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Diurnal population trends of *Megalurothrips sjostedti* and *Frankliniella occidentalis* (Thysanoptera: Thripidae) and their natural enemies on French bean *Phaseolus vulgaris* (Fabaceae)

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Abstract. A field experiment was conducted to track the daily population trends and occurrence of the flower thrips *Megalurothrips sjostedti* Trybom and *Frankliniella occidentalis* (Pergande), and their indigenous natural enemies *Orius* spp. and *Ceranisus menes* (Walker), infesting French beans. French beans in monocrop or interplanted with six companion crops (*Zea mays* L., *Coriandrum sativum* L., *Tagetes erecta* L., *Brassica oleracea* var. *acephala* L., *Daucus carota* L. and *Capsicum annuum* L.), and two chemical insecticides, methiocarb (Mesurol 500SC) and L-cyhalothrin (Karate 1.75% EC), were evaluated for their effects on the abundance of flower thrips, throughout the day, at 1-h intervals. The average population peak of thrips was found to occur at around 1300 h, but each species had different peak periods. Adult *F. occidentalis* populations peaked at midday and adult *M. sjostedti* populations at 1500 h, while the larvae of the two thrips species peaked at around 1300 h. *Orius* spp. were the most abundant natural enemies and their populations peaked at around 1400 h. *Ceranisus menes* population also peaked at around 1400 h.

Key words: companion crop, *Ceranisus menes, Frankliniella occidentalis, Megalurothrips sjostedti, Orius* spp., *Phaseolus vulgaris*, population trend, diurnal activity,

Résumé. Une expérimentation de terrain a été conduite afin de déterminer la dynamique des populations des trips de fleurs *Megalurothrips sjostedti* Trybom et *Frankliniella occidentalis* (Pergande), et de leurs ennemis naturels indigènes *Orius* spp. et *Ceranisus menes* (Walker) sur haricot vert au cours de la journée. L'abondance des trips a été évaluée sur des haricots verts cultivés en monoculture ou en culture associée avec six autres plantes (*Zea mays* L., *Coriandrum sativum* L., *Tagetes erecta* L., *Brassica oleracea* var. *acephala* L., *Daucus carota* L. et *Capsicum annuum* L.) et avec deux insecicides methiocarb (Mesurol 500SC) et L-cyhalothrin (Karate 1.75% EC), pendant toute la journée, à 1 heure d'intervalle.

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Le pic d'infestation des trips a été observé vers 1300 h, avec toutefois une période différente pour chaque espèce. Le pic de population des adultes de *F. occidentalis* est observé à la mie journée et celui de *M. sjostedti* à 1500 h, alors que le pic de populations des larves des deux espèces est observé à 1300 h. Les espèces du genre *Orius* sont les ennemis naturels les plus abondants avec un pic de population vers 1400 h. La population de *Ceranisus menes* est maximum vers 1400 h.

Mots clés: culture associée, *Ceranisus menes*, *Frankliniella occidentalis*, *Megalurothrips sjostedti*, *Orius* spp., *Phaseolus vulgaris*, dynamique des populations, activité diurne

Introduction

In Kenya, the flower thrips *Frankliniella occidentalis* (Pergande) and *Megalurothrips sjostedi* Trybom (Thysanoptera: Thripidae) are major economic pests of French beans *Phaseolus vulgaris* L. and cowpea *Vigna unguiculata* (L.) Walp. They have been reported to exhibit population increases after the flowering period, i.e. 4–6 weeks after emergence for French beans (Gitonga, 1999) and 7–9 weeks after emergence for the cowpea crop (Kyamanywa *et al.*, 1993).

Elsewhere, several studies have reported certain diurnal patterns of *F. occidentalis* on other crops such as cotton and tomato (Cho *et al.*, 2000; Kiers *et al.*, 2000). However, there is scarce information on the influence of companion crops on the diurnal trends of thrips on French beans. Earlier studies have only concentrated on the thrips abundance in a monocrop system. Information from studies on the diurnal population trends of flower thrips and their natural enemies may be useful in designing a more effective sampling protocol for the thrips management and especially help in determining the best time to apply insecticides. This study was undertaken to monitor diurnal population trends of flower thrips and their indigenous natural enemies at different times of the day in mono- and intercropped systems of French beans. However, little is known of their diurnal population trends on French beans or other legumes in Kenya.

