International Journal of Pest Management
Vol. 55, No. 1, January–March 2009, 57–61

Taylor & Francis
Taylor & Francis Group

Thieves, bats and fruit flies: local ecological knowledge on the weaver ant *Oecophylla longinoda* in relation to three 'invisible' intruders in orchards in Guinea

P. Van Mele[a]*, K. Camara[b] and J.F. Vayssieres[c,d]

[a]*Africa Rice Center (WARDA), Cotonou, Benin;* [b]*Institut de Recherche Agronomique de Guinée (IRAG), Foulaya, Guinea;* [c]*CIRAD, UPR Production Fruitière, Montpellier, France;* [d]*IITA, Cotonou, Benin*

(*Received 3 September 2008; final version received 3 September 2008*)

We held interviews with 100 mango and cashew growers in Guinea, West Africa. Fewer than 20 questions dealing with the tree-inhabiting weaver ant *Oecophylla longinoda* were developed, based on local context and related research conducted on farmers' knowledge in other countries. More than half of the growers reported that ants protect their orchard from thieves. Apart from deterring snakes, about 46% of the growers mentioned that weaver ants reduce damage by fruit-eating bats; some reported that bats do dislike the smell of weaver ants. Whereas the relationship between ants and humans or conspicuous fruit bats is well understood, a quantitative appreciation of the effect of *Oecophylla* on small insect pests, such as fruit flies, is more complex. Despite the fact that 57% of the growers reported that *Oecophylla* had a positive effect on mango fruit quality, many classified *Oecophylla* as a pest due to its nuisance during harvest, and they requested the plant protection staff to help them with pesticides. Strategies to strengthen local ecological knowledge are discussed.

Keywords: local ecological knowledge; *Oecophylla longinoda*; fruit flies; fruit quality; fruit bats; biological control; Africa

1. Introduction

Appropriate pest management options for fruit and nut growers in sub-Saharan Africa should be cost-effective, locally available and sustainable. The weaver ant *Oecophylla longinoda* (Hymenoptera: Formicidae) is endemic to Africa and is often abundant in unsprayed orchards. Being a generalist predator with a sophisticated communication and recruitment system, *Oecophylla* patrols trees continuously seeking prey. A colony comprising 12 nests may capture about 45,000 prey items per year (Dejean 1991). However, many African farmers, extension staff and scientists have a negative attitude towards weaver ants and are unaware of their beneficial effects (Van Mele 2008a).

Fruit flies (Diptera: Tephritidae) are considered to be a key pest in mango production in West Africa (Vannière et al. 2004) with species covering a wide range of host plants. In Benin, four out of the eight fruit fly species caused most damage, namely *Ceratitis cosyra*, *C. quinaria*, *C. silvestrii* and *Bactrocera invadens*. The latter is an invasive species from Asia, only recently observed in West Africa (Vayssières et al. 2005). In Guinea, multiple fruit fly species occur, including *C. cosyra* and *C. rosa* (Vayssières and Kalabane 2000). Different fruit flies have different population peaks, adding to the complexity to manage the fruit fly problem. In Africa, small growers prevent fruit fly infestation by picking fruit early before they mature, yet labour is not always available and damage can remain significant. Others use blanket pesticide sprays, or, uncommonly, use imported bait sprays (Lux et al. 2003). Recent research in northern Benin indicated that mean fruit fly damage ranged from 1 to 24% with the weaver ant *Oecophylla* being either abundant or absent. In some cases, damage caused by fruit flies increased to 67% towards the end of the harvesting season in the absence of weaver ants (Van Mele et al. 2007).

