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Pollination in *Wedelia chinensis* (Osbeck) Merr and *Tridax procumbens* L. (Compositae) by Thrips (Thysanoptera: Insecta)

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The role of thrips in pollination of Compositae is examined with respect to four species of thrips: *Microcephalotorips abdominalis*, *Frankliniella schultzei*, *Haplothrips tardus* and *Haplothrips gowdeyi* inhabiting *Wedelia chinensis* and *Tridax procumbens*. The nature of thrips movements within the capitulum, their pollen-carrying capacity, the stigma-recognition capacity with special reference to *H. tardus*, colour change in the corolla of ray florets in *W. chinensis* subsequent to pollination by thrips and the synchronisation of the biology of *Microcephalothrips abdominalis* with the development of the capitulum of *Wedelia chinensis*, are discussed.

Key Words: Thrips, Pollination, Compositae

Introduction

Available information on the role of thrips as pollinators of various species of Chenopodiaceae, Sterculiaceae, Ericaceae, Verbenaceae and Palmae pertains to the works of Müller (1883), Shaw (1914), Annand (1926), Billes (1941), Hagerup (1950), Hagerup and Hagerup (1953), Ananthakrishnan (1973), Mathur and Mohan Ram (1978) and Syed (1978). Although Bailey (1937), Raizada (1961), and Bullock (1964) have provided some basic information on the thrips-Compositae association, their specific role as pollinators has not received any particular attention. Sufficient evidence exists suggesting the role of thrips as pollinators in Compositae, and an attempt has been made to study the role of *Microcephalothrips abdominalis* (Crawford), *Frankliniella schultzei* (Trybom), *Haplothrips tardus* Priesner, and *Haplothrips gowdeyi* (Franklin), frequenting the floral heads of *Wedelia chinensis* and *Tridax procumbens*.

Material and Methods

Random weekly collections of thrips were made from *W. chinensis* and *T. procumbens* to study the population dynamics of various species for correlation with their activities in relation to pollination. The movement of thrips within, and between, the florets and colour change in the ray florets simultaneous with thrips pollination were observed

in the laboratory by keeping fresh plants bearing young capitula in Knop's solution. For observing stigma-recognition capacity (SRC) of thrips, varying numbers of thrips were placed along with the stigmatic lobes of *T. procumbens*, *Helianthus annuus* and *W. chinensis* individually as well as in groups, in small petri dishes 7.5 cm wide filled with paraffin wax and having a shallow moat along the periphery containing water. (Varadarasan 1979).

Observations

The terebrantian species *M. abdominalis* and *F. schultzei* oviposit within the ovarian tissues (figure 3,C) and bracts (figure 3, D) and enable the larvae to move into the floret on hatching. *H. tardus*, a tubuliferan species, however, lays eggs on the petals, bracts, and pappus.

With the opening of the florets, thrips inhabit the capitula and their population reaches a maximum when the stigmatic lobes get exposed. Overnight observations on the movement of the growing style of *W. chinensis*, indicates that it takes 68–70 hr for the complete projection and opening out of the stigmatic lobes.

Frequent movements of different species of adults and larvae of *M. abdominalis* (the dominant species in the heads of *W. chinensis*), *F. schultzei*, *H. tardus* (the dominant species in the heads of *T. procumbens*), and *H. gowdeyi* from floret to floret were observed. These thrips carried pollen grains on their body, particularly within the disc florets, and were observed to feed on pollen, nectar, and tender tissues of style and stigma. *F. schultzei* was found to carry the maximum pollen load of about 200, followed by *H. gowdeyi*, *H. tardus*, and their larvae (figure 2, B,E; 3,A; and table 1). Longer and larger number of setae on *F. schultzei* enable it to carry pollen grains in clusters on legs, wings, anal setae, and rarely on antennae. However, individual pollen grains were found attached to the thoracic and abdominal setae. The agile movement of *F. schultzei* involving frequent spreading and shaking of wings causes the pollen grains to fall on the stigmas. Pollen grains carried by *Haplothrips* spp. on the abdominal region, particularly at the region of the anal setae, rub against the stigmatic surface, owing to the large body size as compared with that of *M. abdominalis* and *F. schultzei*; this process is further facilitated by the peculiar backward movements of *H. tardus*. The frequent combing of the body surface with its hind legs enables shedding of pollen grains on the stigmatic surface when the insect lands on the stigma. *H. tardus* has been observed to migrate to the ray florets after visiting the disc florets, thereby pollinating ray florets to a certain extent.