Materials and methods

Study site

The experiment was conducted twice in Mwea-Tebere, Central Kenya, a major French bean production area. The first planting was initiated on 28 January and the second on 8 July 2002. Nine treatments were used in a randomized complete block design with plot sizes of 3 × 10 m replicated four times. The treatments were a French bean monocrop, two insecticides, i.e. methiocarb (Mesurol 500SC) and lambda cyhalothrin (Karate 1.75% EC), and six companion crops (*Zea mays* L., *Coriandrum sativum* L., *Tagetes erecta* L., *Brassica oleraceae* var. *acephala* L., *Daucus carota* L. and *Capsicum annuum* L.) interplanted with French beans.

Diammonium phosphate (DAP) was applied at the rate of 494 kg/ha at the time of planting, while calcium ammonium nitrate (CAN) was top-dressed in the 2nd and 4th week post-emergence. Weeding was done at 2, 4 and 6 weeks after French beans emergence, while furrow irrigation was conducted to supplement rainfall. Insecticide sprays were applied twice, in the 2nd and the 4th week after French beans emergence, using a lever-operated knapsack sprayer, at a concentration of 1 kg a.i./ha (or 50 ml/20 l water) and 200 g a.i./ha (40 ml/20 l water) for L-cyhalothrin and methiocaro, respectively.

Thrips sampling

Flower thrips data were collected daily from each plot at 1-h intervals for 12 h beginning from 0700 to 1800 h. Sampling started the 5th week after bean planting and continued for 2 weeks. Ten flower buds were taken at random and immersed in universal bottles containing 70% ethyl alcohol. In the laboratory, flowers and buds were dissected and thrips washed from the flowers and buds into a Petri dish engraved with a grid on the bottom to facilitate counting under a dissecting microscope. Thrips were separated by species into *M. sjostedti* and *F. occidentalis*, while the larval counts of both species were pooled together.

Monitoring of natural enemies

Three weeks after emergence of the French beans, natural enemies were recorded once a week on randomly collected leaves (10 from each plot) for 7 weeks. At the time of bean flowering, natural enemies associated with flowers were also recorded on 20 flower buds and flowers at 4-day intervals from each plot. Plant samples were preserved in 0.3-l plastic cups containing 70% ethyl alcohol. In addition, the flowers and flower buds collected on an hourly basis for thrips sampling were also analysed for natural enemies.

Statistical analysis

Data were subjected to analysis of variance (ANOVA) and, where there were no significant differences, data were pooled into 3-h intervals for

further analyses. The F-test was used for analyses at 95% significance and standard error of difference of means (SE) used to separate means.

Results

Diurnal thrips population fluctuations

There was no significant difference ($P > 0.05$) among treatments based on sampling hour (Table 1) but treatments had different effects on thrips population (Table 2). This, however, did not affect thrips hourly trend across the treatments. However, the number of thrips sampled at 1-h intervals changed throughout the day. Peak numbers of adult *F. occidentalis* and *M. sjostedti* and their larvae differed during the day (Fig. 1), with each species peak counts occurring at different times. The highest total number of adult *F. occidentalis*, *M. sjostedti* and sum of the larvae of the two species differed during the day (Fig. 1). Adult *F. occidentalis* peak count was at around 1200 h, *M. sjostedti* at 1500 h and the highest count of larvae of both species was observed at 1300 h.

When data on thrips population were pooled into 3-h intervals, their number was high after midday to just before 1600 h (Fig. 2). This period of the day corresponded to the peak interval counts of each species.

Population fluctuation of natural enemies

The number of *Orius* spp. was highest between 1100 and 1600 h with a peak recorded at 1400 h (Fig. 3). Numbers of *Ceranisus menes* peaked at 1400 h but remained stable up to 1800 h. The numbers of both the natural enemies fluctuated similarly throughout the day (Fig. 3).

