InnoVationInfo

International
Journal of Food and Bioscience

Int J Food Biosci 2018
Volume 1: 1

The Potential of Neem, Pongamia Oil and Garlic Extracts Formulation for an Effective Management of Berry Borers in Organic Coffee Plants

Anthony Samy M[1*]

[1]*Loyola Hr. Sec. School, Kuppayanallur, Uthiramerur, Kanchipuram Tamil Nadu, India*

Abstract

Hypothenemus hampei Ferrari, the coffee berry borer is a serious threat for the majority of the world's coffee growers and has proved to be one of the most intractable of today's pests. This research review summarizes the most important aspects of the biology and ecology of *H. hampei* and its control in an organic way. In the search for viable and sustainable control methods emphasis is placed upon an analysis of the non-chemical control methods (organic method) and suggestions are offered for ecological and environmental factors for further research. Two consecutive years of experiments were conducted at the organic coffee fields of Loyola Estate, Sirumalai near Dindigul district of Tamil Nadu, South India during 2014 and 2015 to evaluate bio efficiency of plant oils and leaf, garlic extracts against berry borers in the Loyola Estate's organic coffee field. Among the plant oils tested, spot application of Neem and Pongamia seed oils and garlic extract along with emulsifier was found to be very effective in the initial stage causing 90% to 94%t reduction in borer population over the control in the second year. The overall borer population was 90% reduced in the coffee plants sprayed with Neem and Pongamia oil 3% and garlic extract 2% even at the later stage of borer attack. This was followed by a strict regulation of shade as per integrated pest management techniques. The percentage of damaged green fruits in the first year was 36% followed by 14% in the second year in treated plants against control. Further the mean grade index recorded at the time of harvest was also very low which statistically differed from chemically treated plants. The other plant oil formulations like pongamia and iluppai were less effective.

Keywords: *Hypothenemus hampei* Ferrari, Coffee berry borer, *Coffea arabica*, Organic coffee fields, Pongamia and neem oil, Repellant, Eco-friendly pest control, IPM.

Introduction

Integrated pest management system (IPM)

The panel of experts of FAO (1967) defined it as a system that in the contrast of the associated environment and the population dynamics of the pest species, utilized all suitable techniques and methods in as compatible manner as possible and maintains the pest population at level below those causing economic injury. The following are the tools of IPM: 1. Cultural methods, 2. Mechanical methods, 3. Physical methods, 4. Biological methods, 5. Organic Methods or Chemical methods, 6. Genetic methods and biotechnological approach. A pest in the broadest sense is any organism existing in the habitat where its activities cause it to be inimical to the welfare of man. Pest in general includes bacteria,

Article Information

Article Type: Research

Article Number: IJFB109

Received Date: 13 July, 2018

Accepted Date: 06 November, 2018

Published Date: 14 November, 2018

***Corresponding author:** Dr. Anthony Samy M, Loyola Hr. Sec. School, Kuppayanallur, Uthiramerur, Kanchipuram Tamil Nadu, India. Email: samysj(at)yahoo.com

Citation: Samy MA (2018) The Potential of Neem, Pongamia Oil and Garlic Extracts Formulation for an Effective Management of Berry Borers in Organic Coffee Plants. Int J Food Biosci Vol: 1, Issu: 1 (49-55).

viruses, fungi, weeds, some vertebrates, e.g.-birds and rodents and invertebrates e.g.-Insects, mites & nematode worms. (FAO, 1971) The two major coffee pests are White Stem Borer (Xylotrechus quadripes Chevrolt) and Coffee Berry Borer (Hypothenemus hampei Ferrari). The insect Hypothenemus hampei is commonly known as 'Broca' in Spanish or 'CBB' Hypothenemus hampei (Ferrari): A small black beetle, about 1.5 mm long and 1 mm wide, belongs to Insect Order: Coleoptera, Family: Curculionidae, Subfamily: Scolytinae [1-5]. (Le Pelley, 1968; Baker, 1984; Waterhouse & Norris, 1989; Murphy & Moore, 1990; Barrera, 1994). The distribution was first noticed in the field in 1901 in coffee plantations in Central Africa. Later on, gradually spread to all the coffee growing regions in the world.

