Title	**Efficacy Trial Terminal Report: Parker Neem Tonic as an Effective Organic Bio-Control Agent against Cecid fly (*Procantarinia sp.*), Mango leafhopper (*Idioscopus clypealis),* and Fruit fly (*Ceratitis cosyra)* of Mango of (*Mangifera indica* L.)**
Introduction	Mango is the third most important crop in the country based on export volume and value. Based on Philippine Statistic Authority (PSA) data in 2014, the regional mango performance had declined in terms of production in metric tons, from 382,569 metric tons (MT) in 2008 to 276,661 MT in 2011. Similarly, its yield per hectare had also decreased from 22.09 MT to 21.34 MT. The decreasing yield performance was brought about by the occurrence of pests. The most destructive pest was "kurikong" which was caused by mango cecid fly. Other important pests also contribute to low yields, like fruit flies and leaf hoppers. This leads to the rigorous use of chemical pesticides that kills pollinators in the ecosystem (National Crop Protection Center-University of the Philippines, Los Banos 2008). The cecid fly is a mosquito-like insect that lays its eggs on the fruit surface and young mango leaves. The larvae bore into the fruit, and feed on it, resulting in damage to mango fruits. This renders the fruit non-marketable, thus, bringing out financial loss to the mango grower. Over the past 30 years, crop protection in mangoes has relied heavily on synthetic chemical pesticides, but the intensive application has caused the evolution of resistance in insect pests' populations. Therefore, alternative pest management tactics are needed. Chaudhary (2017) concluded that the use of botanical pesticides offers an eco-friendly pest control strategy to aid agricultural practices. Biological pesticides are pest management agents based on living microorganisms or natural products. They have proven potential for pest management. Neem plant-based insecticides have been the most accepted bio-pesticides, due to the presence of multiple limonoids in neem plant extracts and oil that not only provides a sustainable pest control mechanism but also prevents plant disease resistance, from various synthetic insecticides. Azadirachtin has a variety of physiological effects on many insect pests, such as antifeedant, growth and development inhibition, impairment of oocyte structure, inhibition of fecundity, and egg viability. The commercial name of the product under trial is Parker Neem Tonic and was classified as botanical. This study was conducted to determine the effect of Parker Neem Tonic against the major pests in mango.
Objective	The general objective of efficacy trials was to generate efficacy data for Parker Neem Tonic to support product label expansion with DA-BAFS. Specifically, the trial aimed to determine the efficacy of Parker Neem Tonic against cecid fly, leafhopper, and fruit fly of mango.

Methodology

1. **Time and location of the study**
   The efficacy trials were conducted at Don Montano, Umingan, Pangasinan (Site 1), and Cayamabanan, Urdaneta, Pangasinan (Site 2) from January 2022 to May 2022.

2. **Target crops and pests.**
   Mango *(Mangifera indica)* is an edible stone fruit produced by the tropical tree, a member of the cashew family (Anacardiaceae), and one of the most important and widely cultivated fruits of the tropical world. Mango is one of the most popular fruits, typically 8–12 centimeters (or 3–5 inches) long. Ripe fruits are greenish yellow while unripe ones are green. The fruits can be round, oval, heart, or kidney-shaped. The interior flesh is bright orange and soft with a large, flat pit in the middle.
   Mangoes are a good source of fiber and antioxidants, including vitamin C which supports a healthy immune system.

   Cecid fly (*Procantarinia sp*.) is a very destructive pest of mango. It commonly lays its eggs on the fruit surface and young mango leaves. As the larva bores into the fruits and feeds, the larva causes circular spots or holes in the fruits. When cecid fly attack at an early stage of fruit development, the fruits fall off from the tree. Under heavy infestations, the leaves wrinkle and remain yellow.

   Mango leafhopper (*Idioscopus clypea*lis) is usually a wedge-like shape with a broad, round head, and globular eyes. Adults are golden or dark brown and about 4-5mm long. Nymphs are yellow-brown, with red eyes. Mango hoppers lay their eggs singly in the florets, leaf veins, and leaf lamina, depending on the species. Both nymphs and adults suck the sap from tender shoots and inflorescence resulting in withering and shedding of flower buds and also wilting and drying of shoots and leaves.

   Fruit fly (Ceratitis cosyra) is commonly known as the marula fruit fly based on its common occurrence in mango fruit. Fruit flies caused high production losses and were considered as major pests of many fruit crops like mango. The damage to fruit flies in mangoes begins when the female fly punctures the skin of the fruit and lays eggs underneath it. Decay is caused by the larvae feeding in the flesh of the fruit, which renders the fruit unmarketable. Fruit flies cause direct damage to fruits as a result of the larvae feeding on fruit pulp.