In all treatments, the mean number of *Orius* spp. was significantly different ($P < 0.05$) in flowers compared to that noted in flower buds and leaves of the French beans crop (Fig. 4). *Orius* spp. numbers were also significantly different ($P < 0.05$) in flower buds compared to those in leaves. In addition, the

Table 1. Mean number of *Frankliniella occidentalis, Megalurothrips sjostedti,* their larvae, *Orius* spp. and *Ceranisus menes* as influenced by time of sampling on different treatments

Source	Dependent variable	Mean	F	Significance
Time * Treatment	*F. occidentalis*	12.63	0.672	0.991
	M. sjostedti	0.95	0.854	0.830
	Larvae	15.36	0.625	0.997
	Orius spp.	0.20	1.150	0.173
	C. menes	0.14	0.743	0.964

Table 2. Mean number of *Frankliniella occidentalis, Megalurothrips sjostedti,* larvae, *Orius* sp. and *Ceranisus menes* on French bean crop under different cropping systems

	Treatments											
	Mono-crop	Methiocarb	L-cyhalothrin	*Targetes erecta*	*Daucus carota*	*Coriandrum sativum*	*zea mays*	*Brassica oleracea capitata*	*Capsicum annuum*	Total	SE	*P*
F. occidentalis	65.39	16.08	14.21	10.47	12.53	10.77	8.56	11.23	12.95	21.41	1.3	0.000
M. sjostedti	1.26	0.99	1.23	0.92	0.84	1.15	0.53	0.83	0.92	0.98	0.05	0.029
Larvae	45.53	23.11	14.16	12.37	14.65	12.39	12.03	13.59	17.84	20.35	0.9	0.000
Orius sp.	0.16	0.17	0.19	0.27	0.20	0.19	0.19	0.16	0.31	0.20	0.02	0.585
C. menes	0.06	0.19	0.17	0.17	0.15	0.17	0.09	0.17	0.04	0.13	0.02	0.115

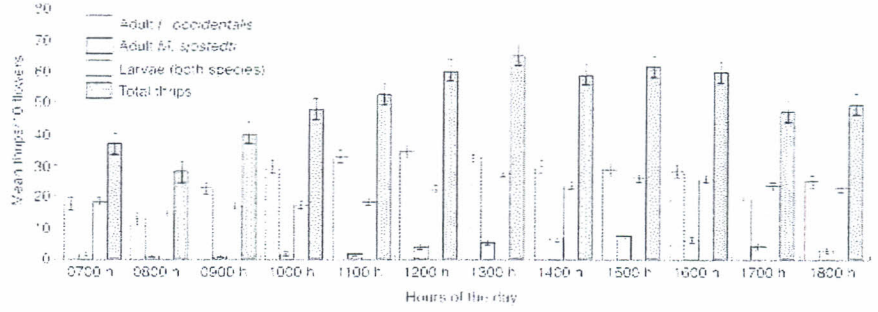

Fig. 1. Mean number ± (SE) of flower thrips on French bean flowers in a day at Mwea-Tebere, Central Kenya

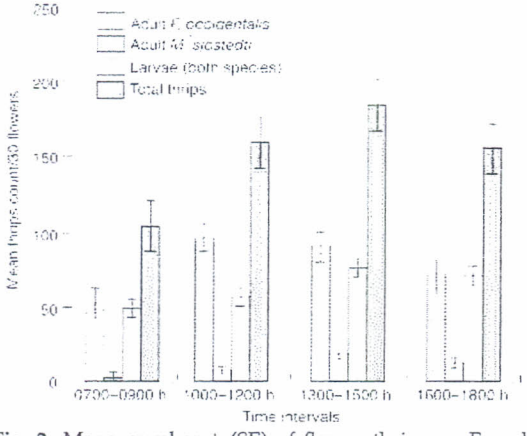

Fig. 2. Mean number ± (SE) of flower thrips on French bean flowers at 3-h intervals in a day at Mwea-Tebere, Central Kenya

French beans planted in mono-crop had the highest number of *Orius* spp.

The numbers of *C. menes* were significantly different ($P < 0.05$) on French bean leaves in all treatments compared to those in the flowers and flower buds and the L-cyhalothrin (Karate) treatment had the lowest *C. menes* counts (Fig. 5).

