Utilization of *Trigona spinipes* as a Pollinator in Onion (*Allium cepa* L.) Breeding Programmes in Brazil.

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ABSTRACT

Trigona spinipes (Hymenoptera:Apidae, Meliponini), known commonly as 'irapuá', is an indigenous non-stinging bee. It is easily found, the nests are simple to collect, and colonies can be managed so that the bees are highly effective pollinators of onion (*Allium cepa* L.) when placed in isolation cages. The use of this low cost but efficient pollinator for onion seed production in Brazil is described.

Additional index words: bees, onion seed production, isolation cages, house fly, nests.

INTRODUCTION

The inflorescence of the onion plant is an umbel of 50 to 2000 bisexual flowers. The flowers are hermaphroditic and protandric, as the anthers dehisce before the development of the style, and the pollen grains are released prior to the stigma becoming receptive. The flowers in the umbels open in successive layers over several weeks, and are prolific producers of nectar. These factors give onion an allogamous reproductive pattern, with >90% cross pollination effected by insects from different families. Lorenzon and Martinho (1992) reported that Apidae (*Apis mellifera, Trigona spinipes* and *Tetragonisca angustula)*, Mutilidae, Sphecidae, Vespidae, Bombydae, Tachinidae and Bibionidae were the families found most frequently during flowering in onion hybrid seed production fields. *A. mellifera* and *T. spinipes* were the most active species but the latter was a less efficient pollinator than the former.

Bees, mainly those of the genus *Apis,* are commonly used by seed companies and their co-operators for onion pollination in field production, either with open pollinated or hybrid cultivars (Melo and Ribeiro, 1990). In enclosed spaces such as glasshouses or screen cages used in onion breeding programmes, *Apis mellifera* has been used (Pesson and Louveaux, 1994) instead of other bee species that are more efficient pollinators (Wada, 1993). In Brazil, *Trigona spinipes* has high potential as a pollinator for enclosed spaces, because it is easy to find, and its nests are easy to collect and handle. The onion breeding programme at EMBRAPA-HORTALICAS has used *Trigona* and the house fly (*Musca domestica*) as pollinators with great success. In this paper we report on our use of the *Trigona* bee.

DESCRIPTION AND BIOLOGY

*Trigona spinipes (*Hymenoptera: Apidae, Meliponini) is a native Brazilian bee species which does not sting and is commonly referred to as "irapuá", "arapuá" or "cachorra". This *Trigona* species is very prolific, and colonies with up to 180,000 workers are not uncommon (O'Toole and Raw, 1992). The genus *Trigona* occurs also in other countries of South America, Africa, Australia and South Asia (McGregor, 1976).

Trigona adults are black in colour (Fig. 1), and are 5-6.5 mm long by 2.5 mm wide (Gallo *et al.,* 1978). They build their nests on trees, between branches, giving them an oval or globular shape (Fig. 2). They extract fibre filaments from leaves, flowers or bark and for this reason are considered as pests; they can damage commercial crops such as citrus (Gallo *et al.*, 1978) macadamia (Myasaki, Filho and Sampaio, 1984), *Musa*, *Pinus* and *Rosa* spp., and *Phaseolus vulgaris* (Giorgini and Gusman, 1972).

Figure 1. *Trigona spinipes* working on an onion umbel.

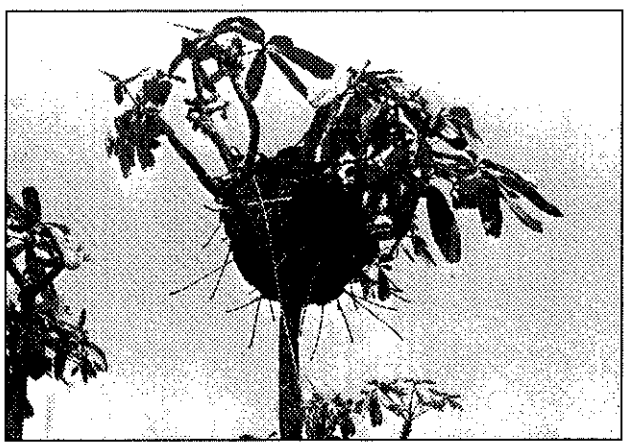

Figure 2. *T. spinipes* nest on a tree in the cerrado. The nest is around 30 cm in diameter.

