Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 92, Number 1, January 1983, pp. 11– 17

Gut spore composition and influence of fungal host on the rate of mortality and post-embryonic development in *Tiarothrips subramanii* (Ramk.)

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MS received 5 July 1982; revised 4 November 1982

Abstract. Studies on the spore composition of the gut of the adult idolothripine sporophagous species *Tiarothrips subramanii* (Ramk.) indicated a greater preference for *Anthostomella consanguinea* as compared to others (*viz.*, *A. phoenicicola*, *A. sepelibilis*, *Pestalotia algeriensis*, *Melanographium citri*, *Phoma* sp., *Diplodia* sp., *Gnomonia* sp., *Stigmina palmivora*). The rates of development and mortality were higher when developing instars were reared on *A. phoenicicola* and *P. algeriensis* respectively.

Keywords. Gut spore composition; host fungi; fungal preference; mortality; post-embryonic development; *Tiarothrips subramanii*; *Borassus flabellifer*.

1. Introduction

Mycophagous Tubulifera involve essentially the mycetophagous phlaeothripines and sporophagous idolothripines. Ananthakrishnan and William James (1982) in a preliminary discussion on some of the idolothripine-fungal associations, refer to the complex of fungi (Ascomycetes, Coelomycetes, Basidomycetes and Hyphomycetes) associated with *Borassus flabellifer* L. Information on the qualitative as well as quantitative analysis of the spore composition in the gut of Idolothripinae, appears important for a proper assessement of the spore preferences when a fungal complex is involved. Available information on these aspects being restricted to *Stictothrips fimbriata* (Anan.) fed on the fungi *Rhizopus* and *Pilobolus* (Joshi 1974) and to the biology of *Ecacanthothrips tibialis* (Viswanathan and Ananthakrishnan 1973), an attempt has been made to discuss the percentage composition of the gut spores in relation to the rates of mortality and post-embryonic development in *Tiarothrips subramanii*.

2. Material and methods

Different areas of the fungal-infested dried leaves of *B. flabellifer* were isolated, cultured in potato-dextrose-agar and oat-meal-agar media as indicated by Ananthakrishnan and William James (1982). The cultured fungi were mounted in lactophenol (phenol 20 gm, lactic acid 20 gm, glycerol 40 gm, and distilled water 20 ml) with cotton blue for identification. In order to prevent the germination of spores attached to the parts of the body of thrips, both adults and larvae were surface-sterilised using 0.01% mercuric chloride for 2-3 seconds and then washed in sterile water (distilled water sterilised in an autoclave at 1.1 kg/cm^2 for 30 min.) This ensured complete elimination of surface spores from contaminating the spore complex from the gut.

Spores removed from the gut were inoculated into the culture media, using an inoculation chamber. Three different methods were employed to culture such fungal spores. One set of spores was treated with 1% KOH, another with 1% HCl, and the third with sterile water. The treated spores were inoculated on the potato-dextrose-agar and oat-meal-agar media for culture.

The following fungi were isolated and identified from the specific areas of the leaf of *B flabellifer:* (a) *Anthostomella phoenicicola* (Ascomycetes) from dead, dropped leaves. (b) *A. consanguinea* (Ascomycetes) from folds of leaves turning yellowish. (c) *Pestalotia algeriensis* (Coelomycetes) from the green leaves and (d) *Melanographium citri* (Hyphomycetes) from yellowing senescent leaves (figure 3-A).

To study the rates of mortality and post-embryonic development in *T. subramanii* on different fungi, freshly emerged first larvae were introduced into transparent plastic vials (4.5 × 3 cm) each containing the particular fungi-infested portions of the leaf of *B. flabellifer.* The percentage of larvae surviving to become adults indicated their preference for a particular fungus. Stock material was kept in a BOD incubator at 30 ±1°C at 88% RH. Observations were made every day and the host leaf with the fungi replaced on alternate days. Spore counts from the dissected gut of adults and larvae of *T. subramanii* fed on different fungi were made, using a haemocytometer (figure 2).