Despite the positive effect of *Oecophylla* on fruit fly control, most farmers are either unaware of or do not fully appreciate it. According to Bentley and Rodriguez (2001) folk knowledge is uneven, being determined by the cultural importance of each item and its ease of observation. The cultural importance of weaver ants differs depending on people's profession. In Benin, fruit growers considered *Oecophylla* to be mainly a *gendarme* or police that protects their orchards from thieves, whereas women fruit pickers stated that ants improve the mango quality and yield by reducing the amount of rotten fruit, extending the mango shelf-life, giving the fruit a healthy appearance and improving its juice quality, especially its sugar content (Sinzogan et al. 2008). Interestingly, before having had frequent interactions with scientists, citrus farmers in Vietnam equally emphasised the ants'

*Corresponding author. Email: p.vanmele@cgiar.org

ISSN 0967-0874 print/ISSN 1366-5863 online

DOI: 10.1080/09670870802450276
http://www.informaworld.com

positive effect on fruit quality rather than its role in pest management (Barzman et al. 1996).

The role of *Oecophylla* in pest management has tended to focus on insect pests, whereas other types of pests have received little attention. One expert farmer in Vietnam mentioned that weaver ants control rats that feed on fruit (Van Mele and Truyen 2002). During his research in Ghana, the biologist Edward S. Ayensu (1974) reported that huge flocks of fruit bats could destroy up to one-third of the mangoes. In Australia, Lokkers (1990) hinted towards the possible importance of *Oecophylla* in reducing fruit damage by bats. This paper investigates what mango and cashew growers in Guinea perceive as their key production constraints, and what knowledge they hold with regard to the effect of weaver ants on thieves, bats and fruit flies.

2. Materials and methods

In October and November 2006, agronomists and plant protection staff from the national agricultural research institute (IRAG) interviewed 100 tree crop growers in the major horticultural zones of Guinea, including Kindia, Kankan and Boké. All interviewees were purposively sampled: their orchards needed to have weaver ant populations. Often farmers were identified by community members as 'knowing something about weaver ants'. Fewer than 20 questions dealing with the tree-inhabiting weaver ant *Oecophylla longinoda* were developed, based on local context and related research conducted on farmers' knowledge in other countries. Our approach confirmed the importance of having a short questionnaire with open-ended, targeted questions. By being aware of local issues, the interviewers avoided the superficiality that can undermine long questionnaires that fish for information. Quantitative and qualitative data were encoded and entered in Excel, after which frequency tables were established.

3. Results and discussion

3.1. Farmers' and orchards' profile

The farmers interviewed were all male, fruit tree production in West Africa being a typical male-dominated enterprise. Farmers were on average 57 years old (range 20–97) with 16 years of experience in orchard management (range 2–50). Orchards varied in size (0.3–80 ha) and composition. One-quarter of the orchards were mango or cashew monocropping systems. However, among all orchard growers, 88% grew mangoes (*Mangifera indica*), 57% cashew (*Anacardium occidentale*), 44% oranges (*Citrus* spp.), 39% avocado (*Persea americana*), 17% cola (*Cola acuminata*) and 15% palm trees. These included *Elaeis guineensis* and to a lesser extent *Borassus flabellifer* and *Raphia sudanica*. The orchards were on average 16 years old (range 3–42). More than two-thirds of the production systems were extensively managed with no systematic pruning or use of external inputs. Apart from avocado and palm trees, the weaver ant *Oecophylla* preferred nesting in all trees, with a major preference for mango trees.

3.2. Constraints in orchard management

The majority of farmers considered weeds the major problem as they hinder orchard operations, especially harvesting (Table 1). Besides, during the dry season people in many West African countries hunt on small wildlife by setting the bush on fire, which often extends to vast areas. Orchards with tall, dried up undergrowth can be entirely destroyed by such fires; farmers literally see years of investment go up in smoke. Fruit flies were mentioned spontaneously as a problem by 53% of the farmers.

When probed specifically to elaborate on key pest problems, many farmers did not specify, but grouped pests in broad classes. Fruit flies and insects causing damage similar to fruit flies were mentioned by 92% of the farmers (Table 2). To what extent this was influenced by the interviewers introducing themselves as conducting a survey as part of a fruit fly project is not clear. About 40% of the farmers reported weaver ants as the second most important pest. Other pests included borers (19%), mammals (14%), termites (13%) and scales (12%). Mammals causing damage included squirrels, fruit bats, grass cutters (rodents) and monkeys.

