The wasps were seen to drink water and then regurgitate onto the soil to make a small mud ball. The mud ball was then carried between the fore legs and mouthparts to a solid surface and used for the construction of the cells making up a "nest." In the cage the nests were built on the metal cage supports while in the fields they were found on rocks, trees, and buildings. A single drink of water appeared to be sufficient for the preparation of two or three mud balls and five or six balls were generally required to construct each cell. In the cage the nests consisted of five to eight cells but in the field there were up to 16 cells in a nest. Most nests found in the field were constructed with red soil.

After each cell was constructed, the wasp collected larvae and placing four to seven of them in each cell. The larvae were paralyzed by stinging, pressed between the mandibles and then carried to the nest. A single egg is laid inside each cell, before or after the first larva is entered. After filling, each cell is then sealed. Only the female wasps built cells and collected larvae, the males appeared to have no role except in mating.

The field-collected adult wasps were fed with honey solution in our cage and they lived for up to 67 days after capture. In the field we have observed them apparently feeding upon the nectar of flowering plants, including *Vernonia* sp. Each female constructed and filled more than one mud nest. The time taken from cell closure to emergence of the young adult from the cell varied from 34 to 48 days for *D. pyriforme* and 30 to 40 days for *D. conoideum*.

The *D. campaniforme esuriens* wasps in our cage were not successful in reproduction, because ants fed on the cell contents before the adult wasps could emerge. We also recorded predation by ants in nests in the field. In addition we found that the parasites, *Chrysis fuscipennis* Brulle, *Chrysis quaerita* Nurse, and *Stilbum cyanurum* (Forster) emerged from the cells of *D. conoideum* and *D. pyriforme* having fed upon either the lepidopteran larvae and/or the wasp larvae. The adults of these parasites were seen to follow the female wasps while they were constructing their nests. These elements obviously limit populations of wasps and hence the level of predation on *Heliothis* larvae. It is also probable that the activity of wasps is limited by the nonavailability of water.

Possible means of increasing the activity of these predatory wasps in pigeonpea fields would be to provide sources of water, and nesting sites protected from ants. However, the long generation time and the high level of parasitism would appear to impose strict limitations on the natural increase of populations and consequently the value of these wasps in *Heliothis* control.

We are grateful to Dr. V.S. Bhatnagar for laying the foundations for this study and to the Commonwealth Institute of Entomology for identifying the insects.

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- *C.S. Pawar and D.R. Jadhav (ICRISAT)*

Survey of Pigeonpea Podfly Parasites in India

The podfly, *Melanagromyza obtusa*, is an important pest of pigeonpeas in India. This pest is difficult to study in the field since most of its life stages (egg, larva, and pupa) are concealed inside the pod. At ICRISAT we are searching for varietal resistance to this pest and investigating other means of control.

In order to assess the potential for biological control of this pest we initiated a survey to determine the natural incidence of parasitism that occurs across India. Earlier reports listed two species of *Euderus* occurring as parasites of the podfly (Ahmad 1940; Gangrade 1960). Our collections of podfly larvae and pupae at ICRISAT Center from 1977 to 1980 revealed three more parasites, *Ormyrus* sp, *Eurytoma* sp, and *Antistrophoplex* sp. The first two of these were also reported from this podfly in Sri Lanka (Fellowes and Amarasena 1978). However, taxonomists of the Commonwealth Institute of Entomology (CIE), London, and the Indian Agricultural Research Institute (IARI), Delhi, warned us that *Ormyrus* spp are generally involved in forming plant galls and some *Eurytoma* spp feed on seeds, so they suggested we should check that these insects were in fact parasitic. We therefore conducted further observations during the 1980-81 season at ICRISAT Center and confirmed that both the *Ormyrus* sp and *Eurytoma* sp emerged from the puparia of the podfly and so are clearly parasitic or hyperparasitic.

We also conducted a preliminary survey during 1980-81 to record the occurrence of these parasites in other areas of India. We collected pods from some areas and received pods from other areas through cooperation of the entomologists in the All India Coordinated Pulses Improvement Project (AICPIP). We recorded the numbers of larvae and puparia in these pods and the emergence of parasites from these in our laboratory. The results of this survey (Table 1) indicated that *Ormyrus* sp might be as widespread and common as *Euderus* spp; *Eurytoma* sp was less common, and *Antistropholex* sp was rare.