Orius spp. and *C. menes* increased in number as the thrips population increased on French bean flowers at different times of the day (Fig. 6). The peak period of both natural enemies coincided with decreasing thrips populations after the thrips peak period.

Discussion

The different cropping systems did not significantly affect the diurnal population fluctuations of *M. sjostedti, F. occidentalis* and the larvae of both species. However, the thrips population peaks were noted at different times of the day depending on the thrips species and/or the thrips immature stages (larvae). This may imply that the population peaks are a characteristic of the thrips species infesting the French bean crop. The results confirm those from previous studies that *F. occidentalis* population peaks are at midday (Kiers *et al.*, 2000) and thereafter decrease. *M. sjostedti* population peaks occurred around 1500 h. Earlier work by Taylor (1969) showed that *M. sjostedti* populations peak between 1200 and 1300 h on cowpea. The population peaks of *F. occidentalis* and *M. sjostedti* could indicate an avoidance of competition between the two species. Taylor (1969) also reported

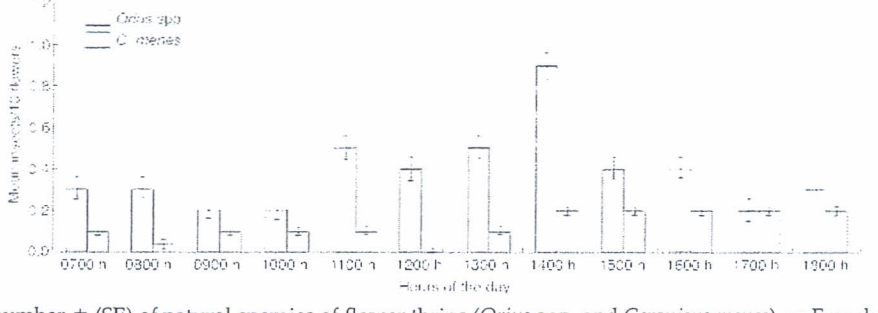

Fig. 3. Mean number ± (SE) of natural enemies of flower thrips (*Orius* spp. and *Ceranisus menes*) on French bean flowers in a day at Mwea-Tebere, Central Kenya

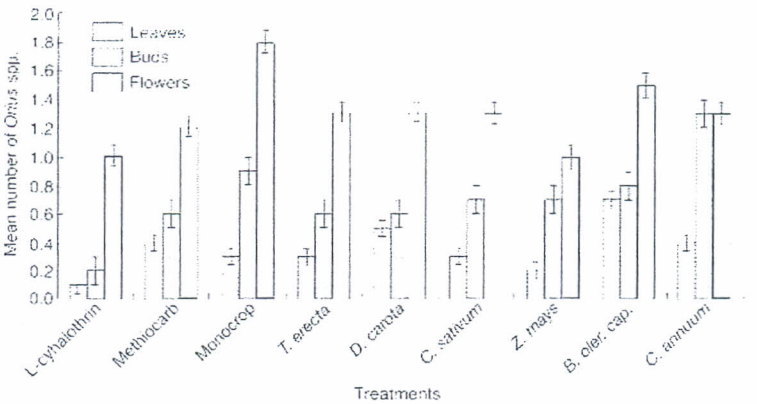

Fig. 4. Mean number ± (SE) of *Orius* spp. on French bean leaves, flower buds and flowers at Mwea-Tebere, Central Kenya

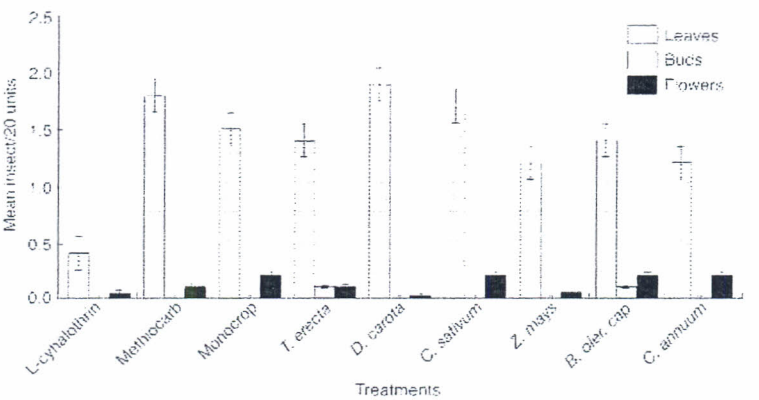

Fig. 5. Mean number ± (SE) of *Ceranisus menes* on French bean leaves, flowers and flower buds at Mwea-Tebere, Central Kenya