Coffee berry borer in India

First it was noticed in Gudalur area of The Nilgiris District in Tamil Nadu during February 1990. During the same year it was noticed in Wayanad district of Kerala and Kodagu District of Karnataka. Now very prevalent in almost all the coffee growing zones in Karnataka, Kerala and Tamil Nadu (88% of the coffee area in India). Till date it has not spread to the Non-traditional areas of Andhra Pradesh and Odisha and the North-Eastern States [6].

The Morphology and Life Cycle of Hypothenemus hampei

Many researchers like Leefmans, Toledo-Piza-Junior, Bergamin, Schmitzet and Crisinel, Ticheler, Urbina, Hill and Waller, Baker et al., and Borbón-Martinez [7-16] have described in detail about Hypothenemus hampei's morphology and life cycle in coffee. Briefly, according to Barrera [5], CBB adult is a black beetle about 1.5 x 1 mm in size. Males are smaller, the synovogenic female lays between 31 and 119 eggs within a single coffee berry of suitable ripeness and the life stages consist of the egg, larva, pupa (with a brief pre-pupal stage) and adult. The juvenile stages last for an average of 4 (egg), 15 (larva) and 7 (pupa) days, respectively, at 27°C. The complete life cycle may take from 28-34 days. Reports of the life expectancy of the adults are varied; males may live for 20-87 days and females for an average of 157 days. Baker [17] stated that H. hampei is not an explosive pest, having a relatively low multiplying value. Male: Female ratio 1:10. Males are incapable of flight. The maximum flight distance is 345 meters. These factors were verified and noted as follows: Favorable conditions are highest emergence recorded is at 90-100% humidity at optimum temperature is 25°C-26°C. And the dense shade favor's survival and initial multiplication. Continuous or multiple flowering and intermittent summer showers allows this pest to thrive better for longer duration. Source of inoculums is left over berries, fallen berries, off-season fruits, and un-harvested tree coffee fruits and seed coffee, (possibly) gunny bags in storage houses. (figure 1)

The insect Hypothenemus hampei by burrowing through exocarp, mesocarp and endocarp to reach in, which may take, under optimum conditions, up to 8 hours feeds on and reproduces in the endosperm of the seed of the coffee berry [18]. Usually infestation first occurs in berries attached to the plants but reproduction continues in berries that subsequently fall to the ground and in processed berries [19]. considered the aggregation behavior of bark beetles to be a response to host defenses, mediated by pheromones, i.e. the need for a mass attack to overcome the defenses of a vigorous host plant, as described [20]. An extended dry season can reduce H. hampei infestations due to the sensitivity of the scolytid to humidity levels [21,22] claims that the majority of individual H. hampei fly very little, but a small proportion can travel long distances in search of new berries, generally aided by air currents. Flight is induced by various factors: after the first rains following the inter-harvest period, the depletion or deterioration of food resources within the berry. Or move in the search for a mate or berry suitable for ovi-position [23]. Though rain is one of the factors that induces females to fly, female H. hampei have not been observed to fly when it is actually raining [24] and are usually reported to fly during mid to late afternoon [25,26]. Dissemination of the pest is generally considered to take place by long and short distance flight, passive transport (animals, vehicles, humans, wind, etc.) and the coffee trade [18]. In Ecuador, H. hampei was seen to spread at a rate of 30-60 km per year. In case of severe infestation, 38% crop loss also was noted in the drought hit years.

Coffee

The genus Coffea, comprising more than 70 species, belongs to the botanical family Rubiaceae. Coffea arabica

Figure 1: A. Coffee Berry borer larva, B. Adult coffee berry borer.

Linne., species is divided into several varieties, some tall and some dwarf. It is a tetraploid species (4 n=44) that yields clearly superior coffee taste combining low caffeine content with fine aroma [27]. Coffee is a popular beverage that is obtained from different varieties of coffee beans. A healthy coffee is the first taste to begin the day with as energizer and a mind activating agent. This important drink that contains many micronutrients, some of which have proven bioactivities, Such as anticancer, antimicrobial, antioxidant, and host of other effects. Coffee berries and parchment beans serve as a host for the multiplication of Hypothenemus hampei beetles.

