COTTON RESEARCH COUNCIL

FINAL REPORT

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DAQ36L (1987/88)

"The Application of Chemical Techniques in Determining the Age of Field Collected Adult Pests (Lepidoptera)of Cotton"

Organisation: Queensland Department of Primary Industries, Agricultural Chemistry Branch, Biloela

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Allocation: $2,750

Aims: The application of the chemical technique developed in DAQ27L in determining the age of field collected adults of Pectinophora scutigera (pinkspotted bollworm).

CONTENTS

2.3 Results and Discussions

A. Pteridine analysis for age determination

(i)

a) Effect of diet

Concentrations of all five pteridines were lower in the heads of adult P. scutigera whose larval stages were reared on flowers of Hibiscus spp. than in equivalents from artificial diet. These differences were statistically significant only for isoxanthopterin ($p<0.05$) and pterin ($p<0.001$) in males and "conjugated xanthopterin" ($p<0.05$) and pterin ($p<0.05$) in females. Although the differences were mostly small, a comparison of pteridine levels in moths from a wider range of host plant origins including cotton and major native hosts needs to be carried out. While larger differences would not be anticipated, if found, these would complicate the use of pteridine analysis for age determination but would be useful for host plant origin studies.

b) Effect of mating

Pteridine levels in mated and virgin moths were similar. The only statistically significant differences were for higher concentrations of isoxanthopterin ($p<0.05$) in mated males and biopterin ($p<0.001$) in mated females. Age interpretations would not have been greatly changed.

c) Effect of temperature

$25^{o}C$ versus $35^{o}C$ - 10 day old moths

The most marked difference in pteridine levels was the reduction in "conjugated xanthopterin" for both sexes at $35^{o}C$. In most cases at constant $35^{o}C$ this compound was not detected. Significant reductions in concentrations at $35^{o}C$ were also recorded with males for xanthopterin and pterin ($p<0.001$) and with females for pterin ($p<0.001$).

$25^{o}C$ versus $18^{o}C$ - 20 day old moths

The levels of all five pteridines were significantly higher ($p<0.001$) in males cultured at $18^{o}C$. Differences were less marked for females where only biopterin and isoxanthopterin ($p<0.05$) were higher for the $18^{o}C$ moths. The consequences of temperature are further considered with results for field collected moths.

(ii) Field specimens of P. scutigera

Some effects of temperature on pteridine levels have been discussed above. Table 1 lists the day-degree data for the cotton seasons 1985/86, 1986/87 at Biloela with the approximately equivalent total heat units for constant 18oC, $25^{o}C$ and $35^{o}C$. When comparing pteridine results for P. scutigera from the field moths with those cultured at $25^{o}C$ a few points were relevant.

a) Early and late in the season $25^{o}C$ represents a "higher than field" situation whereas mid season (December, January, February) this is a "lower than field" heat input.

b) Constant 18°C or 35°C represent fairly extreme conditions. The differences in pteridine levels between field moths and those cultured at 25°C should not be of the magnitude found for the comparison 25°C versus 18°C or 35°C.

Figure 1 shows the distribution of "ages" of adult P. scutigera collected in light traps on the Biloela Research Station in March and April 1987. The "ages" were determined as if the moth had been cultured at 25°C. For March/April the total heat units were not too different from the 25°C approximation. For each collection date, the weighted mean for "ages" for male and female was similar. This is important as pheromone trapping for males is far more efficient than use of light traps.

Adults collected in a light trap at Biloela in late September 1986 ranged in "age" from 10 to 30 days with weighted means for male (23 days) and female (23.5 days). This compares with samples from pheromone traps in commercial cotton (November 1986) where "ages" ranged 20 to >40 days with a weighted mean of 32 days.

The September adults are presumably a first Spring generation derived from native hosts or an overwintering population, as cotton should not be available as a host at this time.

The November specimens look to be an ageing first generation while the younger moths in the March/April catch probably represent a third (or fourth?) generation.