Stigma-Recognition

Under natural conditions, in the protandrous disc florets, stigmas with pollen grains along the lower surface emerge through the staminal column. Experiments to confirm any preference for stigmas with pollen indicated that *T. procumbens* stigmas without pollen (mechanically removed in the laboratory) were not recognised. When stigmas of *T. procumbens*, *H. annuus*, and *W. chinensis* with pollen were kept individually as well as in groups, *H. tardus* showed preference for *T. procumbens* stigmas only.

Colour Change

As a result of pollination by thrips the colour of the ray floret corolla in *W. chinensis* changed from yellow to white. In the natural conditions when a non-infested capitulum bud was allowed to grow in a glass tube in which one end was plugged with cotton and the other with

Table 1 *Pollen-carrying efficiency of thrips*

Species of thrips	Number of thrips examined	Number of Pollen grains carried by each thrips			
		W. chinensis		*T. procumbens*	
		Min	Max	Min	Max
Microcephalothrips abdominalis	30	35	60	40	75
Frankliniella schultzei	30	120	180	150	200
Haplothrips gowdeyi	25	90	120	125	180
Haplothrips gowdeyi (larvae)	20	70	110	90	140
Haplothrips tardus	25	90	140	120	160
Haplothrips tardus (larvae)	20	70	100	80	120

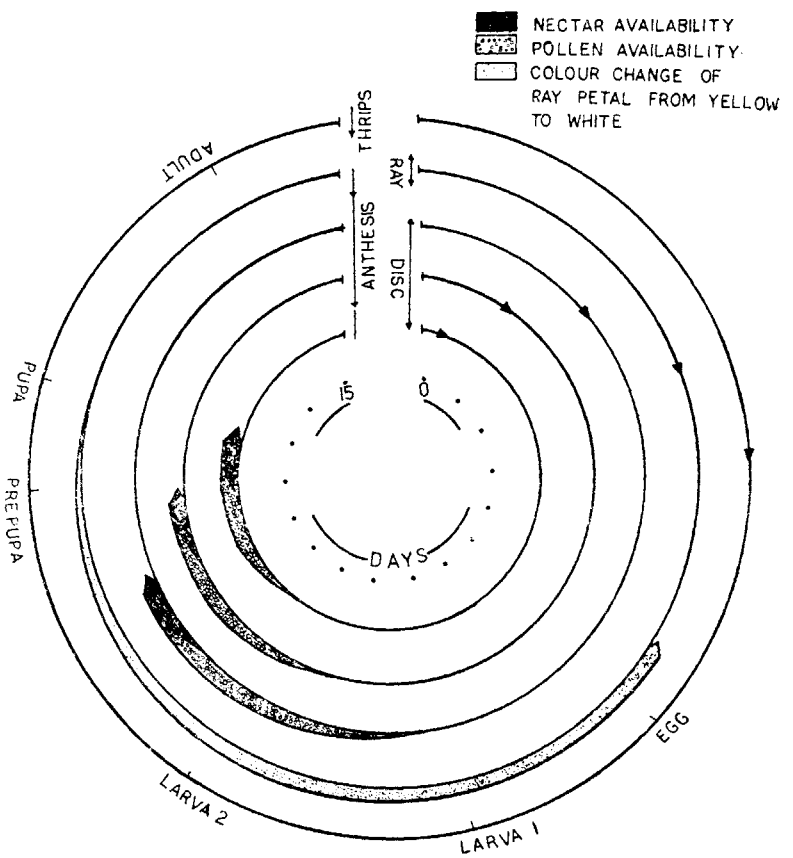

Figure 1. The phenology of *Wedelia chinensis* in relation to the biology of *Microcephalothrips abdominalis*

a polyethylene sheet, facilitating sufficient exposure to sunlight, colour change and seed formation did not occur. Colour change was gradual; from yellow—pale yellow—patches of yellow and white and finally to white when the seed formation started.

