Original article

Efficacy of coloured sticky traps for citrus thrips *Scirtothrips aurantii* Faure (Thysanoptera, Thripidae) in mango ecosystems of South Africa

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Efficacy of coloured sticky traps for citrus thrips *Scirtothrips aurantii* Faure (Thysanoptera, Thripidae) in mango ecosystems of South Africa.

Abstract — Introduction. The South African citrus thrips, *Scirtothrips aurantii* Faure (Thysanoptera: Thripidae), is a pest of mango (*Mangifera indica* L.), in southern Africa. *Scirtothrips aurantii* cause lesions to young fruit and damage to young mango growth results in leaf malformation and stunted growth. **Materials and methods**. The sticky traps of various colours were tested in mango orchards in South Africa for their attraction of adult *S. aurantii*. **Results**. Yellow colour was superior to green, red, white and blue ones to catch *S. aurantii*. Green, red, white and blue traps attracted similar numbers of thrips although *S. aurantii* tended to respond more to green than red, white and blue in this sequence. **Conclusion**. Yellow traps can be used effectively for assessing activity levels of *S. aurantii* in mango orchards. © Éditions scientifiques et médicales Elsevier SAS

South Africa / *Mangifera indica* / *Scirtothrips aurantii* / traps / attractants

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Efficacité des pièges collants colorés pour la capture du thrips des agrumes, *Scirtothrips aurantii* Faure (Thysanoptera, Thripidae), dans des écosystèmes de manguiers en Afrique du Sud.

Résumé — Introduction. Le thrips sud-africain des agrumes, *Scirtothrips aurantii* Faure (Thysanoptera, Thripidae), est un parasite du manguier (*Mangifera indica* L.) en Afrique méridionale. Il cause des lésions au jeune fruit et endommage la croissance de jeunes arbres en provoquant une malformation des feuilles et un retard de croissance. **Matériel et méthodes**. Des pièges collants de différentes couleurs ont été testés en vergers de manguiers en Afrique du Sud vis-à-vis de leur pouvoir attractif d'adultes de *S. aurantii*. **Résultats**. La couleur jaune s'est révélée meilleure que le vert, rouge, blanc ou bleu pour capturer les individus de *S. aurantii*. Les pièges verts, rouges, blancs ou bleus ont attiré des nombres semblables de thrips bien que *S. aurantii* ait tendu à répondre davantage au vert qu'au rouge, au blanc et ou bleu, respectivement. **Conclusion**. Des pièges jaunes peuvent être employés efficacement pour évaluer des niveaux d'activité du thrips *S. aurantii* en vergers de manguiers. © Éditions scientifiques et médicales Elsevier SAS

Afrique du Sud / *Mangifera indica* / *Scirtothrips aurantii* / piège / attractif

1. introduction

The South African citrus thrips, *Scirtothrips aurantii* Faure (Thysanoptera: Thripidae), is an important and well documented pest of citrus in southern Africa [1–4]. *S. aurantii* also causes lesions to young fruit of the mango (*Mangifera indica* L.) and its status as a pest of this crop has increased over the past number of years [5]. Fruits with large lesions are not suitable for the export market although the damage is merely cosmetic. The damage to young mango growth results in leaf malformation and stunted growth.

Before integrated pest management can successfully be implemented against *S. aurantii* in mango orchards, an effective technique for monitoring population numbers must be available in order to determine whether the application of control measures is required, to determine the correct timing of control applications and for gauging their effect. Monitoring thrips using coloured sticky traps is well documented [6–13], but it has not yet been used in mango orchards.

When white, yellow, blue, red, green and black sticky traps were used to capture *S. citri* (Moulton) on navel oranges in California, the white traps caught greater numbers [8]. Moreno [14] suggested the use of yellow to monitor *S. citri*. The fluorescent Saturn yellow trap was developed for monitoring *S. aurantii* in citrus orchards in South Africa [15, 16]. These traps are not commonly used because they are expensive and cumbersome [17]. Grout and Richards [18] found that smaller non-fluorescent yellow card traps on the sunny side of trees were more attractive to *S. aurantii* than Saturn yellow traps used on the shady side. Yellow card traps were also less expensive and easier to use. Citrus producers were therefore encouraged to use them. As sticky traps could also be useful for monitoring population fluctuations of *S. aurantii* in mango orchards, the attraction of traps of different colours for *S. aurantii* was evaluated in this study.

