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SHORT COMMUNICATION

Use of polypropylene bags for mass rearing *Neoseiulus baraki* (Acari: Phytoseiidae), a predatory mite of *Aceria guerreronis* Keifer (Acari: Eriophyidae)

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An efficient, low cost and practicable mass rearing method for the predatory mite, *Neoseiulus baraki* Athias-Henriot (Acari: Phytoseiidae) was developed using a bag made of two-ply polypropylene (gauge 150, 24 cm × 36 cm) sheets. Introducing 20 *N. baraki* females into the bag produced a mean number 5218 ± 212.10 offspring in 6 weeks with a 260-fold increase of the initial population.

Keywords: coconut mite; mass rearing; *Neoseiulus baraki*; predatory mite

The coconut mite *Aceria guerreronis* Keifer (Acari: Eriyophyidae) is a major pest of coconut throughout the coconut growing areas in the world (Hall, Hussey, & Mariau, 1980; Caberara, 2002; Fernando, Aratchige, & Peiris, 2003). The potential of using predatory mites as a biological control agent of the coconut mite has been discussed (Fernando, Wickramanada, & Aratchige, 2002; Lawson-Balagbo et al., 2007a, 2007b; Moraes, McMurtry, Denmark, & Campos, 2004). *Neoseiulus baraki* Athias-Henriot (Acari: Phytoseiidae) feeds on coconut mites and has morphological characteristics that allow it to reach the micro habitats of the mite. However, *N. baraki* requires inundative releases to reduce pest populations. Studies in Sri Lanka have shown that augmentation of *N. baraki* by inundative releases could significantly reduce the coconut mite population and damage levels (Fernando, Waidyarathne, Perera, & De Silva, 2010). Several techniques have been developed to mass rear phytoseiid mites in Sri Lanka, including *N. baraki* (Aratchige et al., 2010; Fernando, Aratchige, Kumari, Appuhamy, & Hapuarachchi, 2004). However, these methods have several drawbacks. This paper describes a method for an efficient mass rearing of *N. baraki* on *Tyrophagus putrescentiae* Schrank (Acari: Acaridiidae) in polypropylene bags.

Two sizes of bags (18 cm × 12 cm and 36 cm × 24 cm) were compared as rearing arenas, and were prepared from two-ply polypropylene sheets of gauge 150. Three sides of the bags were sealed twice, 2 mm apart, using a polythene sealer. Two-ply facial tissue paper (15 × 15 cm) was folded into a 3 × 1.5 cm rectangle and soaked with water for saturation. The paper was placed inside one corner of the bag and three margins were partially sealed, 0.5 cm away from the tissue to prevent dislodging. The wet tissue paper provided water for *T. putrescentiae* and maintained

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adequate humidity in the rearing unit for 8 weeks. Approximately 2 gm of 1:1 mixture of rice bran and wheat flour were added as food for the mites.

To determine the development of *T. putrescentiae* within the bags, 200–250 *T. putrescentiae* were introduced into 120 bags that were randomly divided into three sets. Bags were maintained in the laboratory at 27 ± 1.5°C and 70–80% relative humidity. After 2 weeks, one set of bags was cut open and 2 gm of food was added and kept under same conditions. The second set of bags received food in the same manner after 4 weeks. The remaining set was not given additional food and was cut open bi-weekly to facilitate ventilation. The numbers of mites were counted in 10 randomly selected bags from each set under a stereo zoom microscope.

In order to determine the initial number of mites introduced into bags, 10 and 20 *N. baraki* females each were introduced into 40 bags with 2-week-old *T. putrescentiae*. All these were properly sealed and kept under laboratory conditions. Each bag was cut open and received 2 gm of food for *T. putrescentiae* at week 4 and week 8. Total number of *N. baraki* (excluding eggs) in 10 randomly selected bags from each set was counted under a stereozoom microscope at 2-week intervals.

In each experiment the mean number of mites per bag representing different treatments were analysed and compared by a General Linear Model (GLM) using SPSS (version 14) statistical package. Comparisons of treatments were done by Bonferroni method.

Significant differences of *T. putrescentiae* populations in bags provided with supplementary food at different intervals and bags without food were observed over time (df = 2, $F = 12.792$, $P = 0.003$). Irrespective of whether or not the food was supplemented, the number of *T. putrescentiae* increased by 20 fold in 4 weeks. Thereafter, the number was significantly higher in only bags supplemented with food (Figure 1). Results suggest that *T. putrescentiae* should be supplied with food at 4-week intervals. *N. baraki* successfully developed and multiplied in polypropylene bags provided with adequate number of *T. putrescentiae*. A significant difference in mean numbers of *N. baraki* over 8 weeks was observed for both treatments. However, irrespective of the number of *N. baraki* introduced, mean numbers of mites per bag increased up to 6 weeks and then declined. In all the observations, the mean number of *N. baraki* was higher in polypropylene bags introduced with 20 females (5218 ± 212.10) than bags with 10 females (4938.8 ± 326.4; df = 1, $F = 12.509$, $P = 0.002$).

A significantly higher mean number of *T. putrescentiae* (df = 1, $F = 96.37$, $P = 0.0001$) and *N. baraki* (df = 1, $F = 470.67$, $P = 0.0001$) were recorded in large polypropylene bags (36 cm × 24 cm) than the smaller bags (Figure 2). The highest population of *N. baraki* was obtained 6 weeks and 8 weeks after introducing the mites in small and large bags, respectively. In large bags *N. baraki* numbers did not decline before 8 weeks. There was no significant difference between procedures in the mean number of *N. baraki* per bag, 8 weeks after their introduction (5641.22 ± 339.17, 5481.0 ± 481.86 and 5352.6 ± 550.74; df = 2, $F = 2.068$, $P = 0.147$).