Organic Coffee

Organic coffee is winning the interest of the premium market price across the world thereby increasing the economic return of coffee producers. Despite the market opportunities and better market price for organic coffee, there are several factors which drastically affect organic coffee production and profitability under small holder farmers. The impact of organic coffee production on farmer welfare is an important issue since organic coffee production has been suggested to lower yields and farmer income compared with what can be achieved using conventional methods. The aim of this study was to use non-conventional readily available organic materials to control or repel coffee berry borers which cause a major loss in production of coffee. Organic coffee is a Socially Responsible Coffee and a "Counter Culture Coffee." All coffees look good, smell good, taste good, but do they have residual pesticides? An organic coffee is a revolutionary coffee that can repair the damage done to our body by harmful inorganic substances in a coffee consumed on a daily basis. India is the 6th largest coffee producer in the world. It is grown in the southern states of Karnataka (70%), Kerala (20%), and Tamil Nadu (7%), specifically in the plantation districts within the Nilgiris Bio-sphere that are known to be ecologically sensitive region of the country.

Materials and Methods

In the Integrated Pest Management of *Hypothenemus hampei* the practical research at Loyola coffee estate, Sirumalai revealed that the following methods were successful from 80% to 90%. They are cultural control, mechanical control, chemical control, bio control and organic control methods.

In Cultural control system regular shade regulation, timely harvest-(Nov-Dec for Arabica), using harvesting mats, etc., removal of gleaning/leftovers, removal of off season fruits and harvesting of tree coffee, drying of coffee to specified moisture level of 11.5-12.5% at the drying yards and storage, using picking mats while harvesting. The use of picking mats reduces gleanings by 72% and increase in gleanings increases incidence in the new crop. Hence complete cleaning of seeds from the farm is a basic requirement. This results in 75% reduction of infestation in the next new crop. And it also improves harvesting efficiency.

The usual Mechanical measures were 1. Disinfesting the infested fruits by hot water treatment for 1-2 minutes or dispose by burying in soil to a depth of 20 inches, 2. Placing oil smeared plastic mats atop the infested fruits spread on the drying yard to trap the escaping beetles, 3. Installation of berry borer traps from September/October to onset of monsoon, 4. Installing Broca traps @ 30/hectare in the field and 5. Traps installed around the drying yards.

The usual Bio-control measure is *Beauveria bassiana*-250gram culture is mixed in 200 liters of water and sprayed over the fruits when the sunshine is less and moisture is seen on the plant. It works better if applied on the right time. Variations in climatic conditions very much affected the success of this control measure.

The usual Chemical controls were 1. Spot spraying of Chlorpyrifos 20 EC at the dosage of 600 mL in 200 liters of water with 200 mL of any wetting agent, 2. Critical time of application-when the beetles are waiting at the tip of the fruit for bean hardening (120-150 days after flowering) i.e., Aug-Sept. every year and 3. Due to irregular timing of flowering beetles are able to manage their escape against the spray that leads to periodical spray and spot sprays of Chemicals.

In the mechanical measures disinfesting the infested fruits by hot water treatment for 1-2 minutes or dispose by burying in soil to a depth of 20 inches was done. Placing oil smeared plastic mats atop the infested fruits spread on the drying yard to trap the escaping beetles was also successful. Installation of berry borer traps from September/October to onset of monsoon helped in controlling flying pests. Installing Broca traps @ 30/hectare in the field, traps installed around the drying yards were also successful.