3. **Experimental design and layout**
   The experiment was laid out in Randomized Complete Block Design (RCBD) with four treatments and replications, as shown in Figure 1. A total of 16 fruit-bearing trees, and one tree per treatment and replication. The approximate area utilized was 2000 square meters.

The treatment applications, including rates and frequency, are shown in Table 1.

Table 1. Treatment applications, rates, and frequency

Treatment	Description	Rate ml/liter water	Liters per tree	Timing of Application
1	Untreated	-	-	**First application –** 14 DAFI (flower bud emergence) **Second application –** 35-40 DAFI (fruit development stage/ corn seed size) **Third Application –** 60-62 DAFI (chicken egg-size)
2	RR	10	500ml/50L/ tree	
3	2RR	20	1000ml/50 L/tree	
4	0.5RR	5	250ml/50L/ tree	

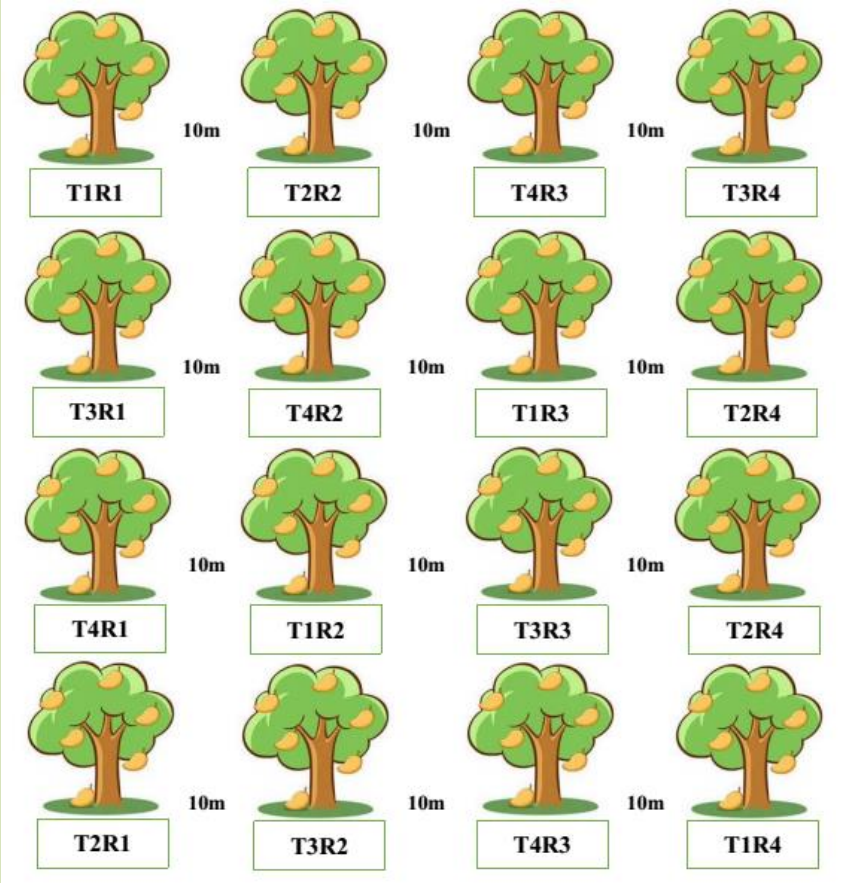


Figure 1. Experimental Design and Layout

4. Cultural management practices

Prior to treatment applications, 20 selected panicles per tree with uniform flower intensity were tagged for sampling and assessment. Flower inducer was used to enhance flowering, using Potassium Nitrate at a rate of 4.0 kg/100L water to attain a higher flowering response. Throughout the duration of the experiment, there were no pesticides applied, except for the flower inducer.

Pruning and fertilization

Minimal or sanitary pruning was done prior to the scheduled flower inducement. All dead and unproductive twigs and branches were removed, including the overcrowded branches to open the canopy center for better

light penetration and air circulation. Fertilizer was applied using 25 kg of organic fertilizer per tree one week before the scheduled flower induction. Irrigation water was applied after the application of organic fertilizer.

Weeding
Grasscutter was used to eradicate taller weeds and followed by spraying of round-up herbicide.

Harvesting
Manual harvesting as practiced by common mango growers was done.