The level of pterin was always lower in field collected moths than in the laboratory cultured (25°C) adults. This effect was noted previously [refer (i) (a)] for adults from flowers of Hibiscus spp.

These results for field specimens are obviously of a preliminary nature. Suggestions for further research are made later.

(iii) Pteridines in Heliothis spp.

Initial analyses of heads of both H. armigera and H. punctigera adults have shown similar pteridine compounds to those present in P. scutigera. The quantitative differences and possible changes with age have not been studied at this time.

B. Host plant origins of Lepidoptera - an organic chemistry approach

In Table 2 the major fatty acid profile present in adult P. scutigera whose larvae were reared on artificial diet is compared with that from adults arising from flowers of Hibiscus spp. The acids are qualitatively similar but interesting quantitative differences in the C16 content and the $^{C16}/_{C18}$ ratio are apparent. In the male adult of H. armigera, C16 and C18 acids are also the major components (Table 2) but this species seems to contain a much wider range of minor fatty acids than P. scutigera. While the host range of P. scutigera is fairly restricted botanically this is not so for Heliothis spp. These initial results encourage further work, especially with Heliothis spp.

2.4 Conclusions/Recommendations for Future Research

A. Pteridine analysis for age determination

(i) P. scutigera

With refinement, the technique developed in DAQ27L for laboratory cultured moths should give reliable data for field collected specimens. Two areas need to be addressed - the important effect of temperature and the lesser influence of diet (host plant).

From a practical point, using the day-degrees data of Table 1, three to four generations of P. scutigera raised under ambient conditions at Biloela should represent fairly well early, mid and late season field populations. Pteridine data from these individuals would act as "field standards". Concurrently, trapping of field individuals should be made and ages determined using the "field standard" data. Errors arising from the presumably continuous emergence of field populations during the season should not be of practical significance.

Generations should be raised under ambient conditions on several hosts including cotton to verify that host origins for P. scutigera do not effect age determinations using pteridine analyses.

(ii) Heliothis spp.

From the initial results above and following strong support at the Entomology Workshop of the 1988 A.C.G.R.A. conference, it would seem worthwhile to evaluate the pteridine approach for age determination in adults of Heliothis spp.

B. Host plant origins for Lepidoptera - an organic chemical approach

Early results for the fatty acid profiles encourage further work to complement the studies with profiles of inorganic elements being carried out at Narrabri.

Initial work would determine variations in the fatty acid profiles of adults of Heliothis spp. raised under standard laboratory conditions on an artificial diet. Predictability in these results would make the influence of different hosts worth investigating.

Fatty acids are not the only organic compounds that may reflect dietary differences. Others may be worthy of initial screening.

PUBLICATION

Noble, R.M. and Walker, P.W. 1988. Using Chemistry to Estimate the Age of the Pinkspotted Bollworm (Pectinophora scutigera). Proc. Aust. Cotton Growers' Res. Conf. pp 133-138.

BIOGRAPHICAL NOTE

In early 1988, R. Noble transferred from the Agricultural Research Laboratories in Brisbane to the Biloela Research Station. Funding assistance was not sought from the Cotton Research Council for 1988/89 but the results and suggestions above will form the basis for submissions in 1989/90.