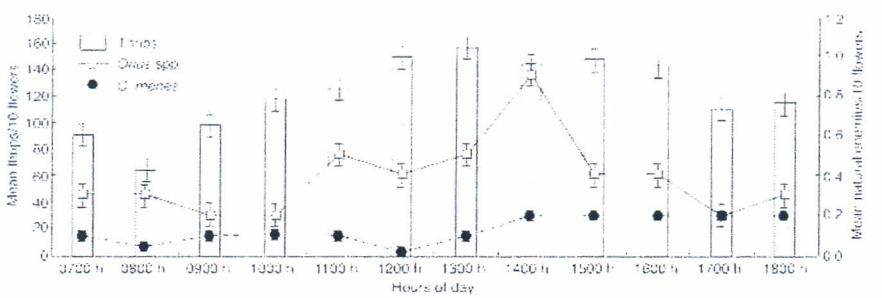

Fig. 6. Mean number ± (SE) of thrips and their natural enemies on French bean flowers in a day at Mwea-Tebere, Central Kenya

that both temperature and light intensity could influence thrips flight and thus affect their diurnal peaks.

Companion crops could have some effects on the French bean crop by changing the microclimate around the crop; however, no such effects were observed in the present study. The presence of *Orius* spp. and *C. menes* on leaves and flowers of French beans infested by flower thrips emphasizes their role as natural enemies. *Orius* spp. is known to

predate on both adults and larvae of *F. occidentalis* and *M. sjostedti* (Gitonga, 1999; Suresh *et al.*, 2001). However. thrips populations remained relatively high, indicating that the low number of both natural enemies recorded in this study could not efficiently regulate the thrips populations. (The low populations of *Orius* spp. and *C. menes* in French bean fields in Kenya were also reported by Gitonga, 1999). It is therefore essential to incorporate other control methods for thrips management.

Companion crops used in this study had no effect on the population of natural enemies. However, in the L-cyhalothrin-treated plots, relatively low mean numbers of *Orius* spp. and high thrips counts were recorded.

Conclusions

Diurnal population fluctuations of both the flower thrips and their natural enemies are important aspects to consider in integrated pest management (IPM) of French bean thrips. If insecticides are to be applied, these should be selective and have least residual effects. Some insecticides are known to cause high mortalities to natural enemies and, as such, may be applied when the populations of natural enemies are expected to be low.

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References

Cho K. J., Walgenbach J. F. and Kennedy G. G. (2000) Daily and temporal occurrence of *Frankliniella* spp (Thysanoptera: Thripidae) on tomato. *Applied Entomology and Zoology* 35, 207–214.

Gitonga L. M. (1999) Bioecology of thrips in French bean growing ecosystem in Kenya. Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya. PhD Thesis. 176 pp.

Kiers E., de Kogel W. J., Balkema-Boomstra A. and Mollema C. (2000) Flower visitation and oviposition behavior of *Frankliniella occidentalis* (Thysan., Thripidae) on cucumber plants. *Journal of Applied Entomology* 124, 27–32.

Kyamanywa S., Baliddawa C. W. and Ampofo J. K. O. (1993) Effects of maize plants on colonisation of cowpea plants by bean flower thrips, *Megalurothrips sjostedti*. *Entomologia Experimentalis et Applicata* 69, 61–68.

Suresh R., Funderburk J., Stavisky J. and Olson S. (2001) Population abundance and movement of *Frankliniella* spp. and *Orius insidiosus* in field pepper. *Agricultural and Forest Entomology* 3, 129–137.

Taylor T. A. (1969) On the population dynamics and flight activity of *Taeniothrips sjostedti* (Trybom) (Thysanoptera: Thripidae) on cowpea. *Bulletin of the Entomological Society of Nigeria* 2, 60–71.