DATA GATHERED.

1. ***Cecid fly damage.*** The efficacy assessment was based on the number of fruits showing the symptom (circular brown scab) of cecid fly infestation. The data collection was done after each spraying period, and using the following rating scale (Table 2):

Table 2. Rating Scale on Damage Fruit

RATING SCALE	% Damage on Fruit
1	No damage
3	1-10
5	11-20
7	21-30
9	> 30

2. ***Leafhopper damage.*** The panicles were rated in terms of the degree of drying from bud break to full bloom one day before, three days, and five days after application using the following rating scale (Table 3):

Table 3. Rating Scale on Dry Panicle

RATING SCALE	% Dry Panicle
1	No damage
3	1-10
5	11-20
7	21-30
9	> 30

3. ***Fruit fly damage.*** Damage of fruit flies in mangoes begins when the female fly punctures the skin of the fruit and lays eggs underneath Damage rating scale used was shown below (Table 4):

Table 4. Rating Scale on Fruit Injury

RATING SCALE	% Fruit Injury
1	No damage
3	1-10
5	11-20
7	21-30
9	> 30

DATA RECORDING AND ANALYSIS

All data parameters were discussed. The results of the rate of treatments were compared with untreated treatment. Photo documentation at stages of observations showing the efficacy of each treatment plot was done.

Results & Discussion

The product, Parker Neem Tonic met the acceptable standard efficacy against control on the following pest damages and other parameters:

1. **Percent reduction of damaged fruits caused by cecid fly.** The average percent reduction of damages caused by cecid fly per site location is shown in Tables 5.1 and 5.2. The applications of Parker Neem Tonic at 10ml/L and 20ml/L were yield a result that passed the minimum standard efficacy set by the PNS/BAFS 183:2016 (Organic Bio-Control Agents)

Table 5.1 Percent reduction of damages caused by cecid fly, Don Montano, Umingan, Pangasinan (Site 1)

Treatments	Dosage Rate per Liter of water	% Efficacy against control	% Efficacy against control at harvest
T2 – RR Parker Neem Tonic	10ml/L	51.34%	52.22%
T3 – 2RR Parker Neem Tonic	20mlL	58.05%	59.04%

Table 5.2 Percent reduction of damages caused by cecid fly, Cayambanan, Urdaneta, Pangasinan (Site 2)

Treatments	Dosage Rate per Liter of water	% Efficacy against control	% Efficacy against control at harvest
T2 – RR Parker Neem Tonic	10ml/L	54.18%	50.37%
T3 – 2RR Parker Neem Tonic	20mlL	60.37%	57.09%

2. **Percent reduction in the leafhopper damage.** The average percent reduction per site location is shown in Tables 6.1 and 6.2. The applications of Parker Neem Tonic at 10ml/L and 20ml/L were yield a result that passed the minimum standard efficacy set by the PNS/BAFS 183:2016 (Organic Bio-Control Agents)

Table 6.1 Percent reduction in the leafhopper damage, Don Montano, Umingan, Pangasinan (Site 1)

Treatments	Dosage Rate per Liter of water	% Efficacy against control
T2 – RR Parker Neem Tonic	10ml/L	53.28%
T3 – 2RR Parker Neem Tonic	20mlL	61.39%

Table 6.2 Percent reduction in the leafhopper damage, Cayambanan, Urdaneta, Pangasinan (Site 2)

Treatments	Dosage Rate per Liter of water	% Efficacy against control
T2 – RR Parker Neem Tonic	10ml/L	59.81%
T3 – 2RR Parker Neem Tonic	20mlL	65.89%

3. **Percent reduction of the damaged fruits caused by fruit fly.** The average percent reduction of damage caused by fruit fly per site location is shown in Tables 7.1 and 7.2. The applications of Parker Neem Tonic at 10ml/L and 20ml/L were yield a result that passed the minimum standard efficacy set by the PNS/BAFS 183:2016 (Organic Bio-Control Agents)

Table 7.1 Percent reduction of the damaged fruits caused by fruit fly, Don Montano, Umingan, Pangasinan (Site 1)

Treatments	Dosage Rate per Liter of water	% Efficacy against control	% Efficacy against control at harvest
T2 – RR Parker Neem Tonic	10ml/L	58.28%	56.61%
T3 – 2RR Parker Neem Tonic	20mlL	55.26%	62.71%

Table 7.2 Percent reduction of the damaged fruits caused by fruit fly, Cayambanan, Urdaneta, Pangasinan (site 2)

Treatments	Dosage Rate per Liter of water	% Efficacy against control	% Efficacy against control at harvest
T2 – RR Parker Neem Tonic	10ml/L	52.28%	54.10%
T3 – 2RR Parker Neem Tonic	20mlL	58.17%	58.96%

Conclusion and Recommendation

The Parker Neem Tonic OBCA was able to meet the percent efficacy standards set by the Philippine National Standards for Organic Bio-control Agents (PNS/BAFS 182:2016) at ≥50 percent, and as required by the Department Circular (DC) 5, Series of 2020 (*Guidelines on the Registration of Organic Bio-Control Agents Producers and Products*).