A bag made of two-ply polypropylene sheet (gauge 150) is a readily available packing material and placing a piece of wet tissue in a partially separated chamber proved an ideal habitat similar to the natural one for *N. baraki* and its alternative host *T. putrescentiae*. *T. putrescentiae* served as the food for *N. baraki* while a mixture of rice bran (1 part) and wheat flour (1 part) was also a suitable food for *T. putrescentiae*. Addition of 2 gm of food into the bag at 4 weeks successfully

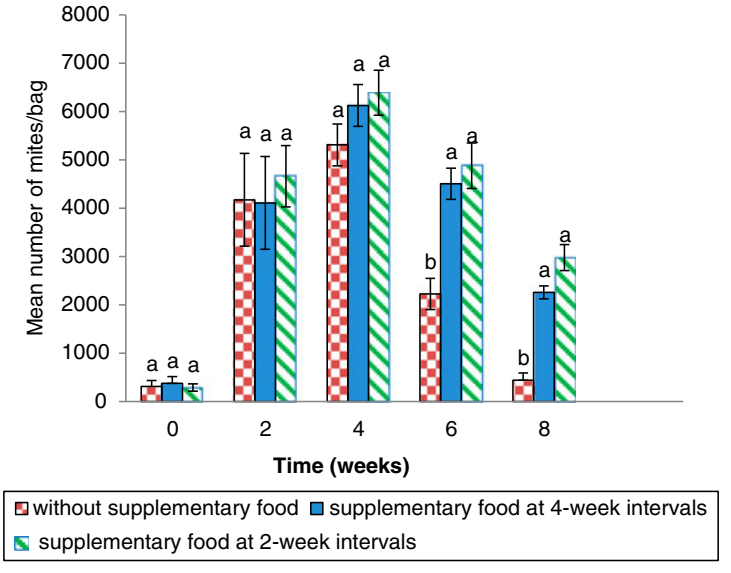

Figure 1. (Colour online) Mean number of *T. putrescentiae* per polypropylene bag provided with supplementary food at 2 weeks and 4 weeks and without supplementary food over 8 weeks. The mean numbers with the same letter at each week were not different at $P = 0.05$ (error bars represent the standard error of mean).

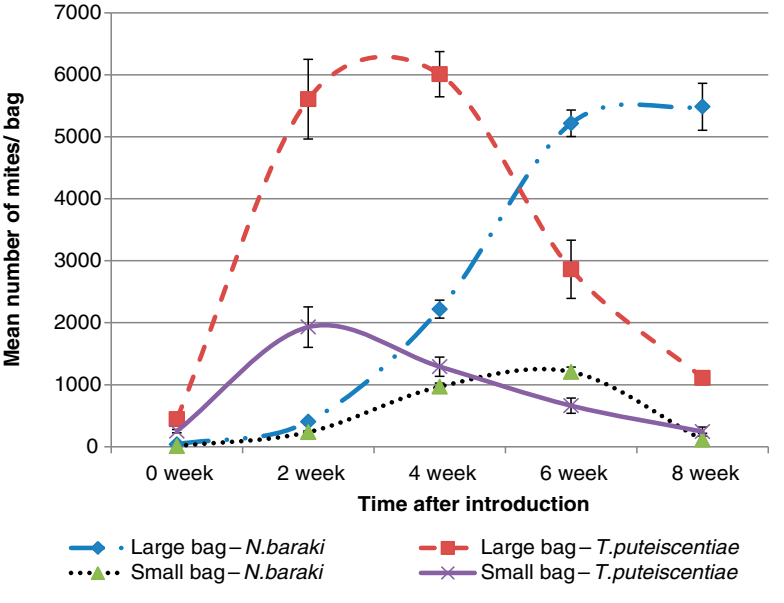

Figure 2. (Colour online) Population development of *N. baraki* and *T. putrescentiae* in large (36 cm × 24 cm) and small (18 cm × 12 cm) polypropylene bags. The mean number of mites in each category is significantly different at $P = 0.05$ (error bars represent the standard error of mean).

increased the numbers of *T. putrescentiae*. Although, *N. baraki* could be mass reared in closed arenas without a water barrier (Fernando et al., 2004) and in tray-type arenas (Aratchige et al., 2010) continuous production of *N. baraki* in those systems has limitations. Frequent contamination of rearing cultures by other mites, especially *Lasioseius* sp. (Acari: Ascidae) that feeds on *N. baraki* and *T. putrescentiae* was one of the major drawbacks in the method of Fernando et al. (2004), hindering a steady supply of *N. baraki* for field releases. The presence of a glue barrier in the tray-type arena (Aratchige et al., 2010) reduced the efficiency of field releases of *N. baraki* because of the difficulty in removing the barrier before transporting the mites into the field. Both these types of arenas need frequent monitoring to ensure a pure culture of *N. baraki,* due to an inherent open rearing system. These disadvantages are overcome by polypropylene bags and it is ready to transport and field release. After introducing both mites into the bags and providing food 4 weeks later, mites are ready for release in 6 weeks. Large bags (36 cm × 24 cm) introduced with 20 female *N. baraki* produced nearly 5000 of offspring after 6 weeks, sufficient to release on one coconut palm (Aratchige et al., 2010). Hence, mass rearing of *N. baraki* using the larger 36 cm × 24 cm polypropylene bag is recommended.

Use of polypropylene bags for rearing has other advantages. The bag is ready to use, being hung in the crown of the coconut palm, and can be cut open for escape of predatory mites. Mass rearing of *N. baraki* in bags can easily be developed as an on-farm production method due to its simplicity, cost effectiveness and the use of readily available materials for its construction.

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