The newly studied Organic Control was two consecutive years of organic control method experimented was to study the Impact of Neem, Pongamia oil and garlic extract formulation and plant extracts for the management of berry borers in the organic coffee plants as part of coffee integrated pest management system:

Treatments Experiment

1. Neem Oil - 3%
2. Pongamia oil - 3%
3. Illuppai Oil - 3%
4. Ipomea leaf extract- 5%
5. Jatropha Leaf extrct- 5%
6. Neem oil 3%+Garlic extract - 2%
7. Pongamia oil 3%+Garlic extract - 2%
8. Neem oil 3%+ Pongamia oil -3%+Garlic extract 2%
9. Untreated Control Nil
10. TGGN leaves extract in cow urine (Tobacco, Green chilli, Garlic and Neem)

The fields were chosen in randomized block design and marked. Each treatment consisted of three rounds of spraying and monitoring. Results were recorded. 5 days of interval was taken between each spray. Borer population

was recorded every day before and after (3 hours) spraying. The damage assessment was done after 7 days.

Oil and Extract Preparations

Neem Oil (*Azadirachta indica* A. Juss), Pongamia/Karanj oil (*Pongamia pinnata* L.) and Illuppai Oil Mahua (*Madhuca longifolia* Macbr) were bought from the local farmers. These oils were emulsified with water and 0.3% 'Teepol' then tested at 3% concentration.

Leaf and Garlic Extracts

Leaves and Garlic were collected fresh, washed in running cold water. 500 gm of leaves crushed and soaked in 10 liters of water for 15 hours. 250 gm of Garlic was crushed and soaked in 10 liters of water for 15 hours. Both separately filtered through muslin cloth for spraying.

Assessment of Coffee Berry Borer Population and Damage

Population Assessment record was done in all Coffee Berry Borer affected fields. In Live Beetle population both larva and adults were recorded from one fruit of each bunch of fruits of more shaded areas. Thick shaded plants showed maximum borer population.

Damage Assessment:

Before the spray plants were selected for assessment and marked with poles. Post treatment observations on the poled plants were taken. After seven days once in 15 days (X 3) assessment gave a picture of total possible damage.

Results and Discussion

Berry borer: *Hypothenamus hampei* Ferrari.

Coffee Berry borer was one of the big threats in the first year of the study. Mechanically removing all the infested fruits at the beginning stage and boiling the infested fruits helped in a big way in controlling the pest. Application of *Bevaria basiana* also helped in the control of the pest. The organic CBB control mechanism is discussed below.

The results of the experiments revealed

1. The continuous presence of the borers throughout the year in the plants that are at the borders of neighborhood estates. That remained as a source of the borer supply source and hence complete eradication was not possible.
2. The overall borer population reduced significantly in the fields sprayed with Neem oil 3% Pongamia oil 3% and Garlic extract 2% along with emulsifier.
3. The % reduction in borer population in other numbered fields with other plant oils' efficiency of control was less than 50% compared to Neem+Pongamia oils and garlic extract formulation.
4. Chemical pesticide applied field showed better results than all the above mentioned formulations. But it needed spray all through the fruiting season. i.e., Spot spraying 3-5 times. Hence chemical spray field was not taken for regular assessment.

Analysis

Grade Damage /symptom category

1. Fruits with no borer damage (Bunches and average fruits total)
2. Fruits with 1-10% of borer damage
3. Fruits with 11-25% of borer damage
4. Fruits with 26-50% of borer damage
5. Fruits with >50% of damage with shrinkage and early ripening

Mean Grade Index (MGI)

The Mean Grade Index was worked out by using the formula,

$$MGI = \frac{G1T1 + G2T2 + G3T3 + G4T4 + G5T5}{T1 + T2 + T3 + T4 + T5}$$

Where, G-grade T- total number of fruits in corresponding grade

$$\% \text{ of infestation in fruits} = \frac{\text{Number of infested fruits}}{\text{Total number of bunches}} \times 100$$

New findings with this formulation

Among these plant oils tested, spot application of Garlic extract+Neem and Pongamia oils along with emulsifier was found to be very effective in the initial stage causing 90%-94% reduction in borer population over control after three rounds of spraying in the second year. The overall borer population was found to be 90% reduced when sprayed even at the later stage of borer attack.

The percentage of damaged green fruits in the first year were 36% followed by 14% in the second year in treated plants against control 100%. Further, the mean grade index recorded at the time of harvest was also very low which statistically different from chemically treated plants. This application also helped to repel leaf rust attack. Also helped the growing plants as a growth promoter with strong branches and broad leaves.