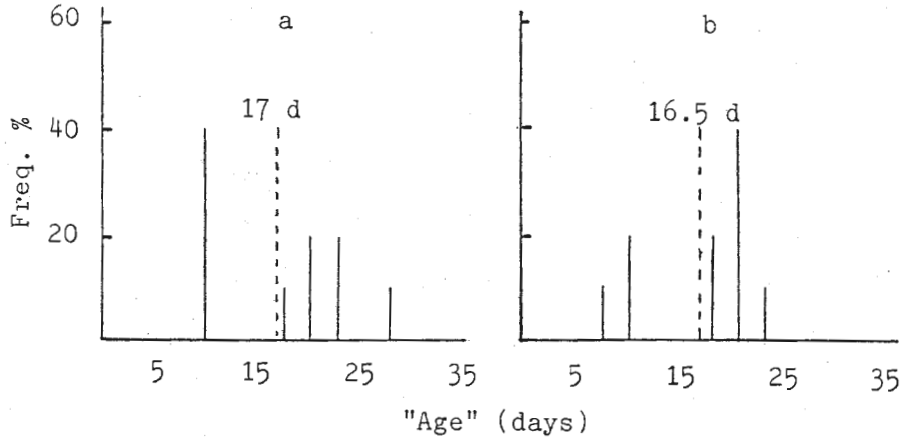
TABLE 1. Day-degrees data for the cotton seasons 1985/86 and 1986/87 at Biloela with approximate equivalent heat units for constant 18°C, 25°C and 35°C (13.5°C threshold).

Year/Month	Day-degrees			
	Actual	Approximate at constant °C		
		18°	25°	35°
1985				
September	170	135	345.0	645
October	222	140	356.5	667
November	319	135	345.0	645
December	420	140	356.5	667
1986				
January	397	140	356.5	667
February	363	126	322.0	602
March	343	140	356.5	667
April	304	135	345.0	645
TOTAL	2538	1091	2783.0	5205
1986				
September	183			
October	264			
November	279			
December	386			
1987				
January	447			
February	361			
March	385			
April	272			
TOTAL	2577			

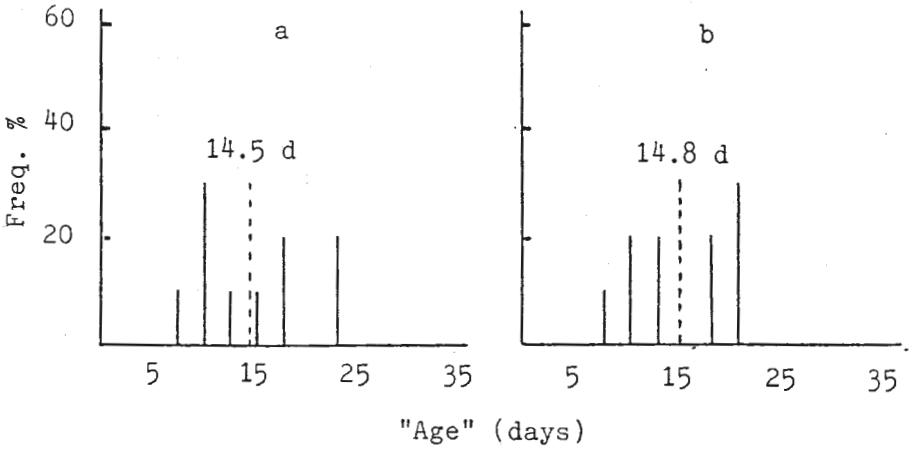
FIGURE 1

Distribution of "Ages" for adult P. scutigera caught in light traps on the Biloela Research Station on A (8/3/87) and B (6/4/87).

The dotted line represents the mean age for each distribution.



A



B

a - male

b - female

TABLE 2. Major fatty acids of adult *Pectinophora scutigera* and male adult *Heliothis armigera*

Fatty Acid Identity	Concentration (as % of total fatty acids)			
	P. scutigera			*H. armigera*
	(from artificial diet)		(from flowers of *Hibiscus spp.*)	(from artificial diet)
	male	female	male and female	male
C14.0	0.6	0.5	1.0	0.9
C16.0	20.0	7.5	32.3	6.2
C16.1	2.1	1.0	6.3	2.7
C18.0	4.7	9.1	5.9	4.0
C18.1	27.0	23.0	27.6	11.5
C18.2	10.2	15.0	6.9	13.8
C18.3	17.8	26.7	7.8	20.8
C16 / C18 ratio (%)	37.0	11.5	80.0	18.0