The majority (79%) of the farmers did not do anything to manage pests, 12% applied mechanical control against borers (by inserting a piece of metal wire in the holes in the trunk the larvae of the borer are killed) and 9% sprayed chemicals against mango fruit flies or cashew trunk borers. Farmers do not have ready access to pesticides and those using them received them through the regional agricultural

Table 1. Key problems reported by mango and cashew growers in Guinea, 2006 ($n = 100$).

Key problem	First order (%)	Second order (%)	Third order (%)	Fourth order (%)	Total (%)
Weeds	46	11	4	0	61
Fruit flies	9	22	16	6	53
Pests	5	13	13	1	32
Fruit rot	13	11	5	1	30
Lack of fertilisers	4	12	6	4	26
Diseases	7	9	4	4	24
Ants roll up leaves	9	6	5	1	21
Bush fires	2	7	4	0	13

research centres (CRAB and ARCA Guinea) or a private production and agricultural trading company (SPCIA).

3.3. Local ecological knowledge on weaver ants

Most growers consider *Oecophylla* to be a pest because it is a nuisance during harvest and it rolls up leaves (Table 3). About 26% of the growers highlighted the positive effect of the ants on mango fruit quality and 22% reported the ant chasing away pests, mainly snakes. Poisonous snakes most commonly encountered in orchards are *Dendroaspis viridis*, *Bitis arietans*, *Bitis nasicornis* and *Naja nigricollis*. In fact, poisonous snakes make up less than 25% of all encountered snakes. As bites from these snakes are often fatal, they are generally feared, especially at harvesting time when people have to enter the orchards and climb trees.

Interestingly, only 12% said that ants make the fruit dirty. Ants tend scales and this is highly visible. Farmers are aware of the relationship between ants and scales. In fact, most consider that scales are the eggs of the ants; they do not see them as different insects. Scientists in many countries have often used ant attendance of homopterans as an argument to classify *Oecophylla* as a pest. However, in Australia, in mango orchards with weaver ants the percentage of fruit with mealybugs and scales was less than 6% (Peng and Christian 2005). Only occasionally were higher levels of damage by scales observed in Burkina Faso, when farmers hindered the weaver ant colonising neighbouring trees (Van Mele 2007).

Again, when probed with a more targeted question, 57% reported that *Oecophylla* had a positive effect on fruit quality, such as a higher sugar content. This knowledge is comparable to this of fruit-pickers in Benin although only few growers knew about this (Sinzogan et al. 2008). Reasons given by the Guinean growers for improved quality varied from ants depositing their eggs on the fruit (6%), ants protecting the fruit from pests (24%), and because fruit in orchards with ants are allowed to ripen before being picked (26%). As was the case in Benin, some fruit-pickers used the presence of scales as an indicator of fruit quality.

When asked about the relationship between *Oecophylla* and pests, growers were less certain (Table 4). This can be explained by various factors, including: (1) mango trees are often very tall, making observations difficult (see also Van Mele et al. 2001); (2) tree crops are often considered as crops that require little attention, so not much time is spent in the orchards; and (3) growers often rely on labourers.

Despite the challenges of observing tree crop pests and their natural enemies, 58% of the farmers had seen *Oecophylla* prey on pests, mainly on small insects (52%), followed by winged insects (29%), black ants (8%), worms (4%), scales (3%) and snakes (2%). This was much higher than in Benin, where only 20% of the farmers had ever observed predation (Sinzogan et al. 2008). Having observed insect predation has apparently not automatically led to deeper insights regarding the extent of predation. Farmers, unlike scientists, do not conduct controlled experiments, and hence often have difficulties to make quantitative assessments of the actual impact of natural enemies on pests.

When asked whether they had ever seen *Oecophylla* being attacked by other ants, 33% responded positively. None had any idea how to manage competition between ant species. This is in stark

Table 2. Pest problems reported by mango and cashew growers in Guinea, 2006 ($n = 100$).