This organic oil formulation received fields showed a result with bigger heavy fruits and new shooting up of many new tertiary branches for the next fruiting compared to conventional coffee plants. Overall plant health was comparatively better than conventional field coffee plants. Organically healthy plants naturally had the capacity to repel the pests by being healthy and shining. Overall pest and disease resisting power of the organic coffee plants was very good compared to conventional coffee fields.

Coffee berry borer and conventional coffee quality

The major loss is quantitative rather than qualitative. As infestation goes up, the quantity of blacks, bits and browns increases leading to increase of 2nd and 3rd quality coffee. Once these defective particles are removed while processing, quality is not affected. (Tables 1-4).

Table 1: Bio efficiency of plant oils and leaf extracts on the CBB population 1st year.

Treatment		Spray 1					Spray 2					Spray 3				%		
	Pre	15	30	45	Mean	% Reduction over control	15	30	45	Mean	% Reduction over control	15	30	45	Mean	% Reduction over control	Overall Mean%	% Reduction over control
Neem Oil 3%	10.9	9.5	9.3	10.6	9.8	53.9	13.3	12.1	14.5	13.4	45.3	14.5	16.9	15.2	15.5	35.1	12.9	55.6
Pongamia Oil 3%	12.4	11.9	12.1	11	11.7	45.1	13	14.1	13.9	13.7	44.1	9.4	11.8	18.9	10.3	56.9	11.9	48.7
Illuppai Oil 3%	9.2	10.4	12.3	9.5	10.7	49.8	9.7	10.1	41.3	11.4	53.5	18.3	11.7	14.6	14.9	37.7	12.3	47
Ipomea Leaf extract 5%	11	8.1	11.1	12.9	10.7	49.8	12.7	13.7	13.7	13.2	46.1	6.4	14.5	11.8	10.9	54.4	11.6	50
Jatropa Leaf extract 5%	9.6	7.2	12.9	8.8	9.6	54.4	11.4	8.7	9.1	9.7	60.4	10.1	12.9	15.7	12.9	46.9	11.9	48.7
Neem Oil 3% Garlic extrt 2%	11.2	8.8	12.4	12.8	11.3	46.9	11.8	14.5	10.7	11.5	53.1	11.5	15.3	13.2	11.7	51	10.3	44.4
Pongamia Oil 3% Garlic extract 2%	11.2	8.5	12.5	12.6	11.1	55.9	11.2	12.8	10.1	11.9	46	11	14.8	12.5	11.2	49.2	10.8	43.2
Neem Oil 3% Pongamia Oil 3% Garlic extract 2%	12.8	7.5	7.1	9	10.1	41.2	9.2	6.5	5.8	7.5	22.5	5.9	7.2	4.9	6	18.1	7.8	27.2
TGGN Leaves extract in cow urine	15.6	8.1	5.2	7	9	35.9	8.1	6.2	5.2	6.5	19.8	4.2	2.5	3.1	3.3	19.6	6.2	18.8
Chemical pesticide control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Untreated Control	11.5	21.5	18.9	26.3	22.6	-	23.5	24.4	25.8	24.6	-	23.1	27	21.7	23.9	-	23.2	
	TGGN leaves – Tobacco, Green chilli, Garlic and Neem + Cow urine is prayed on CBB sudden outbreak zones (for emergency only)																	

Table 2: Bio efficiency of plant oils and leaf extracts on the CBB population 2nd year.