More extensive surveys in collaboration with AICPIP entomologists are in progress in 1981-82 to study the regional and seasonal incidence of these natural enemies of podfly. We are grateful to the taxonomists, Drs. Subba

Table 1. Summary of the pigeonpea podfly parasitism survey in India, 1980-81.

STATE/location (Cooperator)	Month	Podfly larvae-puparia		Parasitism (%)	Parasites observed[a]
		Observed	Parasitised		
HARYANA					
Hissar	November	255	7	2.7	A,B,C
	January	35	5	14.3	B,C
	March	407	42	10.3	B,C[b]
KARNATAKA					
Bangalore (M. Vishakantaiah)	December	218	45	20.6	A,B,C[b]
MADHYA PRADESH					
Gwalior	December	442	13	2.9	A,B,C[b]
	March	476	70	14.7	B,C[b]
PUNJAB					
Ludhiana (K.S. Chhabra)	December	25	2	8.0	B,C
TAMIL NADU					
Vamban (C. Ramakrishnan)	February	258	4	1.6	B
UTTAR PRADESH					
Nainital (V.K. Sehgal)	April	685	11	1.6	B,C[b]
Kanpur (S.S. Lal)	December	346	12	3.5	C
	April	422	7	1.7	B,C
Varanasi (A.R. Reddy)	February	49	0	0.0	

a. A = *Eurytoma* sp (Eurytomidae: Hym)
B = *Ormyrus ? Orientalis* (Ormyridae: Hym)
C = Spp (*Eulophidae*: Hym)

b. Dominant parasite.

Rao, Gauld, and Boucek of CIE and Dr. Siddiqui of IARI, and all other cooperators in India for their advice and assistance in this study.

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Differences of Some Chemical Constituents of Pigeonpea Podwalls in Relation to Podfly Susceptibility

The differences in susceptibility of pigeonpea cultivars to podfly, *Melanagromyza obtusa*, are being studied at ICRISAT. Some morphological and anatomical characters of the podwall are probably associated with differences in susceptibility to this pest and water sprays on the fruiting terminals have been found to induce greater oviposition in several cultivars (Sithanantham et al. 1980). Here we present our preliminary observations on some chemical constituents of the podwall in reation to podfly susceptibility, based on oint work done by the pulse entomology and iochemistry units at ICRISAT during 1979-81.

We sampled the pods in several cultivars, at were known to differ in their susceptility to podfly infestation, from the rainy ason plantings in pesticide-free fields of ISAT during 1979-81. These samples inclu- those from water-sprayed ("washed") and trol ("unwashed") terminals. The pods e opened, seeds removed and the podwalls then dried in an oven at about 65°C, nd into fine powder and analyzed for r content of total nitrogen, total solu- ugars and total polyphenols.

The podwalls of more susceptible cultivars had a significantly lower concentration of total soluble sugars than the less susceptible cultivars and a narrower ratio of sugars to nitrogen, but there were no significant differences in total nitrogen and total polyphenol contents between the two groups (Table 1). These results suggest that a detailed analysis of the various sugars in the podwall of more and less susceptible cultivars may be useful. Pods from 'washed' terminals had significantly lower concentrations of all three constituents in their walls, than the 'unwashed' ones. The relative role of the individual constituents inhibiting oviposition in the 'unwashed' pods will have to be assessed through bioassay tests.

We also analyzed the chemical contents of the podwalls of pods at different stages of

Table 1. Summary of biochemical comparison of pigeonpea podwall composition in relation to podfly susceptibility, ICRISAT Center, 1979-81.

	Constituents on dry weight basis			
	Total nitrogen (%)	Total soluble sugars (%)	Ratio of sugar: nitrogen	Total polyphenols (mg/g)
Podfly susceptibility (36 reps/treatment)				
Less susceptible	2.64	4.16	1.58	73.7
More susceptible	2.64	3.43	1.32	75.2
CD (5%)	NS	0.67	0.26	NS
Effect of pod 'washing'				
Washed pods	2.62	3.50	1.35	66.7
Unwashed pods	2.66	4.08	1.55	82.1
CD (5%)	0.03	0.17	0.06	7.2