Pest	First order (%)	Second order (%)	Third order (%)	Total (%)
Fruit flies	86	4	2	92
Weaver ants	1	37	4	42
Borers	5	10	4	19
Termites	1	2	10	13
Scales	2	8	2	12
Squirrels	2	2	2	6
Fruit bats	2	1	1	4
Grass cutters	0	2	1	3
Monkeys	1	0	0	1

Table 3. Growers' perceptions of what *Oecophylla* does to their crops, Guinea, 2006 ($n = 100$).

Farmers' reaction	What do weaver ants do to your crops (%)
Make harvest and farm operations difficult	73
Roll up leaves	44
Improve the quality of fruit	26
Chase away snakes and other pests	22
Make fruit dirty	12
Affect the development of plants	5
I don't know	2

Some gave multiple answers.

Table 4. Growers' perceptions of how *Oecophylla* affects pests in their orchards, Guinea, 2006 ($n = 100$).

Farmers' reaction	What do weaver ants do to pests (%)
Reduces damage by pests	43
Increases damage by pests	24
I don't know	33

Table 5. Growers' knowledge about relationship between weaver ants and fruit bats in Guinea, 2006 ($n = 100$).

Growers' statement	% of growers
Weaver ants do not allow fruit bats to destroy mangos. Bats fear weaver ants, both cannot live together. With abundant weaver ants there will be no damage.	46
I don't know, I do not have bats or I haven't observed any because it is at night.	30
Weaver ants and bats live together and there is no difference in loss.	11
Bats are there at night when the weaver ants sleep in their nests.	9
Bats do not like the smell of weaver ants.	2
Weaver ants chase bats during the day, but bats are there at night.	1
I have observed weaver ants capture a bat.	1

contrast to Vietnam, where over the years citrus farmers developed a range of techniques to reduce ant competition (Van Mele and Cuc 2000).

Insect pests are relatively small organisms and when little time is spent in the orchard, observations may be infrequent and *ad hoc*. Fruit bats fly out in large numbers at dusk and are highly conspicuous. They target fruit trees during the ripening period and can cause much damage. Damaged fruits can be easily observed as the lower half has been eaten, with the seed becoming visible. About half of the farmers said that bats fear weaver ants and that there will be no damage of bats in orchards with abundant ants (Table 5). Two growers said that the ants smell and as such repel bats. Thirty percent were unsure, because the bats are nocturnal and it is hard to know what goes on in the orchard at night.

Other 'creatures' that are 'invisible' are thieves that come and collect fruit at night. This is a general phenomenon in West Africa. The ones most feared are those that come during the night with a vehicle. As the guards recruited to protect the plantations at night generally sleep, clearly the ants are considered as more effective. About 57% of the growers interviewed reported that thieves did not come to their orchard because of the weaver ants. Some said they could leave their fruit on the trees to ripen properly, whereas growers who do not have weaver ants have to pick their fruit well before maturity in order to avoid the fruit from being stolen. In Benin, the same level of growers considered *Oecophylla* to be a *gendarme* or police that protects their orchards from thieves (Sinzogan et al. 2008).

4. Conclusion

The positive effect of *Oecophylla* on fruit quality has hardly been scientifically tested, apart from the study by Barzman and colleagues in Vietnam (1996). Yet it opens up interesting new avenues for research. The positive effects on farmers' livelihoods and on fruit quality also offer good opportunities for developing communication strategies between African producers and European consumers, as part of organic or Fair Trade schemes (Van Mele 2008b).

Although entomologists and ecologists consider *Oecophylla* to be a biological control agent (Van Mele 2008b), fruit growers across Africa and Asia mainly attribute other values to the weaver ant. More than half of the fruit growers in Guinea appreciated the protective role of *Oecophylla* against thieves and fruit bats. This makes sense as both invade orchards at night when other protective measures are of little use. Local ecological knowledge is influenced by the visibility of interactions between organisms. Whereas the relationship between ants and humans or conspicuous fruit bats is well understood, a quantitative appreciation of the effect of *Oecophylla* on small insect pests, such as fruit flies, is more complex.