Data on the percentage of postembryonic developmental rate and mortality rate were statistically examined and transformed to arc sine (percentage)$^{1/2}$ values and subjected to analysis of variance (Snedecor and Cochran 1967).

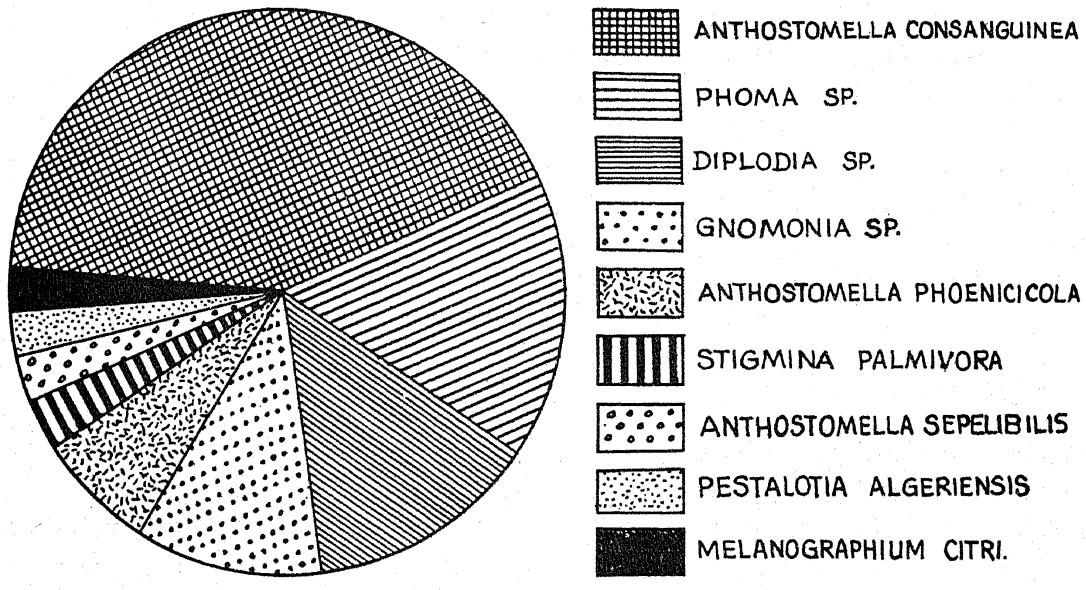

Figure 1. Distribution of different spores in the gut of adult *Tiarothrips subramanii.*