Researchers and Company Profile

CONSTANCIA C. DACUMOS, PhD
Retired University Professor,
DA-BAFS Certified Researcher
DA Special Order No. 065 series 2022

ENVIRO SCOPE SYNERGY INC.
270 Gasanco Compound Merville Access Road, Pasay City

DA - BAFS Registered Products
Organic Soil Amendments (OSA)

1. Parker Neem Cake
2. Enviro Ultra Action
3. Enviro Hi-Crop

Organic Bio-control Agents (OBCA)

1. Parker Neem Tonic
2. Enviro Ultra PK

Reference/s

Chaudhary S., Kanwar, R. K., Sehgal, A., Cahill, D. M., Barrow, C. J., Sehgal, R., and Kanwar, J. R. (2017) Progress on *Azadirachta indica* based biopesticides in replacing synthetic toxic pesticides. Frontiers in Plant Science. Front Plant Sci 2017; 8: 610. DOI:10.3389/fpls.2017.00610

National Crop Protection Center. (2011) Development of Pest Control Strategies against Cecid Fly in Mango. UPLBFI. Department of Agriculture Bureau of Agricultural Research.

Philippine Statistic Authority (2014). Consumption of selected agricultural commodities in the Philippines. National and Regional Levels. *Volume 1*. http://countrystat.BAS-PSA.gov.ph

Annex

-Photo Documentation

Photo 1. The photos showing the leafhopper damaged panicles- mango leafhoppers cause drying of flowers in panicles.

Photo 2. Fruit fly damage –characterized by holes and oozing of sap–like substance.

Photo 3. Cecid fly damage - damage on fruits known as “kurikong”.

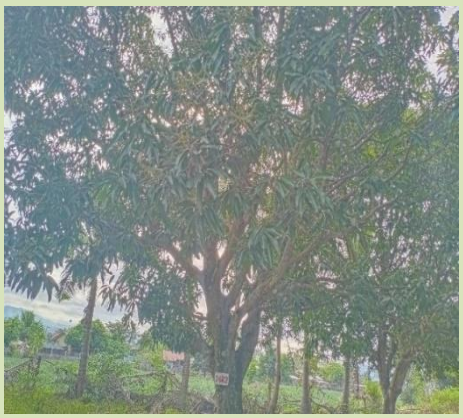
Photo 4. Cleaning of the experimental area using a grasscutter.

Photo 5. Selection of experimental trees.

Photo 6. Tagging on selected panicles per tree.

Photo 7. Measurement of panicle at 28 DAFI

Photo 8. Treatment application showing the application of treatments using power sprayer.



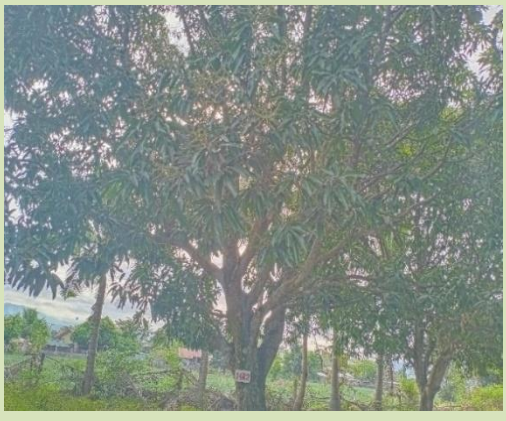


Photo 9. Flowering stage at 25 DAFI


Photo 10. Fruiting stage at 45 DAFI.

Photo 11. Weight of the fruit dropped at 90 DAFI.

Photo 12. Mango fruit fly damage (left) and cecid fly damage (right).

Photo 13. Harvesting of mango fruits.

Photo 14. Weighing of non-marketable fruits

Photo 15. Weighing of marketable fruits

Photo 16. Representative marketable and non-marketable fruits harvested per tree