Acknowledgements

We thank the staff of IRAG who were involved in the survey, and are indebted to all the growers involved in the research. This work was sponsored by the Conservation, Food and Health Foundation. The study was undertaken through the Inland Valley Consortium (IVC), hosted by the Africa Rice Center (WARDA). IVC aims at developing appropriate technologies to help farmers to profitably increase productivity of inland valleys, while conserving the environment and biodiversity.

References

Ayensu ES. 1974. Plant and bat interactions in West Africa. Ann Missouri Botanical Garden. 61(3):702–727.

Barzman MS, Mills NJ, Cuc NTT. 1996. Traditional knowledge and rationale for weaver ant husbandry in the Mekong Delta of Vietnam. Agric Hum Values. 13(4):2–9.

Bentley J, Rodriguez G. 2001. Honduran folk entomology. Curr Anthropol. 42(2):285–301.

Dejean A. 1991. Adaptation of *Oecophylla longinoda* (Formicidae – Formicinae) to spatio-temporal variations in prey density. Entomophaga. 36(1):29–54.

Lokkers C. 1990. Colony dynamics of the green tree ant (Oecophylla smaragdina Fab.) in a seasonal tropical climate [Ph.D. dissertation]. [North Queensland]: James Cook University.

Lux SA, Ekesi S, Dimbi S, Mohamed S, Billah M. 2003. Mango-infesting fruit flies in Africa: perspectives and limitations of biological approaches to their management. In: Neuenschwander P, Borgemeister C, Langewald J, editors. Biological control in IPM systems in Africa. Wallingford: CABI Publishing. p. 277–294.

Peng R, Christian K. 2005. Integrated pest management for mango orchards using green ants as a major component. Darwin (Australia): Charles Darwin University.

Sinzogan AAC, Van Mele P, Vayssières J-F. 2008. Effects of on-farm research on local knowledge related to fruit flies and the weaver ant *Oecophylla longinoda* in orchards in Benin. Int J Pest Manage. 54(3):241–246.

Van Mele P. 2007. Mission de prospection sur les fourmis rouges dans les vergers de mangues biologiques et développement des activités pour découvrir en pratiquant. Rapport de consultation. Rome: FAO.

Van Mele P. 2008a. A historical review of research on the weaver ant *Oecophylla* in biological control. Agric Forest Entomol. 10:13–22.

Van Mele P. 2008b. The importance of ecological and socio-technological literacy in R&D priority setting: the case of a fruit innovation system in Guinea, West Africa. Int J Agric Sust. 6(3):183–194.

Van Mele P, Cuc NTT. 2000. Evolution and status of *Oecophylla smaragdina* (Fabricius) as a pest control agent in citrus in the Mekong Delta, Vietnam. Int J Pest Manage. 46(4):295–301.

Van Mele P, Truyen TV. 2002. Observations and farmer experimentation with predatory ants. LEISA Mag. 18(1):28–29.

Van Mele P, Cuc NTT, van Huis A. 2001. Farmers' knowledge, perceptions and practices in mango pest management in the Mekong Delta, Vietnam. Int J Pest Manage. 47(1):7–16.

Van Mele P, Vayssières J-F, van Tellingen E, Vrolijks J. 2007. Effects of the African weaver ant *Oecophylla longinoda* in controlling mango fruit flies (Diptera: Tephritidae) in Benin. J Econ Entomol. 100(3):695–701.

Vannière H, Didier C, Rey JY, Diallo TM, Kéita S, Sangaré M. 2004. La mangue en Afrique de l'Ouest francophone: les systèmes de production et les itinéraires techniques. Fruits. 59(6):383–398.

Vayssières J-F, Goergen G, Lokossou O, Dossa P, Akponon C. 2005. A new *Bactrocera* species in Benin among mango fruit fly (Diptera: Tephritidae) species. Fruits. 60:371–377.

Vayssières J-F, Kalabane S. 2000. Inventory and fluctuations of the catches of Diptera Tephritidae associated with mangoes in coastal Guinea. Fruits. 55(4):259–270.