Dr. Gatehouse is enthusiastic that such studies take place and would be willing to provide any advice or assistance necessary.

3. ROTHAMSTED RESEARCH STATION, HARPENDEN

Rothamsted is one of the foremost agricultural research institutes in Britain, though at present it, like many institutes and universities in Britain, is facing severe financial restrictions. Consequently the morale of researchers in many departments appeared low. Discussions here were held with Drs. P. Sherlock and J. Perry who have been involved in a project examining the potential of elemental analysis of adult insects as a tool in the study of insect movement. Unfortunately this project has been terminated but it parallels closely part of Dr. Fitt's research programme with Heliothis. The discussions were most useful, particularly with regard to the statistical

treatment of multivariate data obtained in such studies. Dr. Fitt presented the results of his work to date, from which Dr. Sherlock appeared sure that the technique would prove useful in studies of Heliothis here.

Discussions were also held with Dr. C. Wall on moth behaviour in response to pheromone plumes and the influence that different crops may have on the dispersion of odour plumes and their subsequent perception by target insects. The difficulties in using pheromone traps as a predictive tool for Heliothis in cotton were discussed and Dr. Wall related his development of a threshold warning system based on pheromone trap catches for the control of pea moth in field peas.

4. Dr. D.R. DENT NORWICH

Dr. Dent was formerly employed by TDRI to work at ICRISAT, India, on the analysis of a large collection of light and pheromone trap data for Heliothis in various parts of India. This work also involved studies of factors influencing trap efficiency and the relationships between trap catches and egg and larval infestations in various crops. The parallels between this work and that of Dr. Fitt are close and thus the discussions were most useful, particularly in further emphasising the difficulties in using trap data for studies of Heliothis population dynamics.

5. JODRELL LABORATORIES, ROYAL BOTANIC GARDENS, KEW.

The Jodrell Biochemistry Laboratories are involved broadly in studies of plant secondary chemistry, both for taxonomic purposes and their possible uses as novel pest control agents, acting either as insecticides, growth retardants, deterrents or repellants. The group is particularly interested in a new group of hydroxy alkaloids, discovered at Kew, which unlike normal alkaloids which disrupt proteases, have been found to disrupt carbohydrase enzymes in insects. Discussions were held with Dr. L. Fellows and Dr. J. Horn on basic aspects of the chemical studies at Kew. Further discussions were

then held with Dr. M. Simmonds on her behavioural work with Heliothis adults and larvae in relation to host plant chemistry. Dr. Simmonds has conducted electrophysiological work with Heliothis and other Noctuid larvae for some time, identifying the patterning of sensory systems controlling gustation. She is now using Heliothis and Spodoptera larvae as assay tools for studying the effects of a wide range of secondary compounds in collaboration with phytochemists at Kew. Dr. Simmonds is also commencing work on host selection behaviour of adult Heliothis which will involve electrophysiological studies of tarsal and antennal receptors in adults, and cage studies of host preferences with H. armigera and H. virescens. Here again the major aim is to develop a test system with which novel chemicals can be tested as oviposition deterrents or repellants. She was interested to hear of Dr. Fitt's work on Heliothis oviposition behaviour and egg distributions on cotton since she has found similar results in preliminary cage studies.

6. OVERVIEW

The visits to research institutions proved extremely enlightening and valuable. In Britain the parlous state of funding for domestic agricultural research was most evident, with University and Government research groups being closed down or severely cut back. Nevertheless, there appeared to be considerable support for overseas development projects in Africa and India, particularly for Heliothis work. The trip was most valuable in revealing the research techniques in use for studying insect flight and migration, and for work on sensory physiology and host selection. Some of these eg. tethered flight techniques may be usefully applied to research projects in Australia. Useful contacts were made with many researchers, particularly Dr. A.G. Gatehouse and Dr. M. Simmonds, and the trip emphasised the profusion of research groups involved in research on Heliothis in Britain and Europe, where the insect is not itself a pest but for which considerable funds are available for research.

ITINERARY OVERSEAS TRAVEL
DR. G.P. FITT 23/6 - 20/7 1986

MONDAY	23/6	1130	Travel NARRABRI - SYDNEY
TUESDAY	24/6	1830	Travel SYDNEY - LONDON
WEDNESDAY	25/6	1200	Arrive LONDON
THURSDAY	26/6		TROPICAL DEVELOPMENT and RESEARCH INSTITUTE,
FRIDAY	27/6		LONDON - DR. R. COOTER, DR. D. PEDGELEY, DR. J. HURLIS, DR. J. RILEY.
MONDAY	30/6	1300	Travel LONDON - PARIS
		1630	Travel PARIS - PAU
TUESDAY	1/7		PAU - 6th INTERNATIONAL SYMPOSIUM ON INSECT-
SATURDAY	5/7		PLANT RELATIONSHIPS, UNIVERSITY OF PAU
SUNDAY	6/7	0830	Travel PAU - PARIS
		1130	Travel PARIS - LONDON
MONDAY	7/7	1100	Travel LONDON - BANGOR, NTH. WALES
TUESDAY	8/7		UNIVERSITY OF NORTH WALES, BANGOR DR. G. GATEHOUSE and Postgraduate students.
WEDNESDAY	9/7	1030	Travel BANGOR - LONDON
		1630	Travel LONDON - HARPENDEN
THURSDAY	10/7		ROTHAMSTED RESEARCH STATION DR. P. SHERLOCK, DR. J. PERRY, DR. C. WALL.
THURSDAY	10/7	1530	Travel HARPENDEN - LONDON
		1630	Travel LONDON - NORWICH
FRIDAY	11/7		DR. D. R. DENT (formerly TDRI, LONDON and ICRISAT, India)
MONDAY	14/7	1030	Travel NORWICH - LONDON
		1400	JODRELL LABORATORIES, KEW GARDENS DR. J. HORN, DR. L. FELLOWS
TUESDAY	15/7		FREE DAY
WEDNESDAY	16/7 am.		JODRELL LABORATORIES, KEW GARDENS DR. H. SIMMONDS
WEDNESDAY	16/7	1945	Travel LONDON - SINGAPORE
THURSDAY	17/7	1900	ARRIVE SINGAPORE
FRIDAY	18/7	1930	Travel SINGAPORE - SYDNEY
SATURDAY	19/7	0600	ARRIVE SYDNEY
SUNDAY	20/7	1830	Travel SYDNEY - NARRABRI