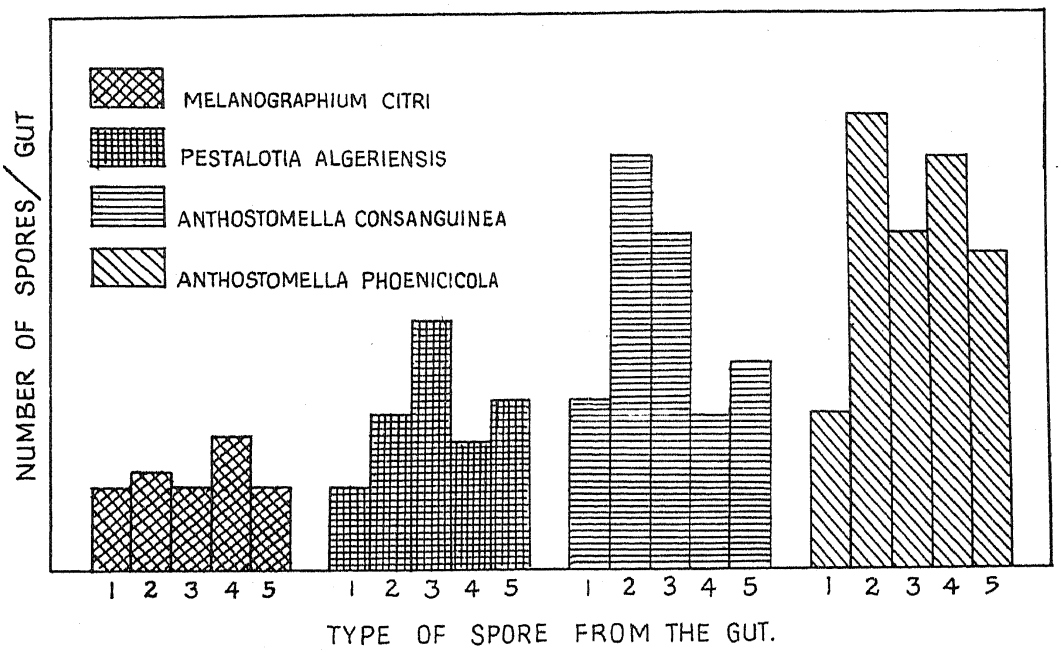

Figure 2. Gut spore composition of II larvae of *Tiarothrips subramanii* fed on different fungi (for five replicates).

Table 1. Gut spore composition of adult *Tiarothrips subramanii* (Mean of Six replicates)

Fungi	Percentage composition of spores in the gut*
A. consanguinea	49.58 a (44.79)
Phoma sp.	18.73 b (24.75)
Diplodia sp.	12.18 c (16.67)
A. phoenicicola	7.27 cd (14.93)
S. palmivora	3.57 d (6.17)
A. sepelibilis	2.47 d (5.26)
P. algeriensis	2.43 d (6.33)
Gnomonia sp.	1.05 d (3.38)
M. citri	0.33 d (1.36)

* Figures in parenthesis are arc sine (percent)$^{1/2}$ values.
Means followed by a common letter are not significant at 1% level.