2. materials and methods

To determine the colour preferences of *S. aurantii*, five different colours were used: blue, yellow, green, red and white. Blue was included because certain thrips species are attracted to blue, for example the western flower thrips *Frankliniella occidentalis* (Pergande) [11, 13]. Blue sticky traps are used for monitoring thrips in nectarine orchards in South Africa [19]. Yellow traps were included because yellow is the preferred trap colour for monitoring *S. aurantii* in citrus orchards in South Africa [18]. Red and green were used because they resemble the young mango leaves while white traps were included because white is highly attractive to some thrips species [10].

The yellow traps consisted of non-fluorescent yellow polyvinyl chloride (140 mm × 76 mm × 0.2 mm) obtained from Capespan. The white, blue, red and green traps were cut from coloured cardboard. The spectral reflectance characteristics of the colours were determined at 10 nm intervals from 380 to 790 nm, using a Perkin Elmar Lambda spectrophotometer; $BaSO_4$ (compressed powder supplied by Merck) standard = 100 % (*figure 1*). Traps were coated on both sides with a sticky adhesive, Fly-tac.

Field work was carried out in mango orchards at the Insitute for Tropical and Subtropical Crops Nelspruit Experimental Farm (25° 26' S, 30° 58' E) in the Mpuma-

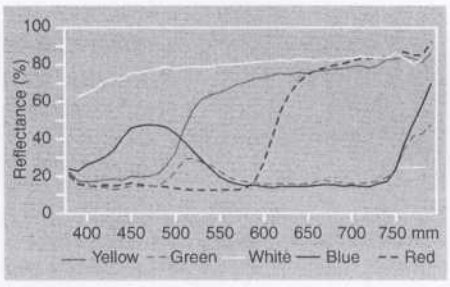

Figure 1.
Percentage of reflectance of light from surfaces of colour traps as measured with a Perkin Elmer Lambda 9 spectrophotometer; $BaSO_4$ standard = 100 %.

langa Province of South Africa. One set of the five different colours was placed at four different localities on the farm. A set consisted of one trap of each colour. The first set of traps was placed in a Sensation mango tree orchard, the second in a mango orchard consisting of different selections, the third in a Tommy Atkins orchard and the last set in mango trees grown from seed. All trees used were older than 10 years. In the first two orchards, fungicides were sprayed against powdery mildew, anthracnose and bacterial black spot. Bait sprays were used against fruit flies (Tephritidae). At the last two locations, no pesticides were applied.

Traps were hung on the outside of five randomly chosen trees and rotated every week. They were placed on the sunny northern side of the trees, 1.5 m from the ground. Traps were changed weekly except on two occasions in April and May 1995 when traps were changed fortnightly. After removal, each trap was wrapped in clear polyethylene plastic and brought to the laboratory. The number of *S. aurantii* present on both sides of the traps was counted using a stereo microscope. The trapping period was from April 1995 until March 1996.

The cumulative number per locality was analysed using an analysis of variance. Tukey's multiple range test was used to separate differences.

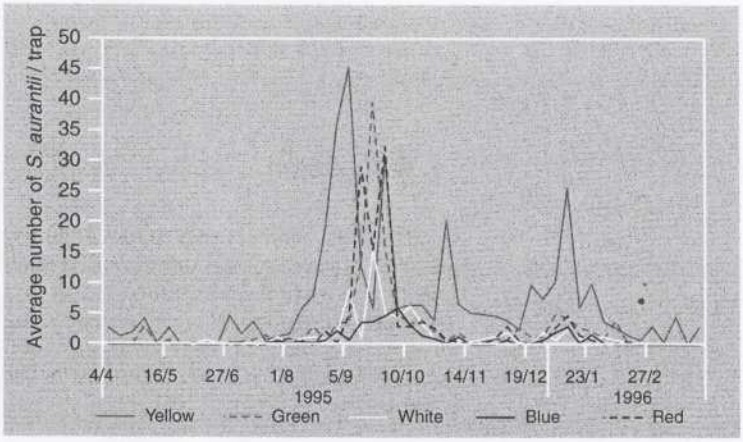

Figure 2.
Weekly catches of *Scirtothrips aurantii* on coloured sticky traps in mango orchards from April 1995 to March 1996 (South Africa).