Seed Viability with Respect to Pollination

The number of florets in a single capitulum of *W. chinensis* ranges from 32 to 36 and the number of viable seeds formed in the natural condition from 4 to 12. The florets allowed to develop without thrips contact failed to set seeds, indicating that there is no provision for autogamy. However, in the case of *T. procumbens* non-thrips-infested flowers produced viable seeds suggesting that both auto and allogamy occur. Seed setting was also affected by considerable damage to the ovarian wall due to oviposition and feeding action often resulting in the exposure of the ovule in *W. chinensis.* (figure 2,F).

Synchronisation of the life-cycle of M. abdominalis with the development of the florets of W. chinensis

M. abdominalis takes 9–11 days to complete its development. Thrips enter the flower at the late bud stage when the ray petals emerge and become showy. At this time it lays eggs in the flower, and as soon as the larva emerges from the egg, pollen grains are made available to the larvae. When pollen grain availability declines, nectar becomes ready; meanwhile the stigma attains the receptive stage. During seed-forming stage of the flower, adult transformation of the insect takes place (figure 1).

Discussion

Observations on the evidence of thrips occurring only in yellow florets suggest the preference of thrips for yellow colour as also observed by Mathur and Mohan Ram (1978) in Lantana flowers pollinated by *Thrips hawaiiensis* Morgan and *Haplothrips tenuipennis* Bagnall. The obvious limitations of *M. abdominalis*, *F. schlutzei*, *H. tardus*, and *H. gowdeyi*, to the small capitula of *W. chinensis* and *T. procumbens* indicate their profound potential to adapt themselves for undisturbed living with a substantial supply of food and shelter, safe from the predatory insects, and providing enough space for oviposition. Although in the natural habitats, butterflies, bees, and beetles have been found associated with the capitula of *W. chinensis* and *T. procumbens* in addition to thrips, under laboratory conditions, however, with enough care taken to prevent insects other than thrips entering/being associated with the heads, it is possible to demonstrate that pollination is effected by thrips.

The flowering phenology with special reference to *W. chinensis* appears well synchronised with the biology of *M. abdominalis* suggesting a possible evolutionary impact made by the pollinator activity on the floral resources. Ecological synchronisation of the pollinating species is facilitated by nectar production providing an inexhaustible supply of nutrition, as well as a vital source of attraction. In *Bidens* and *Coreopsis*, Cronquist (1968) has related the copious nectar secretion to the extensive parallelism between different classes of pollinators and species of Compositae.

