Evaluation of Supplementary Feeding Materials for Red Weaver Ant (*Oecophylla smaragdina*) to Manage the Insect Pest, *Helopeltis antonii* in Cashew (*Anacardium occidentale*)

M.D.C.A. WEERASINGHA[1], B.RANAWEERA[1] and P.M.A.P.K.WIJETHUNGE[2]

[1]*Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura Gonawila (NWP).*
[2]*Cashew Research Centre, Sri Lanka Cashew Corporation, Kamandaluwa Plantation, Andigama.*

ABSTRACT

Red weaver ants (*Oecophylla smaragdina*) are used as biological control agents for *Helopeltis antonii*. An experiment was conducted in two stages to study the capability of some feeds as supplementary feeding materials for red weaver ants in cashew plantations. Dried fish chips, dried fish powder, dried shrimp parts, and sugar were tested as feeding materials with a control (without any feeding materials) and mean red weaver ant movement and mean red weaver ant population were determined without destroying the nests. The results showed that dried fish chips and dried fish powder were the best supplementary feeding materials for supplementary feeding of red weaver ants in cashew plantation under natural condition.

KEYWORDS: Biological agent, Cashew trees, Colony, Red weaver ants, Supplementary feeding

INTRODUCTION

Cashew (*Anacardium occidentale*) a member of family Anacardiaceae with the natural order Sapinadales, is an evergreen tree. It is a native of tropical central and South America. Cashew cultivation was introduced to Sri Lanka in the 15th and 16th centuries (Fernando *et al.*, 2004).It is a hardy and drought resistant crop which can be grown in poor soils and under low rainfall, particularly northern and eastern regions of Sri Lanka.

Annual production of cashew kernels in Sri Lanka was 4912 Mt in year 2000(Jayasekara, 2001). However the annual demand for kernel is about 600,000 Mt per year (Wijerathne, 2000).

Earlier, cashew was considered as a crop, which did not require serious attention regarding pest control. But now, there are strong evidences that there is a serious threat from pest and diseases to cause severe crop losses (Ranaweera, 2000).

More than fifty species of insects are known to be infesting cashew in Sri Lanka in different levels of incidence and severity during all stages of its growth and development (Ranaweera, 2000).

According to the severity of damage, there are two major pests namely Stem and Root borer (*Plocaederus ferrugineus* L.) and Tea Mosquito Bug (*Helopeltis antonii*).Minor pests include the Leaf and Blossom Weber (*Maculla moncusalis* Walker), Branch and Twig Borer (*Analeptes trifasciata*) and various other lepidopteran caterpillars which feed on young leaves, blossoms, immature nuts and young cashew apples (Fernando *et al.*, 2004).

Helopeltis antonii is the most serious pest of cashew in all cashew growing areas of Sri Lanka (Rajapakse, 1997). It feeds on tender succulent shoots, inflorescence, immature nuts and apples resulting in drying of shoots, inflorescence and immature nut fall. Severe infestations cause about 30% yield loss (Rajapakse, 1998).

Helopeltis population begins to develop with the onset of new flushes on trees coinciding with the monsoon rains in December and increases during January to mid March and least abundant in later months (Wijethunge, Ahangama and Ranaweera, 2003).

After each spray of insecticide, insect pest damage may be reduced significantly although major disadvantages still exist. These are high cost of chemicals, higher mammalian toxicity and cumulative effect, reduction of pollinators and other natural enemies of pests, residues in cashew nuts and environmental pollution (Mayfield, 1999).

Red weaver ant, *Oecophyla smaragdina* is an efficient biological control agent of *Helopeltis antonii* and other sap sucking bugs, leaf chewing caterpillars and beetles in cashew plantations, because they are very active and pray on a wide range of arthropods. Field observations showed that nymphs of the *Helopeltis antonii* were captured by red weaver ants (*Oecophylla smaragdina)* and adults were chased away from feeding sites on shoots by the ants (Peng et al.,1998).

In the nut development stage, young nuts continuously secrete extra floral nectar (Peng *et al.*, 2004).This nectar is continuously taken by red ants and thus, trees with ants produce clean and shining nuts. However, with insecticide spray, the nectar is continuously deposited on the inside curve of the nuts, and grow sooty moulds resulting poor quality nuts with dull look (Peng et al., 1998).

Helopeltis bug lives on range of host plants such as neem, drum stick, cashew, cocoa and guava throughout the year, but in cashew their incidence closely related with the foliar and floral flushing period. When the cashew trees are in dormancy, they secrete very little amount of floral nectar, and these trees are not attractive to the range of insects. Therefore, during this period, the trees can not

provide red weaver ants with sufficient foods, and so, the ants often walk down to forage. If the food increasingly scarce, the ants start to walk long distances on the ground, and they begin to forage on other cashew trees that may occupied by another colony. As a result, boundary fights occur (Peng *et al.*, 2004).

Therefore, during the dormant period of cashew, introduction of supplementary dietary substances will help the red weaver ants to retain inside the tree while increasing activities of red ants and making the cashew tree is an attractive niche for them.