3. results

Scirtothrips aurantii adults were present in mango orchards throughout the year (*figure 2*). During August, numbers started to increase and reached a peak from the end of August to September. High numbers also occurred at the beginning of November and during January. This corresponded with flushing periods. During February to July their numbers remained low.

Adults of *S. aurantii* responded significantly more to yellow than any other colour (*table I*). No significant difference was present between the numbers attracted by green, red, white and blue. There was a

Table I.
Mean cumulative numbers of *Scirtothrips aurantii* caught on traps of different colours. Averages not followed by the same letter differ at the level of $p = 0.05$. Tukey's multiple range test was used to separate differences.

Trap colour	Mean cumulative number	Standard error of mean
Yellow	333.500 a	36.762
Green	130.250 b	34.577
Red	115.000 b	36.284
White	68.500 b	20.698
Blue	39.500 b	4.500
Mean-squared error	2 491.43	–
Error degree of freedom	12	–
Least significant difference	112.507	–
Coefficient of variance	36.341	–

tendency for *S. aurantii* to respond more to green traps rather than red, white and blue.

4. discussion

The high numbers of *S. aurantii* during August to September corresponded with the period when the fruit started setting and when many small fruits were present in the tree. *Scirtothrips aurantii* feeds on small fruit and adult females lay their eggs in the fruit.

The high numbers during November and January corresponded with flushing periods. Egg laying and feeding also take place on soft new foliage [4, 21]. Feeding does not take place on mature leaves. A growth model complied for Sensation mango trees at Nelspruit indicates that there are two main periods of shoot growth [20]. Grové et al. [21] found that new flush is constantly present in mango orchards throughout the year and provides continuous feeding and breeding sites. Thus, mango orchards can maintain *S. aurantii* populations throughout the year although numbers decline during the winter.

Yellow attracted the highest number of *S. aurantii* and therefore the results obtained support the recommendation of Grout and Richards [18] for monitoring *S. aurantii* with yellow card traps in citrus orchards. Similar results were obtained with a closely related species, *S. citri* [14]. This species responded more to fluorescent yellow than all other coloured card traps, and secondly to yellow. There was also a tendency for *S. citri* to respond more to green than to white, blue, clear, black and red, although these differences were not significant.

While searching for feeding or egg laying sites, flying insects receive various cues which stimulate or inhibit their behaviour. The colour and colour contrast play an important role in this regard [22]. *Scirtothrips aurantii* must find succulent growth and small fruit where it can feed and lay eggs and the above results indicate that *S. aurantii* is attracted to the green–yellow region of the electromagnetic spectrum. Green traps showed peak reflectance at about 520 nm (*figure 1*). Yellow traps did not have a well defined peak. There was little reflection below 490 nm but there was a sharp rise at 500 nm and the reflectance remained high thereafter (*figure 1*). Most plants are highly reflective in this region (500–600 nm) [14].

This experiment confirms the importance of trap colour for effective monitoring and shows that yellow traps can be used effectively for assessing population activity of *S. aurantii* in mango orchards.

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La eficiencia de las trampas pegajosas y coloreadas para la captura del thrips de los agrios, *Scirtothrips aurantii* Faure (Thysanoptera, Thripidae), en ecosistemas de mangos en África del Sur.

Resumen — **Introducción**. El thrips sudáfricano de lós agrios, *Scirtothrips aurantii* Faure (Thysanoptera, Thripidae), es un parásito del mango (*Mangifera indica* L.) en el África meridional. Éste causa lesiones a las frutas inmaduros, daña el crecimiento de los árboles más jóvenes, provocando una malformación en las hojas y un retraso en el crecimiento. **Materiales y métodos**. Se han utilizado trampas pegajosas y de colores vistosos en vergeles de mangos en África del Sur para provar el poder de atracción que tienen en el *S. aurantii* adulto.

Resultados. El color amarillo destacó frenete al verde, rojo, blanco o azul para atrapar a individuos de *S. aurantii*. Bien que las trampas verdes, rojas, blancas y azules atrajesen cada una a un número de *S. aurantii* similar, el *S. aurantii* respondió ventajosamente al color verde y no al rojo, blanco o azul respectivamente. **Conclusión**. Se pueden emplear eficazmente trampas amarillas para examinar los niveles de actividad del thrips *S. aurantii* en estos vergeles de mango.

Sudáfrica / *Mangifera indica* / *Scirtothrips aurantii* / trampas / atrayentes