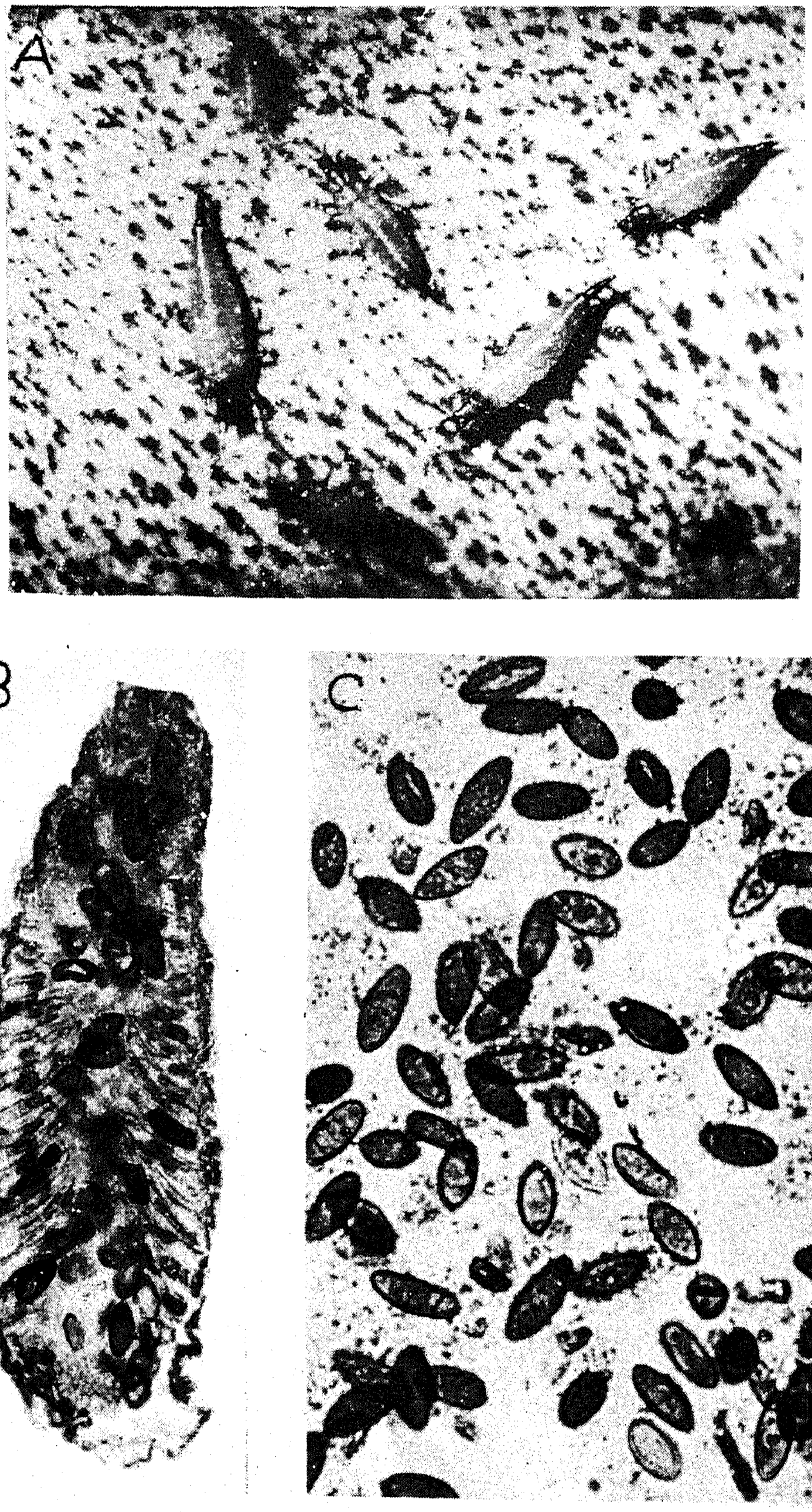

Figure 3. **A.** *Tiarothrips subramanii* larvae feeding on *Melanographium citri* **B.** C.S. of *T. subramanii* foregut showing the spores of *Anthostomella consanguinea* **C.** Spores of *Anthostomella consanguinea* from the gut of *T. subramanii.*

3. Observations

3.1. *Gut spore composition*

Gut spore analysis of the adult *T. subramanii* fed on mixed fungi, revealed significant percentage of *Anthostomella consanguinea* (49.58), *Phoma* sp. (18.73), and *Diplodia* sp. (12.18), whereas the other spores *viz., A. phoenicicola, Stigmina palmivora; A. sepelibilis, Pestalotia algeriensis, Gnomonia* sp., *Melanographium citri* occurred in very insignificant percentage (table 1, figure 1).

3.2. *Duration of different instars fed on various fungi*

Duration of the larval and pupal periods varied with each fungal host. The first larval stage lasted for 1-2 days, 2 days, 2-3 days, and 1-2 days when fed on the spores of *A. consanguinea, P. algeriensis, M. citri* and *A. phoenicicola* respectively. Duration of the second larval period varied from 3-4 days when reared on *M. citri, A. phoenicicola, A. consanguinea* and 6-7 days in *P. algeriensis.* 20% of second stage larvae did not moult further when cultured on *P. algeriensis,* while 26% and 28% of larvae failed to moult further when reared on *A. consanguinea* and *M. citri* respectively (table 2).

Table 2. Fungal preference and its relative effect on larval mortality and post-embryonic development in *Tiarothrips subramanii* (Ramk.) (mean of five replications).

	Host fungi from dried leaves of *B. flabellifer*			
	A. phoenicicola	*A. consanguinea*	*M. citri*	*P. algeriensis*
Development rate (%)				
L_1	96 (84.7)	92 (82.2)	100 (90)	100 (90)
L_2	70 (60)	28 (28.6)	12 (13.1)	8 (7.9)
PP	100 (90)	98.8 (69.2)	40 (36)	20 (18)
P_1	100 (90)	64 (54.2)	40 (36)	20 (18)
P_2	100 (90)	80 (72)	40 (36)	10 (9)
Mortality rate (%)				
L_1	4 (5.3)	8 (7.5)	0 (0)	0 (0)
L_2	17 (18.9)	48 (43.5)	60 (53.8)	72 (61.4)
PP	0 (0)	1.2 (2.8)	0 (0)	0 (0)
P_1	0 (0)	14.4 (16.1)	0 (0)	0 (0)
P_2	0 (0)	0 (0)	0 (0)	10 (9)
Larvae that failed to grow and moult further				
L_1	0 (0)	0 (0)	0 (0)	0 (0)
L_2	13 (16.6)	26 (24.6)	28 (28.9)	20.8 (20.8)

L_1 first larva; L_2 second larva; PP prepupa; P_1 first pupa; P_2 second pupa; Data significant at 1% level. Figures in parenthesis are arc sine $(\text{percent})^{1/2}$ values.