Treatment		Spray 1					Spray 2					Spray 3				%		
	Pre	15	30	45	Mean	% Reduction over control	15	30	45	Mean	% Reduction over control	15	30	45	Mean	% Reduction over control	Overall Mean%	%Reduction over control
Neem Oil 3%	17.1	10.3	7.3	5	7.5	60.9	7.9	9.3	11.7	9.5	51.5	11.8	12.1	16.9	13.6	50.1	10.2	50.2
Pongamia Oil 3%	23.1	8.3	17.5	6.6	10.5	41.8	10.9	17	17.1	15.5	20.9	14.2	15	17.6	15.7	30.8	14.3	30.2
Illuppai Oil 3%	16.5	16	15.4	9.6	10	43.8	10.5	14.5	9.6	11.7	40.3	17.8	20.9	10.2	16.3	26.4	12.9	37.1
Ipomea Leaf extrct 5%	22.7	12	13.4	4.9	10.1	47.4	10.3	13.3	21.1	14.9	23.9	10.6	14.7	12.4	12.6	44.8	12.5	39
Jatropa Leaf extrct 5%	16.3	29.3	16.4	5.8	17	11.4	17	16.2	13	15.4	21.4	19.3	12.9	12.6	16.4	27.8	15.6	43.9
Neem Oil 3% Garlic extract 2%	17.6	19.6	23.6	12.8	11.3	23.2	11.8	15.2	10.7	11.5	53.1	21	11	6.3	11.7	45.2	10.3	44.4
Pongamia Oil 3% Garlic extract 2%	11.2	8.5	12.5	12.6	11.1	55.9	11.2	12.8	10.1	11.9	46	11	14.8	12.5	11.2	49.2	10.8	43.2
Neem Oil 3% Pongamia Oil 3% Garlic extract 2%	17.6	10.3	12.8	3.3	8.6	53.3	9	12.6	13.3	11.7	40.3	10.9	13.3	9.9	11.4	49.8	10.6	43.3
TGGN Leaves extract in cow urine	11	8.2	4.2	8	8.6	35.9	7.2	6.8	4.9	6.1	18.6	5	3.9	2.1	2	17.5	6	18.2
Chemical pesticide control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Untreated Control	24	20.8	17.5	19.3	19.2	-	17.9	18.2	26.1	22.7	-	23.1	25.1	20.4	20.4	-	20.5	-
	TGGN leaves-Tobacco, Green chilli, Garlic and Neem+Cow urine is prayed on CBB sudden outbreak zones (for emergency only)																	

Table 3: Assessment of damage by coffee berry borer in the first year.

	% Bunch damage in green fruits (One month after third spray)				MGI at the harvest in marked bunches			
Treatment	Bunch 4	5	6	Mean	Bunch 9	10	11	Mean
Neem oil3%	24.5	33.6	49.5	35.5	2.2	2.9	3.1	2.7
Pongamia oil 3%	41.5	65.3	84.2	63.9	2.8	4.1	4.1	3.7
Illuppai Oil 3%	23.1	38.5	74.1	40.1	2.9	2.8	3.5	3.1
Ipomea leaf extract 5%	63.3	100	100	81.6	4	3.2	3.8	3.6
Jatropha Leaf extract 5%	78.6	100.2	100.6	87.2	3.8	4.4	3.5	3.9
Neem oil 3%+ Garlic extract 2%	40.1	60.3	29.6	48.6	3.1	2.5	2.6	2.9
Pongamia oil 3%+Garlic extract 2%	41.6	61.3	27.2	50.3	2.8	3.2	3.7	3.9
Neem 3%+Pongemia 3%+Garlic 2%	34.8	66.8	25.9	42.5	2.5	3.1	2.9	2.2
TGGN leaves extract in cow urine	30.1	12.8	15.7	35.3	1.6	2.5	2.1	2
Untreated Control	100	100	100	100	3.6	3.8	4.6	4

Table 4: Assessment of damage by coffee berry borer in the Second year.

Treatment	% Bunch damage in green fruits (One month after third spray)				MGI at the harvest in marked bunches			
	Bunch 4	5	6	Mean	Bunch 7	8	9	Mean
Neem oil 3%	21.7	31.7	42.3	31.3	2.7	3.4	3.9	3.3
Pongamia oil 3%	50	49.1	60.2	53.2	3.8	4.2	3.6	3.9
Illuppai Oil 3%	41.3	51.5	55.6	49.3	4.1	4	4	4
Ipomea leaf extract 5%	47.2	61.5	71.2	60.1	3.1	3.9	4.2	3.7
Jatropha Leaf extract- 5%	40.2	49.7	55.2	48.6	4.5	3.2	4	3.9
Neem oil 3%+Garlic extract 2%	20.3	28.3	36.2	27.3	2.3	2.9	3.1	2.7
Pongamia oil 3%+ Garlic extract 2%	45.2	40.3	55.2	46.2	2.8	3.8	5.2	4.2
Neem 3%+Pongamia 3%+Garlic 2%	15.6	18.8	12.1	15.1	2.1	3	2	2.3
TGGN extract in cow urine (Tobacco+Garlic+ Ginger+Neem)	10.3	10	13.6	11.5	1.5	2.1	2.5	2
Chemical pesticide control	-	-	-	-	-	-	-	-
Untreated Control	51.7	76.9	78.4	69	4.3	4.5	3.7	4.1