This study was conducted to evaluate supplementary feeding materials for red weaver ants and thereby, increasing their activities and reduce the damage incidence of insect pest, *Helopeltis antonii* during the flushing, flowering and fruit setting periods of cashew. The progress of the colony establishment can be determined by opening the nest and counting the ants. Here that method is a destructive method, it is necessary to find out non-destructive method to evaluate the progress of colony establishment of red ant. In 2000, Dr. Peng states that there can be a correlation between number of ants in a nest and the total number of ants entering into the nest and going away from the nest. According to his study highest ant movement can be observed during 9 am to 11am in the morning and 3 pm to 5 pm in the evening (Fernando *et al.*, 2004). Therefore, another objective in this experiment was to determine the availability of a correlation between the numbers of ant movement and total number of ants in a nest.

MATERIALS AND METHODS

Location

This experiment was conducted at the Cashew Research Centre, of Sri Lanka Cashew Corporation (SLCC) located at Kamandoluwa plantation, Andigama in Low Country Dry Zone (DL_{1a}) from March to August 2006 under natural condition.

1) Selection of Cashew Plants

Twenty five cashew plants in same size and at same age (8 years old) were selected from an experimental site of the Kamandoluwa plantation for the experiment and their canopies were not overlapped by their branches and initially were not colonized by the red ants. The selected cashew block was applied with all the cultural practices except application of pesticides for 7 years.

2) Introduction of Red weaver ant Nests

Nests with 50-75 ants' movement per two minutes were selected from a neighboring cashew plantation for introduction. Deformed nests and nests with more than one entrance were rejected. The red weaver ants' movements were counted within 2 minutes between 9.00am to 11.00am and 3pm to 5 pm. Three selected nests were introduced to each tree and hanged opposite direction of the canopy using a string.

3) Provision of Supplementary Feeding Material to the Red weaver ants

Twenty, ant introduced cashew trees were provided with four different supplementary feeding materials and five of ant introduced trees were kept without supplementary feeding materials as a control.

Following supplementary feeding materials were used as treatments.

T1 – Dried fish chips (2-5mm)

T2 – Dried fish powder (Below 2mm)

T3 – Dried shrimp parts (3-5mm)

T4 – Sugar

T5- Control – without any supplementary feeding material

To cater these supplementary feeding materials, three hanging cups with a rain guard and an access bridge were used for each tree. A same quantity (10g) of supplementary feeding material was filled to the hanging cups and their feed levels were maintained at a constant level throughout the experimental period.

The study consisted two major parts,

A) Determination of the correlation between movement of adult red weaver ants and adult red weaver ant population in a nest.

B) Observing the progress of colonies and effect of artificial feeding on colony establishment and the effect of supplementary feeding material on red weaver ants' movement.

A. Determination of the correlation between movement of adult red weaver ants and adult red weaver ant population in a nest.

I. Selection of nests

A well formed nest with one entrance was selected from each ant introduced tree.

II. Counting ant movements

Numbers of ants entering and leaving the nest were counted within two minutes period between 9 am to 11 am and 3 pm to 5 pm.

III. Population count in nests

Selected nests with ants were separately inserted to polythene bags, immediately closed and transferred to the laboratory. The ants were killed by introducing cotton wool dipped with chloroform. When all ants become dead, nests were carefully opened and all the worker ants were counted and recorded.

B) Observation on the progress of colonies and on the effect of supplementary feeding materials on colony establishment and red weaver ants' movement.

Newly formed nests in all experimental trees were tagged and red weave ant movements per two minutes were counted once a week between 9 am to 11am and 3pm to 5 pm. This was done up to four nests maximum from each tree.

Number of new nests produced by red weaver ants and movements of red weaver ants in newly formed nests were counted once a week. The availability of mealy bugs, scale insects and black ants on red weaver ants introduced cashew trees were observed.

This section was carried out in two stages, since some red weaver ant colonies were lost due to heavy rain fall and strong wind at early stage of introduction and after reintroducing the red weaver ant colonies the second stage of the experiment was continued.

Statistical Analysis

Data were statistically analyzed using Statistical Analysis System (SAS) and MINITAB (13).

RESULTS

A. Determination of adult red weaver ant population.

Table 1 - Parameter estimates of variables:

Variable	Estimate parameters	Probability
Intercept	3.1583	0.0001
Movement	0.8664	0.0001

R^2=0.8172; significant level 5%

$$\ln Y=3.1583+0.8664\ln X$$

Where;
Y=Adult population
X=Number of adult red weaver ant movement.

There was a significant relationship with total number of ants in a nest and ants' movement. Total number of adult red weaver ant in a nest can be determined using ants' movement and above formula. The total red weaver ant population of a tree can also be determined by multiplying the total nest number with average red weaver ant population of a nest. The above formula was used to determine the ant population during subsequent experimental periods.

B. Effect of supplementary feeding materials on red weaver ant population and movement of adult red weaver ants.

The dried fish chips (T1) showed significant mean population (2345) from other treatments (Table2).