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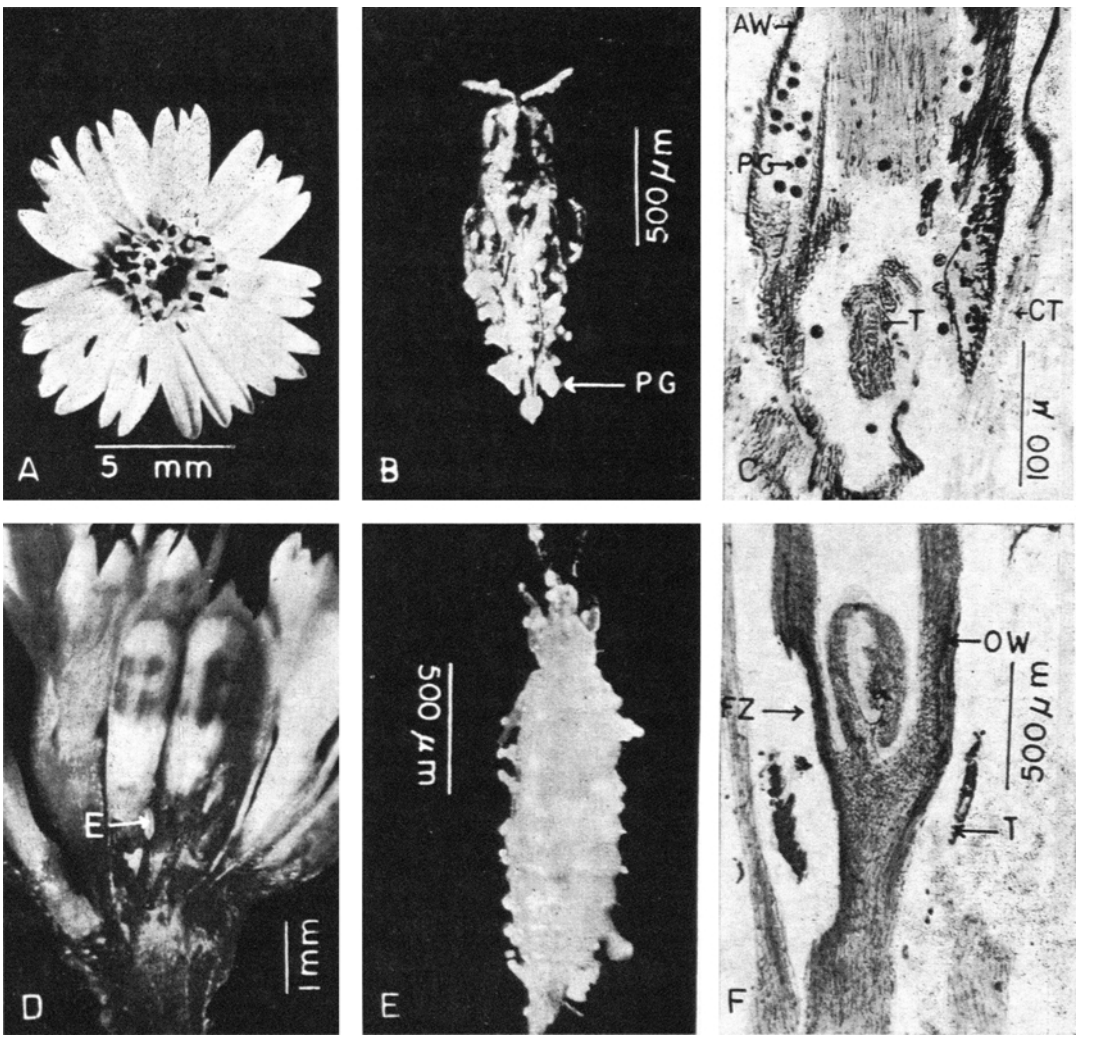

Figure 2 A–F *A*, Capitulum of *Wedelia* showing *Haplothrips*; *B*, *Haplothrips tardus* carrying pollen grains in clusters; *C*, Anther column (L.S.) showing thrips and pollen of *Wedelia*; *D*, Enlarged capitulum of *Wedelia* (V.S.) with *Haplothrips* egg on the disc florets; *E*, Larva of *Haplothrips* with copious pollen on its body; *F*, Portion of capitulum of *Wedelia* (L.S.) showing the feeding zone on the ovary wall with necrotised area.

(**AW**, Anther wall; **CT**, Corolla tube; **E**, Egg; **FZ**, Thrips feeding zone with necrotised area; **PG**, Pollen grains; **OW**, Ovary wall; **T**, Thrips)