CD at 1% level

Between fungal spores: 6.7; Between larval stages: 7.04; Between larval mortality: 26.8; Fungus × larval mortality: 14.9; Larval stages × larval mortality; 19.5; Fungus × thrips: Not significant; Fungus × Thrips × larval mortality: Not significant.

3.3 *Rates of mortality on various fungi*

Larvae reared on *A. phoenicicola* showed 4% mortality in the first larval stage and 17% in the second. The overall mortality during the entire developmental period was 32%. Those reared on *A. consanguinea* showed 8%, 48%, 1.2% and 14.4% mortality during first, second, prepupal and first pupal stages respectively, and an overall mortality of 58% during the entire period of development. Larvae cultured on *M. citri* indicated 60% mortality in the second larval stage with no mortality during the rest of the stages. In *P. algeriensis* mortality rates of 72% and 10% were observed in second larval and second pupal stages (table 2).

3.4 *Rate of development on various fungi*

Thrips cultured on different fungi indicated not only their relative fungal preference during development, but also the influence of the concerned fungi on the rates of development. Post-embryonic developmental period was of the order of 7-10 days when reared on both *A. phoenicicola* and *A. consanguinea.* A comparatively longer duration of 8-11 days and 11-12 days was observed when reared on *M. citri* and *P. algeriensis* respectively. The percentage of adult emergence also varied considerably when reared on the above-mentioned fungi, 56% of larvae developing into adults when fed on *A. phoenicicola,* 16% on *A. consanguinea,* 12% on *M. citri* and 4% on *P. algeriensis.* As already mentioned, mortality rate was considerably less when reared on *A. phoenicicola,* slightly higher on *A. consanguinea* and very much so on *M. citri and P. algeriensis.* The rate of development and percentage of adult emergence appeared high when reared on *A. phoenicicola,* low in *A. consanguinea* and very much lower on *P. algeriensis* and *M. citri.*

4. Discussion

Spore analysis of the gut of the adults fed on a complex of fungi infesting the leaves of *B. flabellifer* revealed only the presence of large numbers of *A. consanguinea* (table 1, figure 1) the other types of spores occurring in negligible numbers. The gut spore analysis of larvae fed on different fungi such as *A. phoenicicola, A. consanguinea, P. algeriensis* and *M. citri* also showed that *A. phoenicicola* was preferred by the first and second larval stages (figure 2), when cultured on these fungal species at 30±1°C, 88% RH, the duration of first instar larvae to adult was 7-10, 8-11, and 11-12 days respectively. The preference of *A. phoenicicola* by the developing larvae and of *A. consanguinea* by the adult *T. subramanii* therefore appears to be of interest. Such observations on the relative preference for particular fungi as well as on the variations involved in the rate of development and in the percentage of adult emergence have also been made on the fungal mite *Galumna flabellifera* Hammer (Reddy *et al* 1978).

Spore analysis of the gut of larvae fed on *M. citri* revealed the presence of young conidia of *M. citri* in different stages of development. Larvae when fed on other fungi such as *A. consanguinea, A. phoenicicola,* and *P. algeriensis* showed only mature spores. *M. citri* being a hyphomycete, the conidia in various stages of development were found on the leaf surface, whereas in the other fungi, the early developmental stages were located inside the fruiting body of the fungi and only mature spores were available on the leaf surface.

Acknowledgements

Our sincere thanks are due to Dr M Pushkaran of the New College, Madras for identifying the fungi. Thanks are also due to Mr K Raman of the Entomology Research Institute, Loyola College, Madras for statistical assistance. This work was done during the tenure of a Research Project financed by the Department of Science and Technology, Government of India.

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