From the above tables we can infer that total eradication of the pest was impossible due to the movement of the pest from adjacent estates and farms which do nothing to control the pests. No single method was effective to handle the pest attack. Cultural control with Neem oil 3%+Pongemia Oil 3%+Garlic extract 2% formulation was most effective and a user friendly approach to control the pest. And this is the cheapest organic way to control the pest. Chemical control was effective but it is not eco-friendly and health friendly. TGGN in cow urine was very effective in controlling the pest but the process of spraying does leaf scorching to plants and Eye and skin irritation to people who are working. Hence it is not user friendly in coffee fields. No useful parasitoids, except *B. bassiana* is really potential. The unseasonal rain does not support the multiplication of *B. bassiana* at the need of the hour. Commercial bio-control agents are mostly inferior quality and higher in rates.

Conclusion

Hypothenemus hampei Ferrari, the coffee berry borer is a serious threat for the majority of the world's coffee growers and has proved to be one of the most intractable of coffee pests. This research revealed that this pest population reduction was not uniform and highly fluctuated in all treatments. Overall in two years' maximum of 85%-95% control was achieved. This application also helped to repel leaf rust attack and as a growth promoter with strong branches and broad leaves. This organic oil formulation received fields showed a result with bigger heavy fruits and Shooting up of many new tertiary branches for the next fruiting compared to conventional coffee plants. Overall plant health was comparatively better than conventional field's coffee plants. IPM system used fields also showed better results but the practice was laborious. The reason for this is due to the multiplication of unaffected pest outside the estate. However, application of eco-friendly agents is completely safer to the environmentally natural health of the plants and laborers. The healthy plants naturally repelled the pests. Hence, in order to achieve maximum control continued application of eco-friendly agents is recommended always.

Acknowledgment

Anthony Samy, M., The author expresses his sincere thanks to Dr. N. Vasudevan for his intellectual guidance. The author also expresses his sincere gratitude to the Superior and Jesuit community of Loyola Hr. Sec.School, K. Nallur for their support and for sharing their knowledge and interest in organic agriculture and genuine curiosity about this research.

References

1. Le Pelley RH (1968) The pests of coffee. Editorial Labor S.A. Barcelona pp: 693.
2. Baker PS (1984) Some aspects of the behavior of the coffee berry borer in relation to its control in southern Mexico (Coleoptera: Scolytidae). Mexican Entomological Folia 61: 9-24.
3. Baker JM, Norris DM (1968) A complex of fungi mutualistically involved in the nutrition of the ambrosia beetle *Xyloborus ferrugineus*. Journal of Invertebrate Pathology 11: 246-250.
4. Murphy ST, Moore D (1990) Biological control of the coffee berry borer, *Hypothenemus hampei*, (Ferrari) (Coleoptera: Scolytida): previous programmes and possibilities for the future. Biocontrol News and Information 11: 107-117.