Table 2 – Mean red weaver ant population of first stage:

Treatment	Mean population
T1	2345[a]
T2	1091[b]
T3	1126[b]
T4	1295[b]
T5	506[b]

Means with the same letter are not significantly different (*p>0.05)

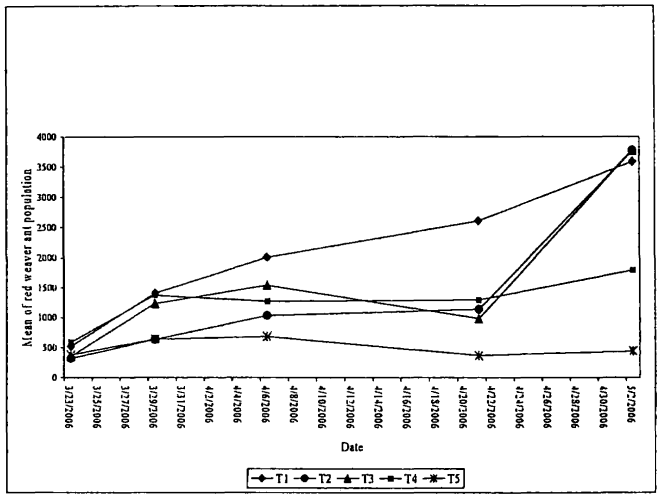

Figure 1 - Variation of red weaver ant population on the trees under different treatments:

Effect of feeding materials on movement of red weaver ant

Table 3 - Average movement of adult red weaver ants on different treatments in first stage:

Treatment	Average movement
T1	26.91[a]
T2	26.85[a]
T3	28.89[a]
T4	27.06[a]
T5	30.10[a]

Means with the same letter are not significantly different (*p>0.05)

Results clearly showed that there was no significant difference between each treatment (T1, T2, T3, T4, T5) on average movement of red weaver ants at P=0.05.

Mean population and mean movement of adult red weaver ants in second stage.

Table 4 - Mean population of red weaver ants in second stage:

Treatment	Mean population
T1	2637[b]
T2	3484[a]
T3	1362[b]
T4	2391[b]
T5	1272[b]

Means with the same letters are not significantly different (*p>0.05)

Significant mean population (3484) was observed in dried fish powder (T2). Other mean populations (T1, T2, T3, T4, T5) were not significant at P=0.05.

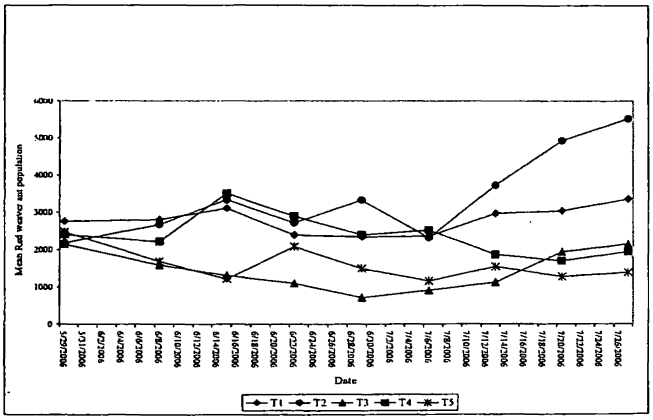

Figure 2 - Variation of red weaver ant population in the tree under different treatments in second stage:

Table 5 – Average movement of red weaver ants in second stage:

Treatment	Movement
T1	24.205[a]
T2	28.237[a]
T3	27.399[a]
T4	26.770[a]
T5	28.114[a]

Means with the same letters are not significantly different (*p>0.05)

Results clearly showed that there is no significant difference among mean value of the movement in different treatments at p=0.05.

DISCUSSION

Results showed a significant relationship between ants' movement and ant population in a nest. Red weaver ant population can be determined by this formula lnY=3.1583+0.8664lnX, where the adult ant movement is known.

The mean population of first stage revealed that dried fish chip (T1) was better for artificial feeding. According to the experimental data in second stage dried fish powder (T2) gave the highest mean population and in both stage none of treatments significantly affected to the average ant movement.

Following extra observations were also made during experimental period. Red weaver ants were rearing homopterous pests such as scale insects (average 60 individuals/tree) and mealy bugs (average 40 individuals/tree) on cashew trees specially on inflorescence, young nuts, and inside the nests. However their population was not significant to cause economical damage. Red weaver ants were aggressively attacking black ants and other ant species.

Even though the artificial feeding enhanced the ant population according to the experiment, heavy rainfall and strong wind cause destroying of red weaver ant colonies (Begg, 1997 and Peng et al., 1999 a). Aggressive behavior of red weaver ants is a problem during cultural practices and further researches are needed to overcome the constraints such as, damaging of nests due to heavy rains and strong wind and invade of other ant species to the red weaver ant introduced cashew trees

CONCLUSIONS

Red weaver ant colonies in cashew can be artificially fed with dried fish powder and dried fish chips and adult red ant population can be determined using adult red weaver ant movements without disturbing the nest. None of supplementary feeding materials affects to the movement of red weaver ants.

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