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COLONY CAPTURE AND BEE MANAGEMENT

In Central Brazil, the nests occur in the 'cerrado' (Savanna), alongside the roads and small rivers on branches of trees. Once a nest is located, the entrance must be closed with a mixture of clay and water, or cotton wool. After this, the branches are stripped of their leaves and cut off the tree, and the nest enclosed in a nylon netting sack. This operation must be done in the early morning or late afternoon.

Inside the isolation cage, the nest(s) are placed on a box at a height of 20-30 cm above ground level (Fig. 3). Adequate fresh water must be supplied in small containers, with dry sticks and leaves in contact with the water to facilitate access for the bees.

Because of the abundant production of nectar and pollen by the onions, damage to the umbels, flowers and leaves caused by *T. spinipes* has not been observed in the twelve years the species has been used. A similar observation was recorded by Lorenzon, Rodrigues and Souza (1993). However, some damage is common with carrots, and the solution to the problem is to add sugar or sugar cane juice to the water. After the end of the onion flowering period of 3 to 5 weeks, the nests must be returned to the cerrado. However, the same nests cannot be used in the following year. According to Nogueira Neto (1953), the *Trigona* bee cannot survive in beehives, and thus new bee colonies must be collected every year.

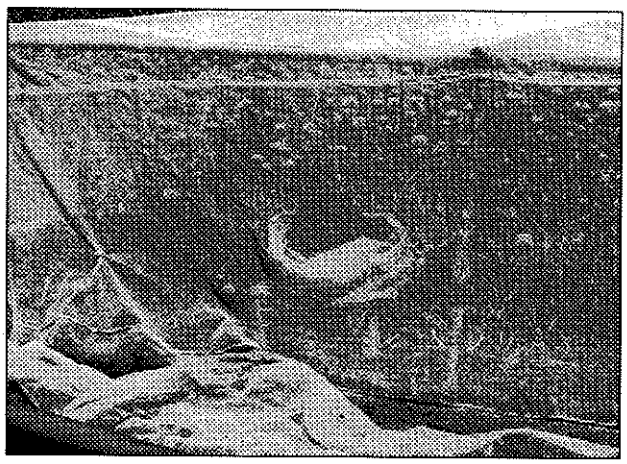

Figure 3. Nest placed inside an isolation cage.

PREPARATION OF THE CAGES FOR SEED PRODUCTION

To avoid cross pollination in the field, the plant populations must be isolated in cages shortly before flowering. These cages, made with nylon screen and frames of aluminium/ plastic water pipes or bamboo, are not taller than 1.5 m and cover a soil surface area varying from 3 to 100 m^2. Generally, one or two nests are put in the interior of a cage after its construction. The adequate proportion of the bee population to the number of umbels is a very important factor for efficient pollination. In small cages (3-10 m^2) one small nest of about 25 cm in diameter, with a small bee population (number of individuals <5000), can be used with good efficiency. In bigger cages (> 10 m^2), one bigger nest (number of individuals >5000) works better. In the 'cerrado' region near Brasilia-DF, the size of the nests ranges from 30 to 60 cm in diameter.

In cages of 3m^2 or less, *Musca domestica* is generally used as a pollinator because it is better adapted to smaller environments; seed yields are almost similar to those obtained with *T. spinipes*. However, it is better to work with bees, because in cages placed in open fields with temperatures below 15°C, high mortality levels occur in the fly population, reducing seed yields if the fly population is not continuously replenished; this replacement is both time consuming and expensive. In contrast, the population of *T. spinipes* remains relatively constant; this pollinator maintains the temperature of brood chambers at 33 to 36°C, while outside temperatures vary from less than 8 to 30°C. The bees raise the temperature by shivering as honey bees do, and lower the temperature by fanning their wings at the nest entrance (O'Toole and Raw, 1992).

In our trials, seed production of selected onion populations pollinated by *T. spinipes* has varied from 100 to over 500 kg ha^{-1} (Table 1). In comparison, in a study where honey bees were used to pollinate onions, plots caged without honey bees, caged with honey bees, and uncaged plots yielded 73, 275 and 97 kg ha^{-1} respectively (Kumar, Mishra and Gupta, 1989).

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Table 1. Seed production of some selected onion populations pollinated by *T. spinipes* under screen protection, Brasilia 1994.

Onion population	Cage area (m^2)	Seed produced per cage (g)	Extrapolated seed yield (kg ha^{-1})
CONQUISTA	18	800	444.4
CNPH-6024	48	500	104.2
CNPH-6028	120	1200	100.0
CNPH-6029	42	1000	238.1
CNPH-6036	28	1500	535.7
CNPH-6039	10	400	400.0

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