5. Barrera JF (1994).
6. Population dynamics of coffee berry borer, Hypothenemus hampei (Coleoptera: Scolytidae), and biological control with parasitoids Cephalonomia stephanoderis (Hymenoptera: Bethylidae), Chiapas, Mexico. PhD thesis, Paul Sabatier University, Toulouse III, France. pp: 301.
7. Coffee guide (2014) A manual of coffee cultivation. Central Coffee Research Institute, Coffee board, India.
8. Leefmans S (1923) The coffee berry borer, *S. hampei*. I. Life history and ecology. Meded. Inst. Plantenzieken 57: 61-67.
9. Toledo-Piza-Junior S (1928) Heterospilus coffeicola Schmied. Parasite of the 'coffee drill' Stephanoderis hampei (Ferr.). Archives of the Institute of Biology 6: 179-199.
10. Bergamin J (1943) Contribution to the biology of the coffee borer Hypothenemus hampei (Ferrari, 1867) (Col: Ipidae). Archives of the Institute of Biology 14: 31-72.
11. Schmitzet G, Crisinel P (1957) The fight against Stephanoderis hampei Ferr. Publicaciones of the National Institute for the Agronomic Study of the Belgian Congo (INEAC). Serie Scientifique, pp: 159.
12. Ticheler J (1961) Analytical study of the epidemiology of the coffee borer Stephanoderis hampei Ferr. In Ivory Coast. Mededelingen Land bouwhoge school Wageningen 61: 1-49.
13. Urbina N (1987) The bit of the fruit of the coffee tree, *Hypothenemus hampei*, and its control.
14. Hill DS, Waller JM (1990) Pests and diseases of tropical crops. in Smith N (Ed.) Intermediate Tropical Agriculture Series, Longman, Singapore. pp: 137-138.
15. Baker PS, Barrera JF, Rivas A (1992a) Life history studies on the coffee berry borer (*Hypothenemus hampei,* Scolytidae) on coffee trees in southern Mexico. Journal of Applied Ecology 29: 656-662.
16. Baker PS, Barrera JF, Rivas A (1992b) Factors affecting the emergence of *Hypothenemus hampei* (Coleoptera: Scolytidae) from coffee berries. Bulletin of Entomological Research 82: 145-150.
17. Borbón-Martinez O (1994) Use of biological control of coffee berry borer Hypothenemus hampei Ferrari1867. Report, Institut de Recherche de Café y Cacao, Kpalimé, Togo. pp: 22.
18. Baker PS, Rivas A, Balbuena R, Ley C, Barrera JF (1994) Abiotic mortality factors of the coffee berry borer *(Hypothenemus hampei;* Coleoptera, Scolytidae). Entomology Experimentalis et Applicata 71: 201-209.
19. Sponagel KW (1994) Coffee brocade Hypothenemus hampei in robusta coffee plantations in the Amazonia Eucatoriana Wisscosen flitcher.
20. Moore D, Abraham YJ, Mills NJ (1990) Effects of competition in the coffee berry borer, *Hypothenemus hampei* (Ferrari) (Col. Scolytidae). Journal of Applied Entomology 109: 64-70.
21. Rudinsky JA (1962) Ecology of Scolytidae. Annual Review of Entomology 7: 327-348.
22. Decazy B (1989) The coffee berry borer, Hypothenemus hampei: considerations on integrated control against kernel. ASIC, 13 Colloquium, Paipa. pp. 655-665.
23. De Oliveira-Filho ML (1927) Contribution for the knowledge of the coffee borer, Stephanoderes hampei (Ferr. 1867) to decomport and be fought in Sao Paulo, Brazil. Commission of the Study and Debate of Prague Caffeira. Sao Paulo 20: 1-95.
24. Hernández-Paz, Sanchez de Leon A (1972) The bit of coffee fruit. National Coffee Association 11: 1-72.
25. Corbett GH (1933) Some preliminary observations on the coffee berry beetle borer Stephanoderes (*Cryphalus) hampei* Ferr. Malay Agriculture Journal 21: 8-22.
26. Morallo-Rejesus B, Baldos E (1980) The biology of the coffee berry borer *Hypothenemus hampei* (Ferr.) (Scolytidae: Coleoptera) and its incidence in the southern Tagalog provinces. Philippine Entomologist 4: 303-316.
27. Hermann AJP, Janssens JJM (2010) Growth and production of Coffee. Soils, Plant Growth and Crop Production-Vol III. EOLSS. pp: 102.

Citation: Samy MA (2018) The Potential of Neem, Pongamia Oil and Garlic Extracts Formulation for an Effective Management of Berry Borers in Organic Coffee Plants. Int J Food Biosci Vol: 1, Issu: 1 (49-55).