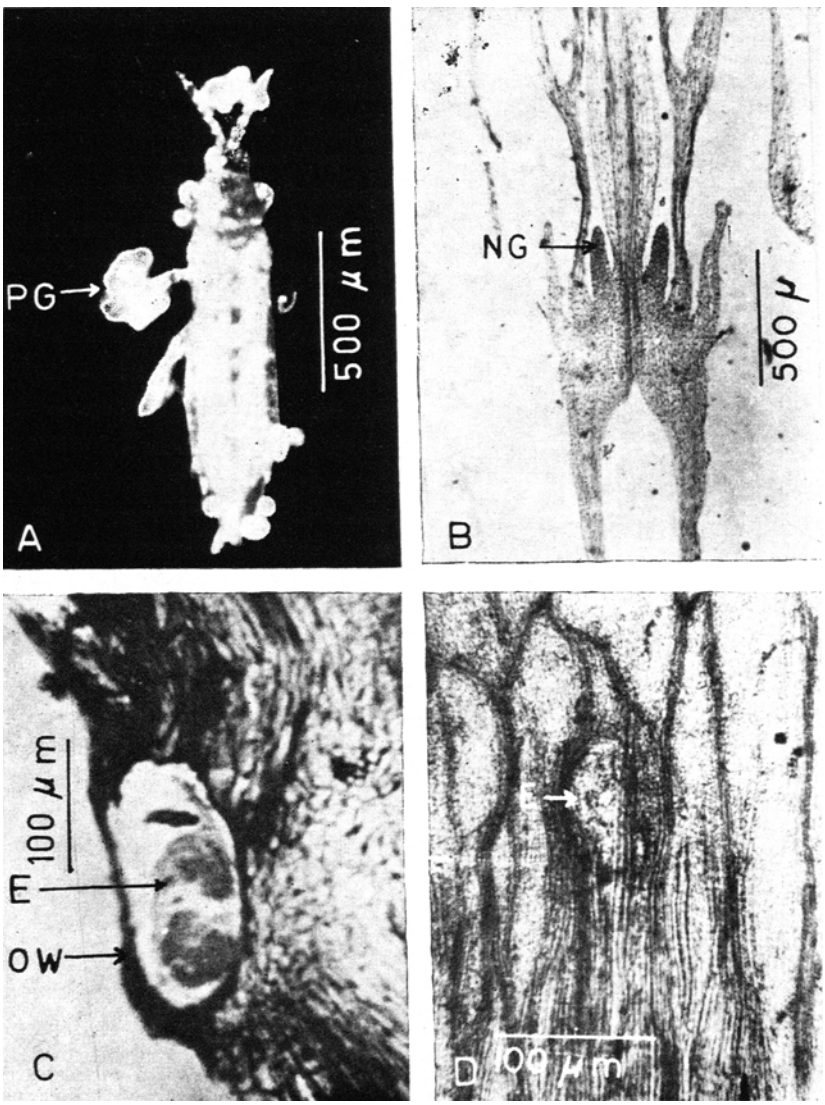

Figure 3 *A*, *Microcephalothrips* with pollen; *B*, Disc floret (L.S.) of *Wedelia* showing nectar gland; *C*,Part of ovary (L.S.) containing the egg of *Microcephalothrips* in *Wedelia*; *D*, Egg of *Microcephalothrips* laid inside the bract of *Wedelia*.

(E, Egg; NG, Nectar gland; OW, Ovary wall; PG, Pollen grains)

References

Ananthakrishnan T N 1973 *Thrips: Biology and Control* New Delhi; Macmillan pp. 120

Annand P N 1926 Thysanopters and the pollination of flowers; *Am. Nature*, **60** 177–182

Bailey S F 1937 The Composite thrips *Microcephalothrips abdominalis* (Crawford); *Can. Entomol.* **69** 121–126

Billes D J 1941 Pollination of *Theobroma cacao* L; *B.W.I. Trop. Agric. Trin.* **180** 151–156

Bullock J A 1964 The assessment of population of *Thrips nigripilosus*; *Ann. appl. Biol.* **55** 1–12

Cronquist A 1968 *The Evolution and Classification of Flowering Plants* Boston: Houghton Mifflin Company, pp. 396

Hagerup O 1950 Thrips pollination in *Calluna*; *D. Kgl. Danske Vidensk. Selsk. Biol. Medd.* **18** 1–116

Hagerup E and Hagerup O 1953 Thrips pollination of *Erica tetralix*; *New Phytol.* **52** 1–7

Mathur G and Mohan Ram H Y 1978 Significance of petal colour in thrips-pollinated *Lantana camera L*; *Ann. Bot.* **42** 1473–1476

Müller H 1883 *The Fertilization of Flowers* (London: Macmillan)

Raizada U K 1961 The life-history of *Microcephalothrips abdominalis* (Crawford) Thysanoptera, Thripidae; *Bull. Ent. Loyola College* **2** 12–20

Shaw H B 1914 Thrips as pollinators of beet flowers; *Bull. U. S. Dept. Agric.* 104

Syed R A 1978 *Thrips pollination of Oil palm in West Malaysia*, Commonwealth Institute of Biological Control Report;. 10pp.+17 tables (Slough: Commonwealth Agricultural Bureaux)

Varadarasan S 1979 Bioecological investigations on some gall-inhabiting Thysanoptera (Insecta: Arthropoda); Ph.D. Thesis, Madras University